UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

DATE: May 6, 2007

FROM: Cate Jenkins, Ph.D.[*]
GCB, HWID, OSW, OSWER, EPA
jenkins.cate@epa.gov
C Jenkins

TO: Senator Hillary Rodham Clinton,
Chair, Subcommittee on Superfund and Environmental Health
Congressman Jerrold Nadler
Congresswoman Carolyn Maloney

COMPLAINT AND ADDITIONAL EVIDENCE OF pH FRAUD BY: USGS, OSHA, ATSDR, NYC, EPA, and EPA-funded scientists

— 1. Falsification of corrosive pH data for WTC dust

— 2. Historical fraud by EPA of hazardous pH levels since 1980

This is a request for an investigation by the Senate Subcommittee on Superfund and Environmental Health into the falsification of pH corrosivity data for World Trade Center dust. This corrosivity is attributed to be one of the causative agents in current respiratory disabilities and/or deaths of first responders, recovery workers, laborers, residents, and office workers. Corrosive dusts would also have facilitated the entry into the body *via* the respiratory system of other toxic substances found in WTC emissions.

Part 1 of this complaint contains new evidence of additional falsifications of pH testing of WTC dust, in addition to the allegations of fraud raised in my 8/22/06 and 10/25/06 complaints to your Congressional delegation[1, 2] as well as to the EPA Inspector General (IG).[3]

Part 2 of this complaint documents the historical falsifications (dating back to 1980) for the pH levels known to cause corrosive human tissue damage. These falsified pH levels were incorporated into EPA's Hazardous Substances list under the National Contingency Plan/Superfund, and thus had a significant impact on the assessment of hazards of WTC dust.

---

[*] This submission is pursuant to 5 USC Chapter 72, Section 7211, the "anti-gag rule," and its subsequent reinforcing statutes (Pub. L. No. 108-199, Div. F, tit. VI, 618, 188 Stat. 3, 354 (Jan. 23, 2004); Pub. L. No. 108-7, Div. J, tit. V, 620, 117 Stat. 11, 468 (Feb. 20, 2003)). The conclusions and opinions are those of the author and do not necessarily reflect those of the U.S. EPA.

PART 1:
The WTC pH LIES

Part 1 of this complaint details the orchestrated falsifications by EPA, other governmental agencies and EPA funded scientists of pH data (actually changing the numbers) as well as their use of laboratory methods known to pre-neutralize samples before testing the pH of WTC dust. Testing pH is one method for estimating the corrosivity, which is the ability to cause irreversible chemical burns to human tissues. Corrosivity was not the only toxic threat from the WTC collapse,[4] but it was an important one. Corrosivity would have acted directly to cause respiratory chemical burns, and also would have increased the toxic properties of other pollutants from the WTC by facilitating their entry into the body through the respiratory system.

"Man covered in ashes assisting and walking with woman holding a particle mask to her face"
www.loc.gov/exhibits/911/911-overview.html

Part 2 of this complaint documents EPA's historical precedent-setting falsifications of internationally recognized pH levels known to cause irreversible corrosive tissue damage (again, actually changing the numbers). In 1980 these falsified pH levels were incorporated into the National Contingency Plan (NCP) Hazardous Substances List. The health evaluations of catastrophic environmental releases like the World Trade Center collapse are addressed by EPA under the NCP statutory authority. Long before 9/11, EPA was locked into covering up the caustic alkaline hazards (high pH) of pulverized concrete and cement dust.

The sections in Part 1 of this complaint include:

- **U.S. Geological Survey falsifies its WTC pH data**
- **Research lead by Rutgers neutralizes WTC dust before pH testing**
- **EPA-funded research using NYU collected dust sample falsifies pH data**
- **ATSDR/NYC false health claims about caustic high pH WTC dust constituents**
- **UC at Davis finds 21% cement in smallest WTC dust, pH 11 to greater than 12**
- **No immediate pH tests at Ground Zero as required by regulation**
- **No pH tests of more corrosive dust subjected to heat at Ground Zero**
- **9/13/01 – EPA Admin. Whitman claims "below background levels," fact ignored by EPA Inspector General when finding "no evidence of false statements"**

U.S. Geological Survey (USGS) falsifies its WTC pH data

Dr. Todd Hoefen, USGS, tests WTC dust after 9/11 (www.usgs.gov)

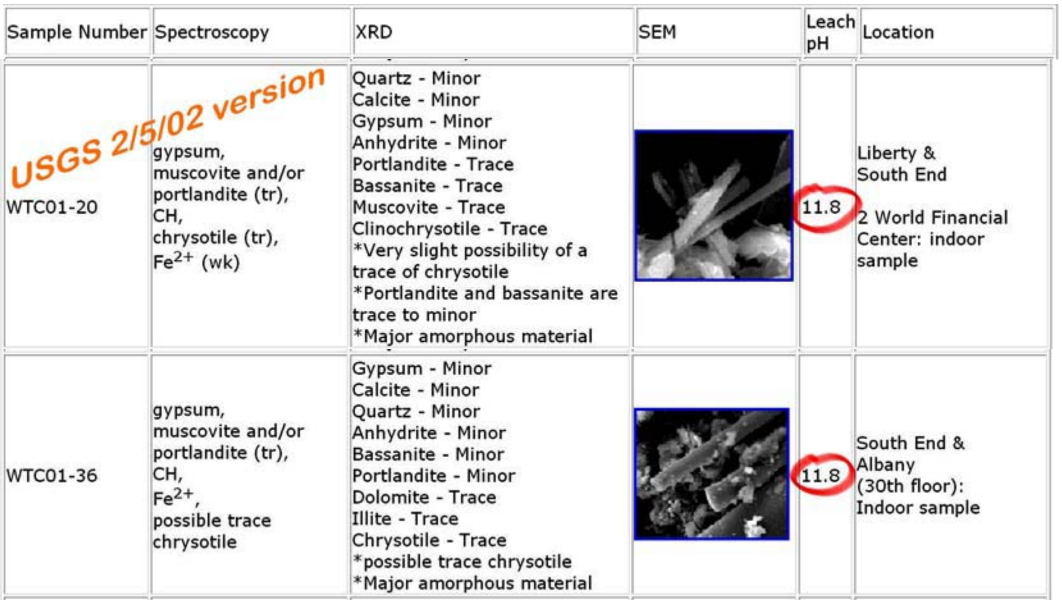
The U.S. Geological Survey (USGS) was requested by EPA to assist in testing for environmental hazards after the collapse of the World Trade Center.[5] USGS was a logical choice for evaluating concrete dust hazards from the largest building implosion in history, as it is the nation's premier agency with technical knowledge about portland cement, concrete, and other mining-related materials. The USGS tested WTC dust samples for pH and toxic metals.

One measure of the potential for corrosivity to human tissues is pH (acidity or alkalinity). Solutions with a pH less than 7 are considered acidic, while those with a pH greater than seven are considered basic (alkaline).[6] The pH scale is logarithmic, which means that each change of one unit on the pH scale means a change in 10 times the acidity or alkalinity. However, pH tests are not always reliable predictors of the true ability to cause chemical burns to human tissues. In part this is because some materials, like mostly insoluble WTC dust, have a high "alkaline reserve capacity," the ability to release caustic levels of hydroxyl ions over extended periods of time as they slowly dissolve.

USGS 2/5/02 report claiming highest WTC dust pH level is 11.8

The first official release of pH data by USGS to the public was through a report posted on the internet about 2/5/02.[7] This report was altered and back-dated in 2004 to an earlier date, 11/27/01, making it appear that USGS had released the report in a timely manner.[8] The following tables are from the USGS report posted about 2/5/02:

Leach Table 1	**USGS 2/5/02 version**				
	Outdoor dust samples				
	WTC-01-2	WTC-01-3	WTC-01-05	WTC-01-06	WTC-01-14
pH	10.1	9.51	9.9	9.65	9.68
...					
	WTC-01-15	WTC-01-16	WTC-01-17	WTC-01-21	WTC-01-22
pH	10	8.22	9.47	9.98	10.4
...					
	WTC-01-25	WTC-01-27	WTC-01-28	WTC-01-30	WTC-01-34
pH	9.37	10	9.93	9.63	9.8
...					
	Indoor Dust Samples		**Girder Coatings**		
	WTC-01-20	WTC-01-36	WTC-01-8		WTC-01-9
pH	11.8	11.8	INS [*insufficient volume to test*]		10.8
...					
	Minimum		**Maximum**		**Mean**
pH	8.22		11.8		10.0
...					



USGS 2/5/02 version

Sample Number	Spectroscopy	XRD	SEM	Leach pH	Location
WTC01-20	gypsum, muscovite and/or portlandite (tr), CH, chrysotile (tr), Fe^{2+} (wk)	Quartz - Minor Calcite - Minor Gypsum - Minor Anhydrite - Minor Portlandite - Trace Bassanite - Trace Muscovite - Trace Clinochrysotile - Trace *Very slight possibility of a trace of chrysotile *Portlandite and bassanite are trace to minor *Major amorphous material		11.8	Liberty & South End 2 World Financial Center: indoor sample
WTC01-36	gypsum, muscovite and/or portlandite (tr), CH, Fe^{2+}, possible trace chrysotile	Gypsum - Minor Calcite - Minor Quartz - Minor Anhydrite - Minor Bassanite - Minor Portlandite - Minor Dolomite - Trace Illite - Trace Chrysotile - Trace *possible trace chrysotile *Major amorphous material		11.8	South End & Albany (30th floor): Indoor sample

October 2002 USGS gives higher pH levels (12.3 and 12.4) for indoor dusts with no explanation

In October 2002, USGS released different pH data at a scientific conference for the exact same indoor dust samples shown above ("WTC01-20" and "WTC01-36").[9] The pH levels for the same samples were claimed to be 12.3 and 12.4 at the conference. The 2/5/02 USGS report had given the pH of 11.8 for both samples. (A change of one unit in the pH scale represents a 10-fold change in the alkalinity.) There was no explanation provided for the change.[10]

These same higher pH levels of 12.3 and 12.4 also mysteriously appeared in a chart on a fact sheet on the USGS website at the same time.[11] However, the fact sheet only showed the higher levels on a chart, where you would have to figure out the pH levels by drawing a line to the x-axis of the chart. USGS did not state the actual values anywhere in the fact sheet, or draw attention to the fact that the pH levels had been dramatically raised from their 2/5/02 report.

Even though USGS presented the higher pH levels at a symposium and in their fact sheet, it did not revise its official report on its website (2/5/02 approximate date) to show the higher pH levels. Lower Manhattan was stilling cleaning up the interiors of buildings and apartments in October 2002. Citizens were still signing up for EPA's voluntary cleanup program at this time, and were unaware of the hazard from the much higher caustic pH levels. Businesses in Lower Manhattan were still cleaning up, taking no precautions to protect laborers against the unknown higher pH levels. To this date, USGS has not changed it 2/5/02 report on the internet to show the higher levels, although it surreptitiously back-dated the report in 2004.

Dr. Geoffrey S. Plumlee, USGS
(USGS Report # 00-397)

2006 USGS gives even higher pH levels for outdoor dust, as high 12.04

Then, in 2006 USGS scientists published even higher pH levels for outdoor WTC dust, compared to their 2/5/02 report. This was by way of a chapter in a book resulting from a scientific symposium, only available for purchase, and certainly not readily available to the general public.[12] One outdoor dust sample had a pH of 12.04. The highest outdoor dust sample in the USGS 2/5/02 report only had a pH of 10.4 (sample WTC01-22). The 2006 publication also gave the 2 indoor dust samples as having pH levels of 12.3 and 12.4, the same as in the October 2002 fact sheet and the October 2002 scientific symposium.

The appendix to the USGS 2006 book chapter had tables showing these new higher results as being the result of "duplicate analyses."[13] However, a "duplicate analysis" is a well defined chemical term, meaning a split sample where all analyses are performed at the same time under identical conditions as a quality control measure. This term is defined in published standard methods such as those of EPA.[14] If these high pH levels were in fact from duplicate analyses as claimed by USGS, then the higher results would have been available to USGS at the same time as the other pH analyses showing lower levels in their 2/5/02 report. USGS would need to explain why they only released the lower, less hazardous pH test levels about 2/5/02. Then they would need to explain why they included only the higher pH levels from these "duplicate analyses" in the table in the main body of their 2006 publication. Why not include a range in the year 2006 publication, if these really were duplicate analyses?

See the table below scanned from the 2006 USGS publication, showing only the higher pH levels.[15]

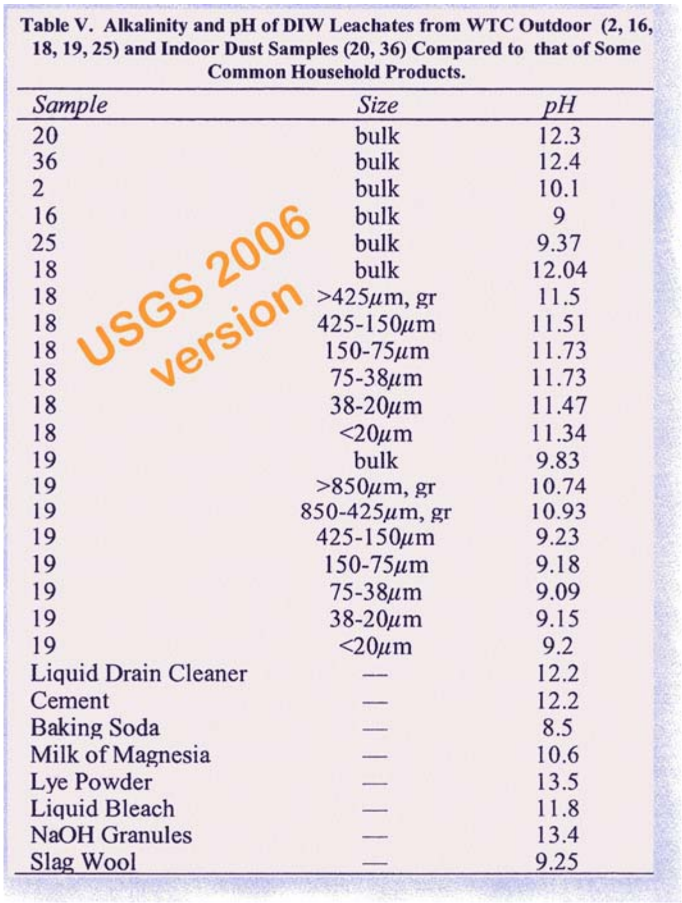


Table V. Alkalinity and pH of DIW Leachates from WTC Outdoor (2, 16, 18, 19, 25) and Indoor Dust Samples (20, 36) Compared to that of Some Common Household Products.

Sample	*Size*	*pH*
20	bulk	12.3
36	bulk	12.4
2	bulk	10.1
16	bulk	9
25	bulk	9.37
18	bulk	12.04
18	>425μm, gr	11.5
18	425-150μm	11.51
18	150-75μm	11.73
18	75-38μm	11.73
18	38-20μm	11.47
18	<20μm	11.34
19	bulk	9.83
19	>850μm, gr	10.74
19	850-425μm, gr	10.93
19	425-150μm	9.23
19	150-75μm	9.18
19	75-38μm	9.09
19	38-20μm	9.15
19	<20μm	9.2
Liquid Drain Cleaner	—	12.2
Cement	—	12.2
Baking Soda	—	8.5
Milk of Magnesia	—	10.6
Lye Powder	—	13.5
Liquid Bleach	—	11.8
NaOH Granules	—	13.4
Slag Wool	—	9.25

The table on the next page compares the different pH levels reported by USGS. The first column gives the 2006 results. The second column gives the pH levels that USGS provided to the public around 2/5/02.

USGS FALSIFICATION OF pH LEVELS – 2006 book chapter *versus* 2/5/02 public report

Sample #	**pH reported by USGS in 2006**	**pH reported by USGS on 2/5/02**
WTC01-20 (indoor) Bulk sample	**12.3** **6.3** times as alkaline as EPA and UN presumptive trigger pH of 11.5. [16]	**11.8** **2** times as alkaline as EPA and UN presumptive trigger pH of 11.5
WTC01-36 (indoor) Bulk sample	**12.4** **7.9** times as alkaline as EPA and UN presumptive trigger pH of 11.5	**11.8** **2** times as alkaline as EPA and UN presumptive trigger pH of 11.5
WTC01-02 (outdoor) Bulk sample	**10.1** lower than EPA and UN presumptive trigger pH of 11.5	**10.1** lower than EPA and UN presumptive trigger pH of 11.5
WTC01-16 (outdoor) Bulk sample	**9** lower than EPA and UN presumptive trigger pH of 11.5, but **6** times more alkaline than USGS 2/5/02 report	**8.22** lower than EPA and UN presumptive trigger pH of 11.5
WTC01-25 (outdoor) Bulk sample	**9.37** lower than EPA and UN presumptive trigger pH of 11.5	**9.37** lower than EPA and UN presumptive trigger pH of 11.5
WTC01-18 (outdoor) Bulk sample	**12.04** **3.5** times as alkaline as EPA and UN presumptive trigger pH of 11.5	**?** pH level for sample not included in 2/5/02 USGS report
WTC01-19 (outdoor) Bulk sample	**9.83 – 10.93** bulk sample lower than EPA and UN presumptive trigger pH of 11.5, but larger particles had pH levels as high as 10.93	**?** pH level for sample not included in 2/5/02 USGS report

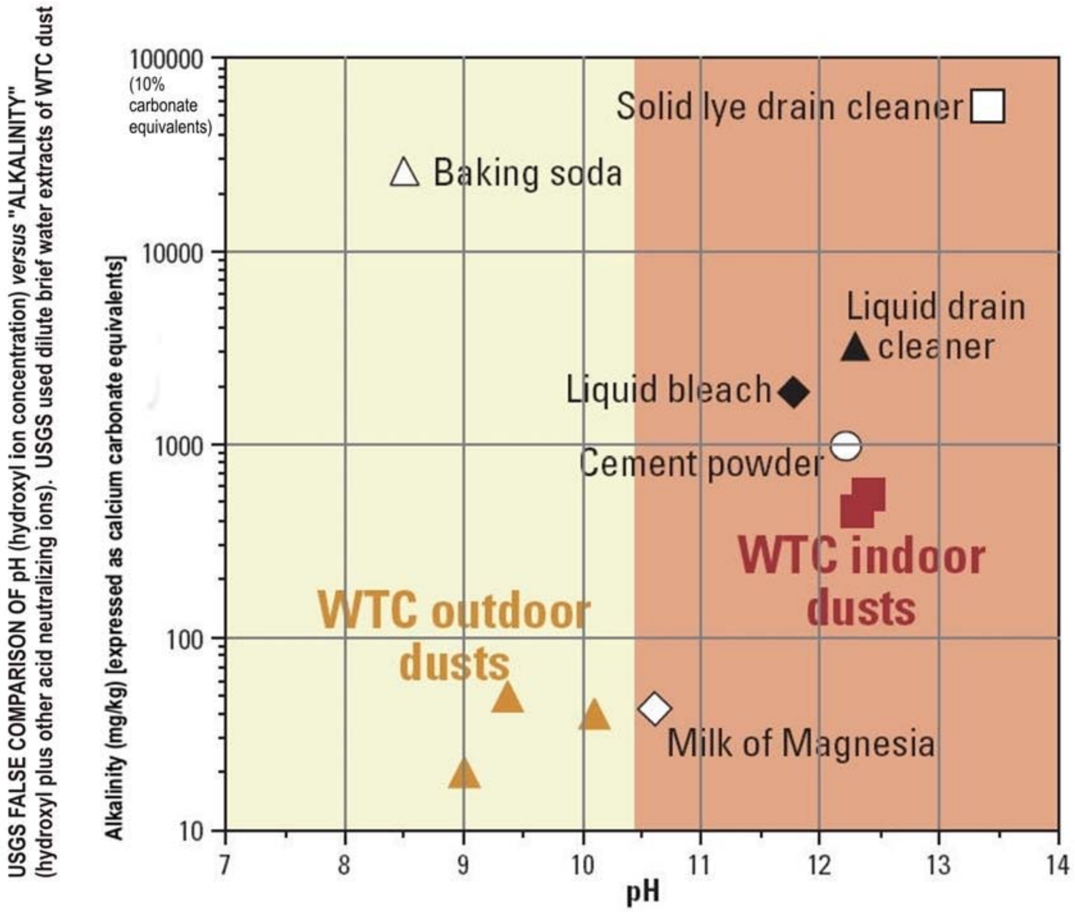
USGS diverts attention from high pH by false comparison to pipe corrosion test

USGS went beyond falsifying the actual pH levels (changing the numbers) to obscure the corrosive hazards of WTC dust. It used irrelevant or newly devised misappropriated tests to give false comparisons to the high pH levels it found, to divert attention away from the high pH. The first such subterfuge was to compare the high pH levels to tests that were intended to measure the corrosion potential to water supply pipes (as in household plumbing).

USGS tested the "alkalinity" (a very specialized term in the context of the laboratory test method used) which gives a combination reading for both the pH and the additional acid neutralizing ability of non-hydroxyl constituents, but only for those constituents that are dissolved under the test conditions. USGS was taking advantage of the commonly understood meaning of "alkalinity" and obviously hoping for confusion on the public's part. "Alkalinity" in common usage means a the concentration of hydroxyl ions, and "acidity" means the concentration of hydrogen ions, as in "acidity *versus* alkalinity."

The USGS "alkalinity" test measured a combination of both hydroxyl ions (measured by pH) plus any other ions that neutralize acids such as bicarbonate and carbonate ions (buffering capacity). Keep in mind that it is the hydroxyl ions that are related to corrosive tissue damage, not other ions like bicarbonate ions. The reference sections provides definitions of the term "alkalinity" as tested by USGS. These definitions specifically caution readers not to equate "alkalinity" with hydroxyl ion concentrations (pH).[17, 18]

The following is the chart USGS included in a fact sheet in October 2002 on its website with the false comparison of the high pH levels of WTC dust with the irrelevant and non-health related property "alkalinity" (for water pipe corrosion).[19] This same false comparison was also presented by USGS at the 10/02 scientific symposium[20] as well as their 2006 publication.[21]

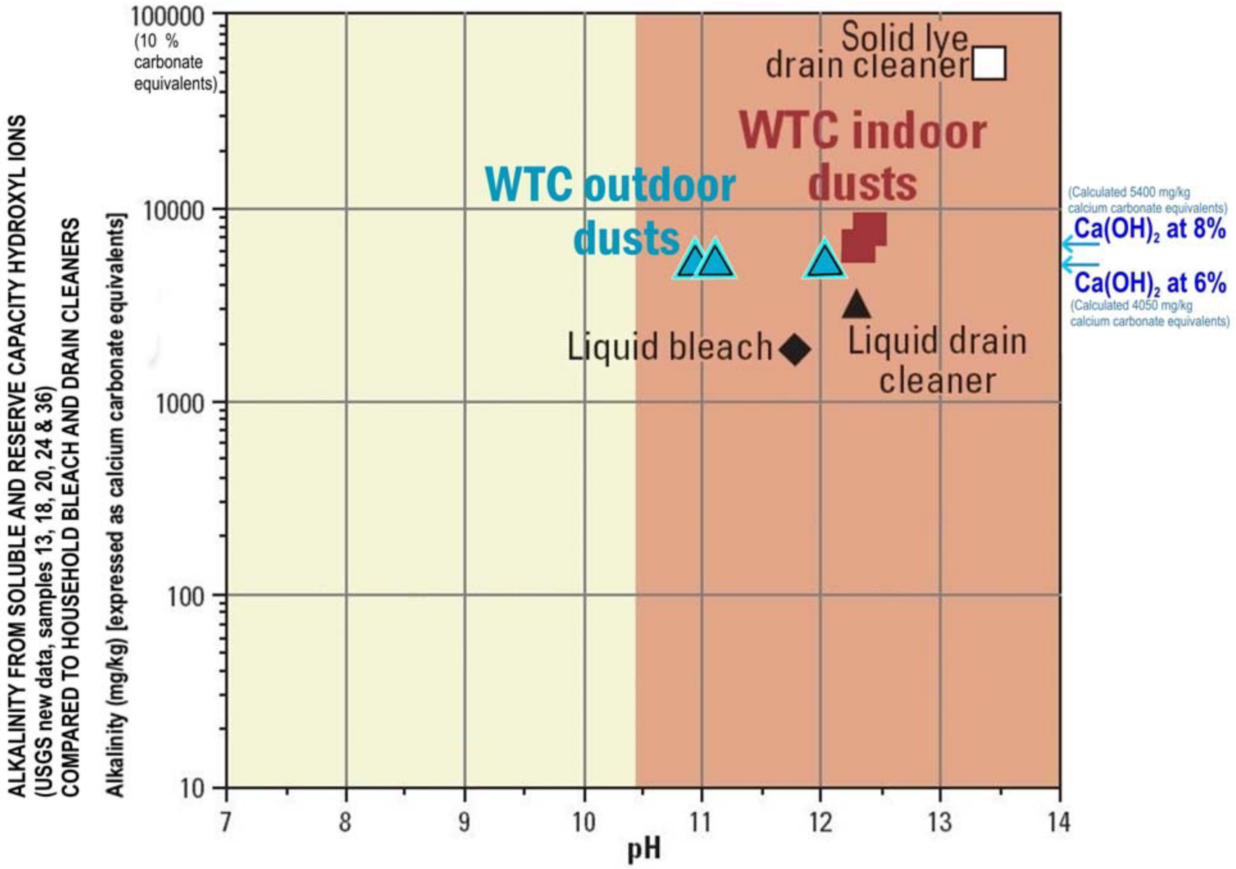


Exposures to WTC dusts were to the whole dusts themselves, inhaled into their lungs. The USGS "alkalinity" test approximated only what happens when the dusts are diluted in a 20:1 ratio, agitated ten-minutes in slightly acidic water, after which the dust is discarded as if it were not longer a concern. This is because only the water was tested in USGS' bogus "alkalinity" test.

If the USGS had been honest, they would have tested the "alkalinity" of whole WTC dust, particles and all. There are established laboratory procedures for testing the "alkalinity" of whole particulates.[22] This would be the correct comparison if USGS believed that the "alkalinity" (hydroxyl ions plus other acid neutralizing ions) was a relevant comparison for WTC dust to caustic household products,. They would have found that WTC dust far exceeded the alkalinity of household products like solid lye drain cleaner (sodium hydroxide), because any insoluble calcium carbonate in WTC dust as well as soluble and insoluble calcium hydroxide would contribute equally to the measurement of "alkalinity."

The most valid comparison, however, would have been for a comparison of the initially solubilized hydroxyl ions from WTC dust combined with the "alkaline reserve capacity," those hydroxyl ions which release slowly as calcium hydroxide slowly dissolves out of WTC dust while in the lungs lodged against soft tissues. $Ca(OH)_2$ was present in WTC dust in concentrations far above its water solubility (0.185%), so it would never fully dissolve during the USGS limited short duration extractions.

A chart of WTC dust pH and *versus* the additional hydroxyl-based alkalinity reserve capacity due its undissolved $Ca(OH)_2$ content is provided below.[23] This plot includes the new higher pH outdoor dust samples reported by USGS in 2006. As can be seen, the hydroxyl-based alkalinity of WTC dust as a whole is far greater than that of either liquid drain cleaner or household bleach. Note that this chart uses $Ca(OH)_2$ concentrations from better quality data on far greater numbers of WTC dust samples than obtained by USGS.[24] Concentrations of $Ca(OH)_2$ in indoor dust were as high as 8%, and outdoor dust 6%, based on 243 samples. The USGS levels for $Ca(OH)_2$ were far less exact, finding a much broader ranges of up to 20% $Ca(OH)_2$, and in far fewer samples.



Note that the 2/5/02 USGS report intentionally mislead readers as to their finding of up to 20% calcium hydroxide ($Ca(OH)_2$) in WTC dust by always calling it by the obscure mineralogical term "portlandite" throughout their report, while fully identifying the chemical composition of all other mineralogical compounds, even the extremely complex ones.[25, 26]

USGS uses fake "lung fluid simulation" test to downplay WTC dust hazards

USGS used a newly devised unfounded method to give another false comparison to the high pH levels it found for WTC dust. USGS used "simulated lung fluid" to extract WTC dust.[27, 28] The simulated lung fluid used an arbitrary 20-to-1 dilution ratio, extracting for a brief 10-minute period. Both these parameters have never been correlated to any physiological process.

Then, USGS made broad human health claims based on the pH and metal concentrations that that had the transitory opportunity to partition into their simulated lung fluid during this high volume 10-minute extraction. USGS described their test as being "physiologically-based leach test" and capable of identifying "chemical characteristics ... that can be evaluated by health workers."[29]

Dr. Geoffrey S. Plumlee, USGS (www.monaco-omm.com)

This is a fabrication by USGS, because their lung fluid simulation test ignored the microenvironment of the lung tissue where WTC dust particles are lodged for many years. Once in the lungs, a dust particle would not suddenly be engulfed on all sides with large 20-to-1 volumes of lung fluid, followed by the dust particles miraculously disappearing, with the lungs only being exposed to the extracting fluid. This is what the USGS procedure approximated. Instead, the particles would lodge directly on a tissue surface, leaching concentrated toxicants and corrosive levels of hydroxides for extended periods, due to the alkaline reserve capacity of $Ca(OH)_2$. $Ca(OH)_2$ has low solubility, but is capable of producing saturated solutions of $Ca(OH)_2$ at pH 12.5 for extended periods of time.

The USGS "lung fluid" test used a misappropriation of an established method designed to test the dissolution rate of fiberglass in the lungs.[30] In the original test method, higher concentrations of fiberglass constituents in the simulated lung fluid extract were indicative of a LESSER hazard from the fiberglass, not a GREATER hazard! This is because higher concentrations of fiberglass in the laboratory extracting fluid indicated that the fiberglass was being dissolved and removed from contact with lung tissue where it was causing the damage. Extended excerpts from this original established fiberglass dissolution study are included in the references. For the USGS to pervert the fiberglass dissolution methods for their own purpose of supporting a claim a lesser hazards from WTC dust is reprehensible.

USGS use of improper test methods for pH

Dr. Greg Meeker, USGS, speaking in NYC as one of EPA's experts (www.tinderboxfilms.com)

Although USGS was finding hazardously high pH levels for WTC dust in its leachate studies, it was using incorrect methods that give erroneously low readings. The actual pH levels were probably even higher. USGS used a 20-to-1 ratio of water to WTC dust, and also used acidified water (pH 5.5) to extract the dust.[31] Using a 20:1 ratio as well as using acidic water will lead to erroneously low pH levels. The standard EPA method for testing pH uses a 1-to-1 ratio of water to solids, and non-acidified water.[32] Even then, EPA states that the method may give erroneously low pH readings.

See the reference section for pH levels reported by manufacturers for household products.[33] These pH levels did not use a 1:20 water dilution, and are more useful for comparing the pH levels of WTC dust tested by other researchers.

USGS failure to cite international and EPA established trigger level of pH 11.5 for presumed corrosivity to human tissues

Instead of devising the irrelevant/unfounded methods described above to downplay the pH levels it found for WTC dust, USGS should have referenced the worldwide, long accepted benchmarks for alkaline corrosivity to the human skin, eyes, and respiratory system. The internationally accepted presumptive trigger level for alkaline tissue corrosivity is a pH of 11.5 and higher. This is always accompanied with the mandate to perform animal or *in vitro* testing at intermediate pH levels. This is because of the problem of pH being a bad predictor of corrosivity when the substance has limited water solubility (releasing alkaline hydroxyl ions or acidic hydrogen ions over long sustained periods, known as "alkaline or acid reserve capacity"), or where corrosive effects are excerpted through mechanisms other than the action of hydroxyl or hydrogen ions.


Dr. Roger N. Clark, USGS (clarkvision.com)

Beginning in 1971, the International Labour Organization (ILO) of the World Health Organization concluded that high alkaline pH levels above 11.5 are not tolerated by the body and would invariably cause chemical burns to both the skin and eyes.[34] In 1981, the Organization for Economic Cooperation and Development (OECD), of which the U.S. is a member, first issued test guidelines with the presumptive alkaline corrosive trigger level of pH 11.5 for both skin and eye corrosion, reissuing its guidelines through the years while retaining this pH 11.5 presumptive level.[35, 36, 37] In a 1999 report, OECD noted the fact that the European Union, EPA (pesticide and toxic chemicals programs, not the Superfund program) and other countries had already adopted this trigger level.[38] The United Nations ratified the OECD test guidelines containing the presumptive trigger level of pH 11.5 as part of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).[39, 40] These same pH presumptive trigger levels for corrosivity were incorporated into the UN Basel Convention treaty for the trans-boundary shipment of hazardous waste in 1998.[41]

The same presumptive trigger levels were adopted by EPA as well. In 1982 and 1984, EPA adopted the presumptive pH level of 11.5 in the context of its industrial chemical testing protocols, stating that if a pH was 11.5 or higher, no further animal testing was required because the substance was presumed corrosive to both human skin as well as eyes.[42, 43] In 1987, the U.S. Congressional Office of Technology Assessment made the same conclusion.[44] In 1998, EPA issued test guidelines conforming with the OECD and UN globally harmonized system, also containing the same presumptive pH 11.5 level for corrosivity to skin and eyes, also requiring a consideration of the alkaline or acid reserve capacity.[45, 46]

USGS failure to promptly warn of high pH levels, and later falsification of release date

As mentioned earlier, USGS did not release its pH data to first responders or the public for many months. It was first released through a round-about way through news articles in a non-local paper on 1/13/02 and 2/9/02.[47, 48] USGS first released their official report by an internet posting about 2/5/02. Furthermore, USGS falsified the release date by back-dating it to 11/27/01, inserting this false date years later in 2004.[49, 50] In contrast, USGS released their thermal imagining data for the hot spots from the fires directly to the first responders at Ground Zero within a few days, by late September 2001.[51]

Research lead by Rutgers neutralizes WTC dust before pH testing

An EPA-funded research team headed by Rutgers University/Robert Wood Johnson Medical School found pH levels as high as 11.5 for one WTC dust sample collected outdoors on 9/16/01 or 9/17/01.[52] This is right at the 11.5 presumptive trigger level for tissue corrosivity. However, the other 2 samples tested had substantially lower pH levels of 9.2 and 9.3. All three of these pH results are questionable.

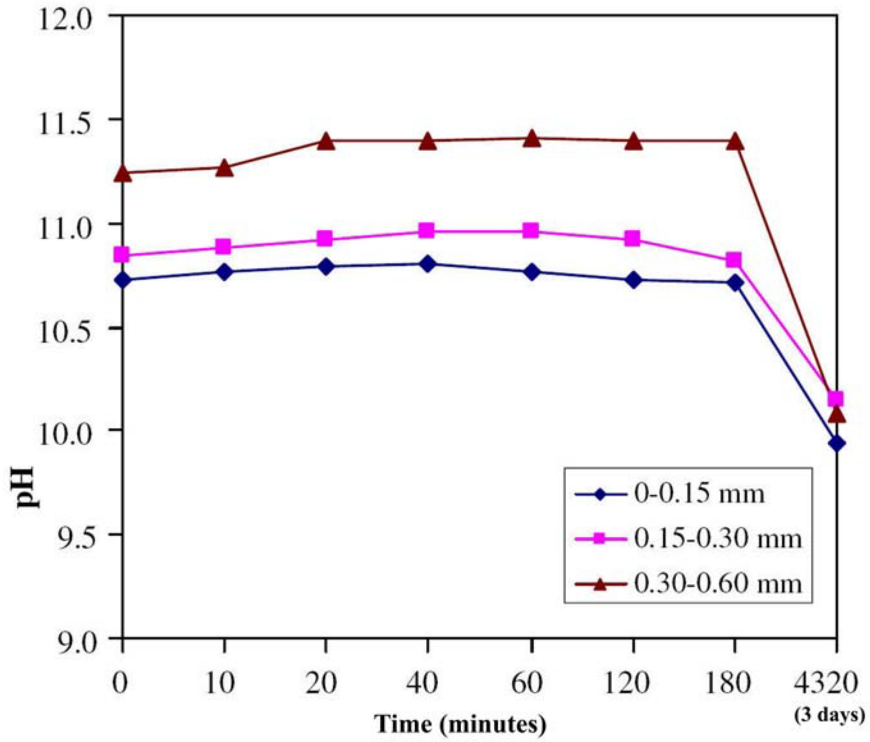
Dr. Paul Lioy, Rutgers University (www.umdnj.edu)

The study itself described taking the precaution to find outdoor samples that had been protected from rain, so as to reassure readers of their study that the original caustic WTC dust would not have been neutralized by contact with water and carbon dioxide from the air (a reaction called "carbonation"). However, if the study is read closely, before testing the samples for pH, the Rutgers team first added water to the samples, inverted the tubes several times, soaked them "several days" at room temperature, and then stored them in the refrigerator for an unknown time period before pH testing.[53] Thus, by their own admission, the Rutgers research team was intentionally and deliberately neutralizing the samples before testing the pH.

Water or exposure to atmospheric moisture to any material containing alkaline calcium, sodium, and potassium hydroxides results in neutralization from carbon dioxide in the atmosphere. This is a very commonly known, well understood chemical reaction, described in high school chemistry textbooks,[54] the NIOSH Pocket Guide to Chemical Hazards,[55] old and new editions of the Merck Index,[56, 57] and other common technical resources.[58, 59] The ability of atmospheric carbon dioxide to acidify water over time would also be very well known to any scientist involved with air pollution research, because this is the basis for the formation of "acid rain" from excessive levels of carbon dioxide in the air.[60]

Calcium hydroxide, sodium hydroxide, and potassium hydroxide are all contained in the pore water of aged concrete in high enough concentrations to generate leachates with pH levels over 11.5, and even over 12.5 for long periods of time when the concrete is pulverized, as documented in Part 2 of this complaint. The speed at which moisture and carbon dioxide from the atmosphere (carbonation) will neutralize the calcium, sodium, and potassium hydroxides that is released from pulverized concrete is well established. A study that is exactly and directly comparable to the test procedures used by the Rutgers research team is available.[61] In this study, the pH of leachates from pulverized concrete were determined as a function of time. Leachates from crushed concrete fines from a commercial concrete recycling facility were tested for pH at intervals up to 3 days after adding water. The samples were sealed from the atmosphere between tests. See the graph on the next page for the results:

Dr. Lung Chi Chen (www.aaari.org)
"Asian Americans in the Aftermath of 9/11"



Leachate pH of different size fractions of recycled concrete from a commercial concrete recycling facility as a function of time.[62]

Note that the pH remained at 11.4 for the smaller size particles (0.15 millimeters or less) for 3 hours, but when re-tested after 3 days, the pH had plummeted to only 10.05. The larger sized particles showed a similar pattern, with a high pH for at least 3 hours, then dropping to near 10 after re-testing at 3 days.[63] Because the pulverized concrete used in this particular study had undoubtedly already undergone some degree of neutralization by exposure to the elements before testing, the initial pH values were not as high as have been observed by other researchers studying the pH of newly pulverized aged concrete. See Part 2 of this complaint for other studies showing higher initial pH levels for pulverized concrete.

Thus, it is not theory that the pH of concrete leachates would dramatically decrease over the "several days" of water soaking, the testing protocols used in the Rutgers team study. The EPA method itself for testing pH for particulate samples states clearly that "samples should be analyzed as soon as possible" to avoid reactions such as hydroxides being neutralized by contact with air and water.[64] The Rutgers team was funded through EPA, and therefore monitored and reviewed for adherence to proper testing protocols, which obviously were not followed.

Rutgers indoor dust tests with questionable uniform pH levels of 11; tests again performed after pre-neutralization with prolonged water/atmospheric contact

There was a second EPA-funded WTC dust study headed by Rutgers University/Robert Wood Johnson Medical School.[65] This study including most of the same original researchers in the Rutgers outdoor WTC dust study, above. This time, the dust was collected from indoor locations near Ground Zero on 11/19/01. Not surprisingly, the highest reported pH level was only 11. The reason that this is no surprise is the fact that the researchers yet again soaked the samples in water for several days and stored them in a refrigerator for an indeterminate period before testing. See the discussions above on the first Rutgers study of WTC dust, showing that this procedure pre-neutralizes the samples.

These pH results are also suspicious because they are not consistent with USGS results that found pH levels from 11.8 to 12.4 for indoor dusts sampled on 9/17/01.

There is another compelling reason for doubting the veracity of the pH results for the Liberty Street building in the Rutgers team study. All the pH results were exactly 11. Yes, 7 out of 7 dust samples from different floors, having different colors, having different measured particulate size distribution ranges, all having different concentrations of a large range of metals, all having widely different concentrations of various organic compounds, all appearing highly heterogeneous from the photographs – yet amazingly, all had a reported pH level of exactly 11. I personally have never seen any data set like this, where a large range of tested chemical and physical properties are different, but the pH levels are exactly the same, the exact same whole number, namely 11. Also, a pH level of 11.0 is ever so conveniently under the established presumptive trigger level for tissue corrosivity of 11.5.

Dr. James R. Millette, MVA Scientific Consultants (www.MVAinc.com) collaborator, Rutgers/EPA study

EPA-funded research using NYU collected dust sample falsifies pH data

A primary focus of my 8/22/06 and 10/25/06 requests for an investigation both to your Congressional delegation as well as to the EPA Inspector General[66, 67] was the clear and irrefutable documentation that research consortiums funded by EPA changed the previously published data (actually changed the numbers) contained in other EPA-funded research reports. The data that was changed was for the pH of the smallest respirable size WTC dust particles, as well as for the pH of the overall bulk WTC dust.

The following table compares the statements in the falsified research publications with the actual language describing the data in the original publications. The table below has been revised from my 10/25/06 complaint to include an additional incident of data fraud in the Landrigan *et al.* publication. Previously, my table only included the Landrigan *et al.* misrepresentation of the McGee *et al.* publication for the smallest PM2.5 particles. However, Landrigan *et al.* also fraudulently misrepresented the pH data from the Lioy *et al.* research for overall bulk WTC dust.

Falsifications by Changing the pH Numbers from One EPA-funded Publication to the Next	
FALSIFICATIONS OF PUBLISHED OR PRELIMINARY DATA	**ORIGINALLY PUBLISHED DATA**
2/11/02 Senate testimony [T]he less than one percent that was as PM2.5, or the particles that would reach deepest in the lung, was found to have a neutral pH, with no detectable asbestos or fiberglass ... 2/20/02 email from EPA-funded Dr. Chen at NYU I am not sure I can answer you questions. We first mechanically separated particles (sieving) with a cut off at 53 µm. We then aerodynamically separated the < 53 µm fraction to between 53 - 10 µm, 10 - 2.5 µm, and < 2.5 µm. We took a small aliquot from each fraction and suspended in a small volume of distilled, deionized water and used a pH meter to measure their pH. We found that the suspensions of the particles larger than 10 µm had a pH above 11, for 10 - 2.5 µm fraction, pH is above 8, and those < 2.5 : is near neutral. 12/02 Lancet medical journal study The pH of most of the suspensions of the bulk World Trade Center settled dust was greater than 10, which is irritating to mucous membranes. However, the dust's alkalinity decreased with decreasing particle size, with particles less than 2.5 µm at about neutral pH. The caustic, alkaline large particles and large fibreglass [*sic*] fibres that were caught in the eyes, nose, and throat were probably responsible for the chronic cough of the residents and workers near Ground Zero. Thus, although the caustic large dust particles caused temporary nose, throat, and upper airway symptoms, they were effectively caught by the body's defenses. Conversely, the fine dust that did reach the deep lung was lower in concentration and much less caustic. Therefore, although the public had severe acute symptoms, the overall dust exposures probably did not have many cumulative health implications 5/04 Landrigan *et al.* in Environmental Health Perspectives study Settled dust. To evaluate the composition of material deposited in lower Manhattan immediately after destruction of the WTC, samples of settled dust were collected at sites in lower Manhattan (Lioy et al. 2002; McGee et al. 2003). ... Each sample of settled dust had a highly alkaline pH (9.0 – 11.0). ... Materials < 2.5 µm in aerodynamic diameter comprised 0.88 - 1.98% of total mass. Alkalinity decreased with decreasing particle size, and particles < 2.5µm had a more nearly neutral pH (Lioy et al. 2002; McGee et al. 2003). This finding is consistent with the dominant presence of highly alkaline, coarse cement particles in the large size fraction.	1/15/02 Lioy *et al.* The pH of an aqueous suspension of each sample was > 7; the Cortlandt Street sample had a pH of 11.5. Both the Cherry and Market Street samples had a pH of ≈ 9 12/02 final study on WTC particulate effects in rat nasal cavities The pH of water extracted WTC PM2.5 ranged from 8.88 in WTCE to 10.00 in WTC8 (Table 2). The alkaline pH is consistent with previous reports of WTC PM (USGS, 2002) and probably results from the building materials comprising much of the dust ... 6/03 McGee *et al.* in Environmental Health Perspectives pH levels of water-extracted WTC PM2.5 and control samples are shown in Table 5. The pH of water-extracted WTC PM2.5 samples before lyophilization ranged from 8.88 in WTCE to 10.00 in WTC8. The alkaline pH results from the building materials comprising much of the dust ... The pH of lyophilized WTC PM2.5 reconstituted in unbuffered saline [*pre-neutralized WTC dust*] was very close to neutral (pH 7.36) ... It is not known why the pH of WTC PM2.5 should be close to neutral after reconstitution in saline. ... We conclude that water-soluble Ca containing compounds were enriched in the WTC PM2.5 fraction compared with those in the whole settled dust. ... The likely major acute inhalation hazards of WTC PM2.5 based on the results from this study are due to the presence of gypsum, calcite, and cement or concrete dust components. ... The high content of gypsum and calcite in the WTC PM2.5 fraction suggests that potentially toxic effects may also extend into the smaller airways and lung parenchyma.

The collapse of the WTC created an unusually large amount of small sized dust particles, with an unusual amount being smaller than 2.5 microns (μm). These smaller particles are called "PM2.5" (particulate matter with average diameters less than 2.5 microns).[68] These small particles can remain suspended and reach deep within the lungs. Thus, the question of whether or not the smallest WTC dust particles were alkaline is a very important one.

Background for NYU involvement in WTC dust testing and community relations


"Dr. Thurston describing results of NYU's air monitoring efforts at World Trade Center community forum." (www.niehs.nih.gov)

Within hours of the WTC collapse, at least by September 12, 2001, EPA funneled money through the National Institute of Environmental Health Sciences (NIEHS)[69] to NYU to collect WTC dust samples, perform limited tests, and communicate hazard information to the public as an allegedly independent source. As per the EPA mandate and funding, Dr. Thurston and his partners Dr. Lippman and Dr. Chen proceeded to transmit EPA's message to the public, with or without concomitant credibility.[70, 71]

In particular, Dr. Thurston was quoted extensively in the press, repeating reassurances that there were no health risks, stating that if there were, he would be "shouting it from the rooftops."[72] After the 8/21/03 EPA Inspector General's report stated that EPA gave citizens misleading and premature assurances, Dr. Thurston changed his stance in the press.[73]

Dr. Thurston's 2/11/02 Senate testimony claiming smallest WTC particles were non-alkaline

On 2/11/02 Dr. Thurston testified at a Senate hearing claiming the smallest PM2.5 particles from WTC dust were non-alkaline.[74] Dr. Thurston stated there was no cause for concern for any corrosive caustic effects from WTC dust exposures deep within the lungs, because the smallest particles had a neutral pH.

His testimony came just two days after the explosive 2/9/02 publication of the St. Louis Post-Dispatch[75] exposing the fact that bulk WTC dust (larger sized particles as well as the smallest respirable PM2.5 particles combined) was highly alkaline according to USGS data, with pH levels of some samples from 11.8 to 12.1,[76] far above the presumptive pH 11.5 trigger level for presumed corrosivity to human tissues.


Dr. George Thurston, NYU speaking about air pollution from traffic in 2005 (www.eesi.org)

As a result, public health professionals had no basis to warn of the more severe threat of deep lung penetration of corrosive WTC dust particles. They were also blinded as to a key causative agent for symptoms they were observing and hindered in specifying appropriate treatment. There was no other pH alkalinity data to refute Dr. Thurston for the smallest particles. It would have required a dedicated laboratory and staff set up and trained long before 9/11 to separate dust samples into different size fractions.

I doubted the credibility of Dr. Thurston's testimony. On 2/13/02, I initiated an email interchange, reproduced in the references. In this interchange, both Dr. Thurston and Dr. Lung Chi Chen at NYU reaffirmed the 2/11/02 testimony claiming that the smallest particulates were non-alkaline.[77]


Dr. Lung Chi Chen, NYU (www.thelancet.com)

12/02 Dr. Chen/Thurston medical journal article claims smallest particles non-alkaline

In the December 2002 issue of the Lancet medical journal, Dr. Chen and Dr. Thurston published their claim that the small PM2.5 particles of WTC dust were non-alkaline.[78] They reasserted the assurances that since the smallest particles were non-alkaline they would not damage the deep regions of the lungs. Dr. Chen and Dr. Thurston stated that their findings were particularly important to rescue and recovery workers, since the dust tested came from near Ground Zero and simulated exposures during rescue and recovery operations.

12/02 EPA report on same laboratory tests gave high pH, alkaline levels for smallest particles

In December 2002, EPA published a report on its mouse inhalation study of WTC dust.[79] This comprehensive report also included the results of the same pH tests of the same WTC dust described by Dr. Thurston and Dr. Chen in their 12/02 Lancet medical journal article. This 12/02 EPA report directly contradicts Dr. Thurston's 2/11/02 Senate testimony. The 12/02 EPA report stated that the pH levels for the smallest particulates ranged from 8.88 to 10, alkaline, not in any way neutral as described by Dr. Thurston and Dr. Chen.

Even this reported pH range of 8.88 to 10 may be erroneous or falsified, due to the probable use of the same fraudulent pre-neutralization analytical techniques employed in the EPA-funded Rutgers team studies, described earlier. EPA provided no details about the test methods or sample preservation prior to the pH analysis, other than to state that deionized water was used. Also, Dr. Chen from NYU had told me earlier in an email in 2/02 that the larger particles had a pH above 11.[80] However, by the time the study was published in 12/02 by EPA, and again published as the McGee *et al.* study in the journal Environmental Health Perspectives in 2003, mysteriously the highest pH of any of the particles, regardless of size, never exceed 10.

Smallest particles alkaline – 2003 publication, lead author John McGee, EPA


Dr. Dan Costa, EPA NHEERL (www.toxicology.org)

In June 2003, a series of studies was published in the journal Environmental Health Perspectives (EHP), breaking up the larger 12/02 EPA report into several different papers. The laboratory chemical analyses of WTC dust, including pH, were published in a separate paper under the lead authorship of Dr. John K. McGee at EPA's National Health and Environmental Effects Research Laboratory in RTP.[81]

The 2003 McGee *et al.* publication also stated that the same dust samples collected by NYU scientists the days after 9/11 were highly alkaline for the smallest PM2.5 particles. If it still seems unclear that the samples and tests were identical, a map from the 2003 McGee *et al.* publication is excerpted into the reference citation, which can be compared to the map from the 2002 Lancet publication, also excerpted into the reference section. The map in the McGee *et al.* publication carries the legend "WTC dust samples were collected by New York University scientists ... on 13 September 2001 ... " These were the same samples. The only difference was the fraudulent reporting of the results (changing the numbers) in different EPA-funded publications.

Apparently, it was EPA's laboratory, not NYU, that performed the actual pH analyses of the samples. NYU only collected the samples and size fractionated them, then sent them down to EPA for chemical work-up.[82] There would not have been enough sample in the small particle size range for testing by more than one laboratory, according to the EPA description.[83] Samples were tested for pH before and after soaking in saline solution (water plus sodium chloride, table salt) for several days. Predictable, the soaking of the samples was seen to neutralize them, a fact noted by EPA. However, the pH tests of the original dusts are what is at issue here, because first responders and the public were exposed to the original dust, not dust that had been neutralized first.


Dr. Lung Chi Chen
(www.med.nyu.edu)

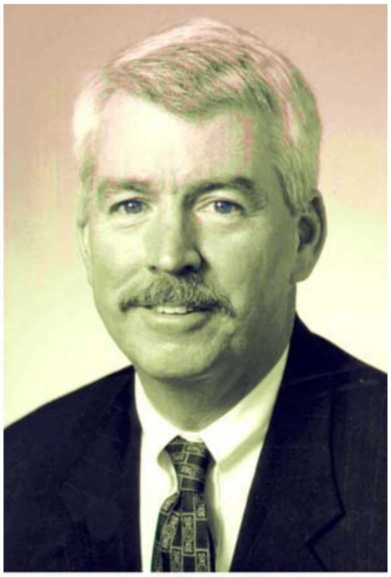
Renewed false claims smallest particles non-alkaline, plus falsification of pH results for bulk WTC dust – 2004 publication, lead author Philip Landrigan, Mt. Sinai

In 2004, a large group of EPA/NIEHS-funded and EPA staff researches published additional findings on the human health consequences of the WTC collapse in the journal Environmental Health Perspectives (EHP).[84] This paper included a summary of the results from the earlier published EPA funded research.

The lead author was Dr. Philip Landrigan, Mt. Sinai School of Medicine. Landrigan *et al.* falsely claimed that McGee *et al*. reported that the smallest PM 2.5 particles in WTC dust were neutral, non-alkaline. The McGee 2003 article said just the opposite.[85, 86]

A new second false claim was made in Landrigan *et al*. to bolster their claim that the smaller particles were not alkaline. This was the claim that the smaller WTC particles did not contain as much cement components that were the assumed responsible agents for the alkaline high pH levels of WTC dust. The 2004 Landrigan *et al.* publication cited the McGee *et al.* study which stated just the opposite.[87]

There was another study which was available to Landrigan *et al*. which also found that the smallest particles were enriched with concrete components like calcium hydroxide, which was conveniently not cited in the Landrigan *et al.* publication. The September 2002 ATSDR/NYC DOHMH study included extensive mineral composition data for the smaller size fractions, as well as larger sized particles in airborne dusts.[88] This study show that the PM4 and PM10 samples appear to contain greater concentrations of $Ca(OH)_2$ (portlandite) and $CaCO_3$ (calcite) than the larger size particle fractions (PM100).


Dr. Philip J. Landrigan
Mount Sinai School of Medicine

The third false claim in the Landrigan *et al*. publication was that bulk samples of WTC dust only had a pH level as high 11.0. Again, the same 2 studies (McGee *et al.* and Lioy *et al.*) were cited as a basis for this claim. Because the McGee *et al.* study only reported a maximum pH level of 10.0, the Lioy *et al.* study would need to be the source for the claim that the highest pH was only 11. This also was a deliberate misrepresentation. The Lioy study[89] found a pH level as high as 11.5 for one sample, which is over 3 times as alkaline as a pH of 11.0. Claiming that the pH was only 11.0 conveniently gets the pH level under the universally accepted trigger level for corrosivity to human tissues (pH 11.5). It would have been hard to overlook the pH level of 11.5 in the Lioy *et al.* publication, because it appeared in bold-faced type in the abstract, as well as being in the text of the article and also a table as well. This third falsification makes it clear that the other falsification of the pH levels for the smallest particles was no casual error in the Landrigan *et al.* paper.

ATSDR/NYC false health claims about high pH and other WTC constituents

During November and December 2001, the U.S. Centers for Disease Control's Agency for Toxic Substances and Disease Registry (ATSDR), funded by EPA through its NCP/Superfund authority, in conjunction with the NYC Department of Health and Mental Hygiene (DOHMH) tested dust inside and outside buildings near Ground Zero.[90] (Hereafter called the ATSDR/NYC study.) Elevated levels of asbestos and fiberglass were found all the way up Broadway into Chinatown.[91]

This study contains some of the most comprehensive data on specific building material-related substances, including calcium compounds (calcium hydroxide, calcium carbonate, and calcium sulfate) over a widespread area. 243 WTC dust samples were analyzed by X-ray diffraction. Importantly for considerations of the pH of WTC dust, up to 8% calcium hydroxide was detected in WTC dust. This is highly significant, because WTC dust containing as little as 0.185% calcium hydroxide could produce a leachate with a pH of 12.5.[92]

> Calcite (calcium carbonate) and **portlandite (calcium hydroxide)** are also components of concrete. They occurred with similar frequency in the dust samples and were often colocated with the quartz. Calcite ranged from an estimated 0.8%J to 19%J in outdoor areas, and from 0.02%J to 21%J in indoor areas. **Portlandite ranged from an estimated 0.07%J to 6%J in outdoor areas and from 0.04%J to 8%J in indoor areas.**

Consistent with the falsifications described earlier in this complaint, ATSDR/NYC also engaged in a strategy to falsify the significance of their findings of consistently high calcium hydroxide concentrations in WTC dust. First, ATSDR/NYC released a brief 4-page press release on 2/8/02 making health claims (all reassuring) about their data,[93] but did not release the full report which contained the actual data until September/October 2002. The study also concealed the identity of calcium hydroxide by calling it "portlandite." It was not defined until page 21 of their report, after using the term 26 times previously. The term "calcium hydroxide" appeared only 2 times in the report, while the term "portlandite" appeared 90 times.

A most serious problem was ATSDR/NYC's falsification of health effects, explained below.

ATSDR/NYC falsified NIOSH, OSHA, and ACGIH hazard evaluations for $Ca(OH)_2$, $CaCO_3$, and $CaSO_4$

ATSDR/NYC falsely claimed that calcium hydroxide ($Ca(OH)_2$, portlandite), calcium carbonate ($CaCO_3$, calcite), and calcium sulfate ($CaSO_4$, gypsum) are all soluble in body fluids and easily cleared from the lungs. ATSDR/NYC further stated that because of their rapid clearance, they had not been associated with adverse effects, even with high industrial exposures.

ATSDR/NYC cited the Merck Chemical Index,[94] the NIOSH Pocket Guide to Chemical Hazards,[95] and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's)[96] as 3 out of 5 sources that purportedly supported these claims. In fact, all 3 of these reference sources state the opposite regarding solubility and lung clearance. In addition, since ACGIH, NIOSH, and OSHA all have established stringent workplace exposure limits for $Ca(OH)_2$, $CaCO_3$, and $CaSO_4$, these organizations do not support the ATSDR/NYC false claim that these substances are harmless and without adverse effects.

See the tables on the following page for a comparison of the claims made by ATSDR/NYC on the solubilities, lung clearance, and health effects compared to what the Merck Index, ACGIH, NIOSH, and OSHA actually state:

COMPARISON OF ATSDR/NYC REPRESENTATIONS OF HEALTH REFERENCE DOCUMENTS versus ACTUAL DOCUMENTS

	ATSDR/NYC solubility-clearance claims, citing Merck Index, NIOSH Pocket Guide, and ACGIH TLV	Merck Index	NIOSH Pocket Guide	ACGIH TLV Documentation
$Ca(OH)_2$	The potential health effects of gypsum (hydrated calcium sulfate), portlandite (calcium hydroxide), and calcite (calcium carbonate) are similar as these minerals are similar chemically and physically. All three minerals are crystalline in form and soluble *[reference to Merck, NIOSH]*. Because these minerals are soluble in body fluid, they are easily cleared from the respiratory tract and lungs when inhaled [*reference to ACGIH*]. Therefore, no long-term respiratory effects have been observed, even at the very high exposures that occur during the mining and processing of these minerals ...	slightly soluble in water - pH of aqueous solution saturated at 25 degrees: 12.4	Solubility (32°F): 0.2%	0.185% in water - The pH of its aqueous solution is 12.4 Calcium hydroxide is a relatively strong base and hence a moderately caustic irritant to all exposed surfaces of the body, including the eyes and respiratory tract. ...
$CaCO_3$		practically insoluble in water	Solubility: 0.001%	practically insoluble in water Research ... in humans indicates that short term exposures to 5 mg/m^3 calcium carbonate will lead to decreases in nasal clearance, airway patency, and nasal secretion and increased levels of nasal dryness and pain.
$CaSO_4$		solubility in water at 18.75 degrees 0.2 parts/100 parts	Solubility: 0.3%	0.2% in water 58 Canadian gypsum miner and millers in 1931 ... The most common symptom was dypsnea (30%). Half showed increased lung shadows on X-ray. ... British gypsum mines ... 241 men ... Higher rates of parenchymal changes ... Lung function tests showed a slight decline associated with length of service TLV ... recommended to protect against long-term respiratory health effects and to minimize the particle clearance alterations that have been demonstrated to occur in both animals and human subjects after exposure to calcium sulfate.

	OSHA PEL – NIOSH REL	ACGIH TLV
Calcium hydroxide ($Ca(OH)_2$) portlandite, slaked lime, hydrated lime	Total - 15 mg/m^3 Respirable fraction - 5 mg/m^3	Total - 5 mg/m^3
	NIOSH Pocket Guide: pH of aqueous solution saturated at 25 degrees: 12.4. Irritant eyes, skin, upper respiratory system; eye, skin burns; skin vesiculation [*formation of vesicles*]; cough, bronchitis, pneumonitis.: Irritant eyes, skin, upper respiratory system; eye, skin burns; skin vesiculation [formation of vesicles]; cough, bronchitis, pneumonitis.	
Calcium Oxide (CaO) unslaked lime, quicklime CaO converts to $Ca(OH)_2$ on contact with moist tissues. Exposure to calcium oxide would be higher at Ground Zero because of the high temperature conversion of $Ca(OH)_2$ to CaO.	Total dust - 5 mg/m^3 Total dust - 2 mg/m^3 (NIOSH REL) NIOSH Immediate Danger to Life and Health (IDLH) Total dust - 25 mg/m^3	Total dust - 2 mg/m^3
	NIOSH Pocket Guide: Irritant eyes, skin, upper respiratory system; eye, skin burns; skin vesiculation [*formation of vesicles*]; cough, bronchitis, pneumonitis.: Irritant eyes, skin, upper respiratory tract; ulcer, perforation nasal septum; pneumonitis; dermatitis Note: Reacts with water to form calcium hydroxide.	
Calcium carbonate ($CaCO_3$)	Total - 15 mg/m^3 Respirable fraction - 5 mg/m^3	Total - 10 mg/m^3 Respirable fraction - 1 mg/m^3 (2005 proposed TLV
	NIOSH Pocket Guide: Irritant eyes, skin, respiratory system; cough	
Calcium Sulfate ($CaSO_4$)	Total - 15 mg/m^3 Respirable fraction - 5 mg/m^3	Respirable fraction - 10 mg/m^3
	NIOSH Pocket Guide: Irritant eyes, skin, upper respiratory system; conjunctivitis; rhinitis, epistaxis (nose bleed)	
Sodium hydroxide (NaOH) in its pure, concentrated solid form; lye, solid drain cleaner. [*included as a comparison for CaOH*]	Total - 2 mg/m^3	Total - 2 mg/m^3
	NIOSH Pocket Guide: Irritant eyes, skin, upper respiratory system; eye, skin burns; skin vesiculation [*formation of vesicles*]; cough, bronchitis, pneumonitis.: Irritant eyes, skin, mucous membranes; pneumonitis; eye, skin burns; temporary loss of hair	

The ACGIH called $Ca(OH)_2$ a "relatively strong base" and set its exposure limit as only 2.5 times the exposure limit of pure concentrated solid sodium hydroxide (NaOH, or lye), one of the most corrosive caustic substances known.[97] NIOSH has established an Immediate Danger to Life and Health (IDLH) standard for calcium oxide (CaO) at concentrations of only 25 mg/m^3. These concentrations may have been approached or exceeded at the Pile at Ground Zero. CaO converts to $Ca(OH)_2$ in an exothermic reaction (emits heat) on contact with moisture (tissues).[98] Calcium carbonate and calcium sulfate are both skin, eye, and respiratory system irritants, causing long term health effects.

Use of outdated 1975 textbook because 2000 edition did not support conclusion of "no hazards"

ATSDR/NYC also deliberately cited 2 other references to support their claim there had never been any adverse health effects from heavy exposures during the mining and processing of $Ca(OH)_2$, $CaCO_3$ and $CaSO_4$.[99] These were from two outdated sources no longer available.

The first outdated reference ATSDR/NYC cited was the 1975 5th Edition of Hunter's *The Diseases of Occupations*.[100]

> [*p. 32 of ATSDR/NYC report*]
> 2. Soluble Minerals: Gypsum, Portlandite, and Calcite
> The potential health effects of gypsum (hydrated calcium sulfate), portlandite (calcium hydroxide), and calcite (calcium carbonate) are similar as these minerals are similar chemically and physically. All three minerals are crystalline in form and soluble (11,12). Because these minerals are soluble in body fluid, they are easily cleared from the respiratory tract and lungs when inhaled (13,14,15). Therefore, no long-term respiratory effects have been observed, even at the very high exposures that occur during the mining and processing of these minerals (16,17).
>
> Although possible skin, eye, and respiratory tract irritants, the soluble minerals gypsum, portlandite, and calcite do not pose any hazard for long-term health effects..
> ...
> [*References*]
> 11. Merck Chemical Index. Merck Research Laboratories, Rahway, N.J., 1998
> 12. National Institute of Safety and Health. Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Washington, D.C., 2001
> 13. American Conference of Governmental Industrial Hygienists (ACGIH). TLV Documentation: Calcium Sulfate, 2001.
> 14. American Conference of Governmental Industrial Hygienists (ACGIH). TLV Documentation: Calcium Hydroxide, 2001.
> 15. American Conference of Governmental Industrial Hygienists (ACGIH). TLV Documentation: Calcium Carbonate, 2001.
> 16. Hunter D. The Disease of Occupations, 5th Ed. The English Universities Press, Ltd., London, 1975.
> 17. Beal AJ, Griffin OG, Nagelschmidt G. Safety in Mines Research Establishment (SMRT) Research Report No. 72, 1956.


Dr. Jessica Leighton, NYC DOHMH lead author, ATSDR/NYC study (www.packer.edu)

Indeed, Hunter's *The Diseases of Occupation*s is one of the most recognized authoritative texts on industrial medicine.[101] However, it is updated every few years, now by a prestigious panel of experts after the death of the original author in 1978. The latest edition is the 9th, published in 2000, and readily available to ATSDR/NYC. [102]

Not only is the 1978 edition of Hunters outdated, ATSDR/NYC even falsified the information in it, claiming that it stated the mining and processing of portlandite minerals ($Ca(OH)_2$) had not resulted in health consequences. In fact, the 5th edition was totally silent about any mining or processing of "portlandite" ($Ca(OH)_2$). This because portlandite is an exceedingly rare mineral in nature, and never mined commercially.[103] Synthetic modern concrete would be the only source of portlandite in WTC dusts.

The health information in the 1975 edition of Hunters truly is outdated as well, and contains errors because our knowledge of toxic substances has expanded dramatically. If the 5th edition of Hunter was to be relied upon today, consider what it said about blood lead levels.[104] Blood lead levels below 40 µg/dL were called "normal," levels between 40-80 µg/dL were called "acceptable," and only levels above 120 µg/dL were called "dangerous." Contrast this with our current understanding that blood lead levels less than or equal to 2 µg/dL are associated with both myocardial infarction and stroke mortality.[105] Clearly it would be criminal malpractice for any physician to tell a patient today that they were not at risk if their blood lead level was tested and found to be 80 µg/dL, based on the information in the 5th edition of Hunter.

The 1975 5th edition of Hunter's also stated that hexachlorocyclohexane, lindane, and DDT had not caused any adverse effects in worker exposures,[106] and that methylene chloride and trichloroethylene are suitable substitutes for benzene.[107] There is a very serious question as to why ATSDR/NYC would go to great lengths to seek out the 1975 edition of Hunter's to support their contention of no hazards from WTC dust, when the 2000 edition was much more accessible.

ATSDR/NYC also cited another extremely outdated and inaccessible British Safety in Mines Research Establishment document from 1956 to make their claim their were no industrial hazards from exposures to $Ca(OH)_2$, $CaCO_3$ and $CaSO_4$.[108] This 50-year old reference is no longer available to the public, and has at best historical significance. One can only guess what it actually states, because the hazards of asbestos were not even well recognized in 1956.

ATSDR/NYC used non-optimal pH test methods known to give falsely low pH levels

The ATSDR/NYC study included pH test information, but only from 2 locations. The method they used states in the method itself that it is likely to give erroneous low pH levels for highly alkaline solid materials,[109] a fact omitted from the ATSDR/NYC report.

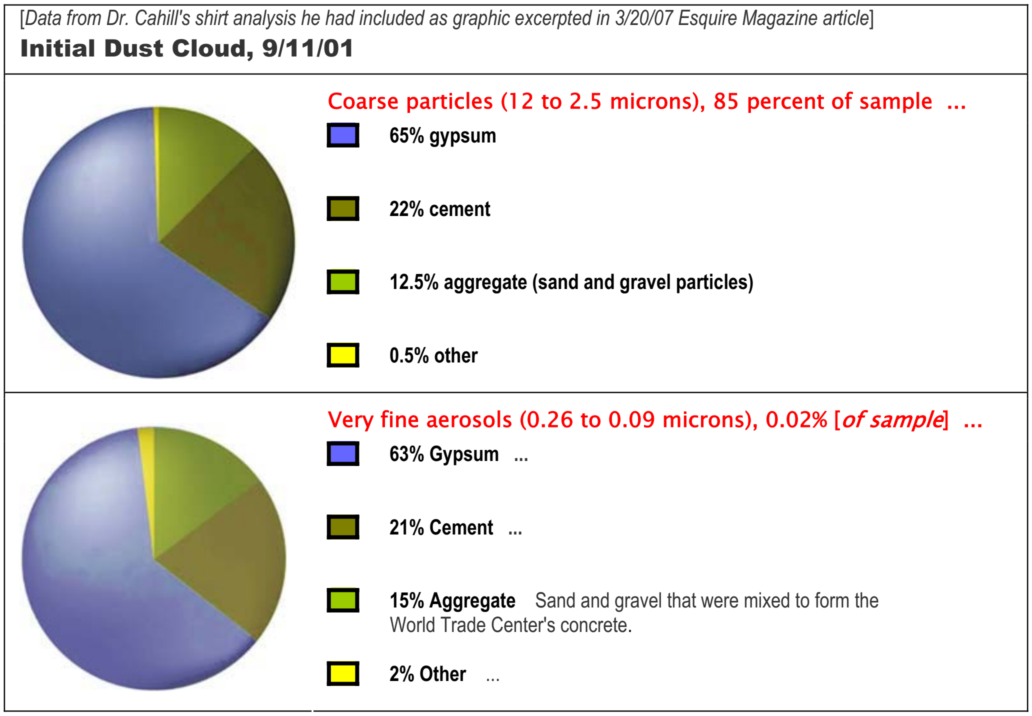
ATSDR/NYC also falsely claimed there was not enough dust for testing more than 2 samples, claiming they were following EPA testing protocols which required large samples for each test.[110, 111] However, ATSDR/NYC decision to use only 10-25 grams dust for a pH test was already a deviation from EPA's protocols, which if strictly followed requires a full 20 grams of material. In evaluating WTC dust for pH, other government funded and approved studies have successfully used much smaller samples for pH testing.[112] As a prudent measure to protect health and safety, thin layers of settled dust could have been misted with water, followed by the application of pH test strips. This is a recognized method for EPA and OSHA emergency response personnel.

The ATSDR/NYC pH test results are not credible for another reason. Their X-ray diffraction tests for the same 2 samples they tested for pH showed calcium hydroxide ($Ca(OH)_2$) at concentrations of 6% and 3%.[113] If the pH tests were performed correctly, soon after water addition, the pH would be predicted to approach 12.5. This because a saturated solution of calcium hydroxide should result if there is only 0.185% calcium hydroxide in a sample. See earlier discussions of the Rutgers team and NYU studies for a description of the intentional pre-neutralization of alkaline substances by soaking in water for extended periods before testing. There was no information available in the ATSDR/NYC report to rule out similar soaking for excessive time periods before testing pH, for the purpose of pre-neutralization.

UC Davis finds 21% cement in smallest WTC particles, pH 11 to >12

A prominent World Trade Center research group, the DELTA Group at the University of California at Davis[114] reported 21 to 22% portland cement in the smallest respirable-sized WTC dust particles.[115, 116] These are highly significant findings, because newly pulverized concrete from old structures has been shown to generate highly alkaline leachates, with pH levels from 11 to over 12. Part 2 of this complaint summarizes these studies.

The following figure was excerpted from the 3/20/07 issue of Esquire Magazine where Dr. Tom Cahill presented data from the DELTA Group testing a shirt exposed to the initial WTC dust cloud at ground level:



[Data from Dr. Cahill's shirt analysis he had included as graphic excerpted in 3/20/07 Esquire Magazine article]

Initial Dust Cloud, 9/11/01

Coarse particles (12 to 2.5 microns), 85 percent of sample ...

🟦 **65% gypsum**

🟫 **22% cement**

🟩 **12.5% aggregate (sand and gravel particles)**

🟨 **0.5% other**

Very fine aerosols (0.26 to 0.09 microns), 0.02% [*of sample*] ...

🟦 **63% Gypsum** ...

🟫 **21% Cement** ...

🟩 **15% Aggregate** Sand and gravel that were mixed to form the World Trade Center's concrete.

🟨 **2% Other** ...

Although the test results provided in the Esquire article are consistent with the high quality laboratory work of the UC Davis research team, Dr. Cahill made several false statements in the article regarding the health implications of the data. Dr. Cahill claimed that caustic cement particles with pH levels of 11 – 12 produced no long-term health effects, and also claimed that gypsum (calcium sulfate) was harmless and easily cleared from the lungs because of its solubility:

> Cahill found that the dust preserved on the shirt and bag was significantly less toxic than samples he had previously tested, which were collected in the weeks following 9/11. Both sets of samples contained large amounts of gypsum and cement. (Gypsum is an innocuous mineral that dissolves in lung fluid and is often used as a food additive because of its high calcium content.) ... Cahill concluded that in addition to the gypsum from drywall in the collapsed buildings, about one third of the sample consisted of alumino-silicates, natural minerals found in the earth's crust, and finely ground cement, which, while caustic--and the cause for the so-called World Trade Center cough -- usually doesn't cause long-term health problems.

Dr. Cahill reaffirmed both his data well as his statements in Esquire that cement and gypsum would not cause long term health effects through an email interchange, in which he also augmented his statements in the Esquire article:[117]

> Sorry that the article bothered you, but I made every effort to make the relatively harmless initial collapse dust contrast the miserable "brutal" materials of the smolder phase, with its disastrous and continuing health impacts. ... Second, the analyses of those samples were in fact very comforting to me. If you put a drop of water on the material from the shirt (the least modified material) much of the dust promptly dissolved, a characteristic of gypsum. When decanted and allowed to dry, the clear liquid returned to a white solid. ... Third, I insisted, and in fact prepared the graphics ... I did not see the article before it was published, but thought they had done a good job. ...


Dr. Thomas Cahill at Ground Zero
(www.ucdavis.edu)

Dr. Cahill is wrong in claiming there would not be permanent damage from cement particulates, which he himself admitted had a pH from 11 to 12. These cement particulates, found at 21 to 22% levels in the respirable size fractions, can potentially generate pH levels higher than 12. This is above pH 11.5, the internationally recognized UN presumptive trigger level for irreversible chemical burns.[118]

Dr. Cahill's claims that calcium sulfate is soluble in lung fluids, easily cleared, and harmless are also false. First, as to solubility, Dr. Cahill claimed he observed "prompt" solubilization of WTC dust from the shirt. However, gypsum has extremely low solubility in water, only about 0.2 to 0.3 percent.[119] He was probably only observing the suspension of gypsum particulates in water, where they would not be visible because of a combination of their low refractive index and their very small particle size.[120]

The refractive index of gypsum is about the same as silica (*e.g.* quartz sand or glass). If sand or glass were ground to this small particle size, they also would not be readily visible as particulates in water. It was an easy task to pulverize a small amount of gypsum from drywall in a mortar and then add water. A very slightly milky suspension could be seen if the water suspension was placed on a black surface. The suspension then dried to an opaque white film. But this in no way constituted a demonstration that the gypsum dissolved; it merely became suspended in the water droplet. Dr. Cahill has yet to answer my request for substantiation that the WTC dust he tested actually dissolved and in what concentrations.

Second, gypsum is not easily cleared from the lung and harmless. It has been shown to accumulate in the lungs of humans and animals and prevent the clearance of other more hazardous substances. It is subject to stringent workplace control standards by OSHA, NIOSH, and ACGIH as explained in the earlier section on the ATSDR/NYC study. One study showed accumulations of calcium sulfate in the lungs of a school teacher only exposed to gypsum from blackboard chalk.[121] Animals historically exposed to gypsum dust developed worse tuberculosis infections, and died more frequently of pulmonary problems.[122] In another study,[123] gypsum could not be found in the lungs of exposed animals using standard chemical analyses, but was in fact found by microscopic examination of the lung tissues themselves, indicating possible destruction of gypsum using standard chemical analyses. This study also found adverse enzyme effects indicating an inflammatory response of the lower lung.

Dr. Cahill's false reassuring statements in the widely available Esquire Magazine article may prevent residents, office workers, laborers and others from seeking medical attention, attribute their illness to WTC exposures, or participate in WTC health screening and monitoring programs.

No immediate pH tests at Ground Zero as required by regulation

As discussed in my 10/25/06 complaint, the immediate field testing for pH and other hazards are required whenever there is a potential release of hazardous materials. This is to protect the safety of first responders and the nearby population. However, EPA's Bonnie Bellow denied any early field testing of pH of WTC dusts in a 2/9/02 press story.[124]

roll of pH paper, cost about $8 for a single roll
(showing of any brand name does not constitute endorsement)

The OSHA and EPA regulations that require immediate field testing for pH apply by all On Scene Coordinators (OSC's) (federal, state, city).[125, 126] NYC and EPA On Scene Coordinators (OSC's) were in fact at Ground Zero the morning of September 11, 2001.[127] EPA and OSHA regulations also require OSC's to be trained how to test for pH at any release incident.[128, 129] EPA and OSHA also require that pre-packed kits and vehicles be ready to deploy to any of these incidents, and include a range of protective equipment and basic chemical sampling apparatus, including pH testing equipment (simple paper test strips and/or pH meters).[130, 131, 132] The United Nations Environmental Programme (UNEP) also recognizes the need for immediate field testing of pH by any enforcement personnel who first encounter suspect hazardous wastes, again using simple pH paper strips or field pH meters.[133]

On the basis of the above, it is not credible for EPA, OSHA or NYC to claim they did not have immediate pH field data for WTC dust.

OSHA deletes calcium data, an indicator for presence of $Ca(OH)_2$, CaO and $CaCO_3$

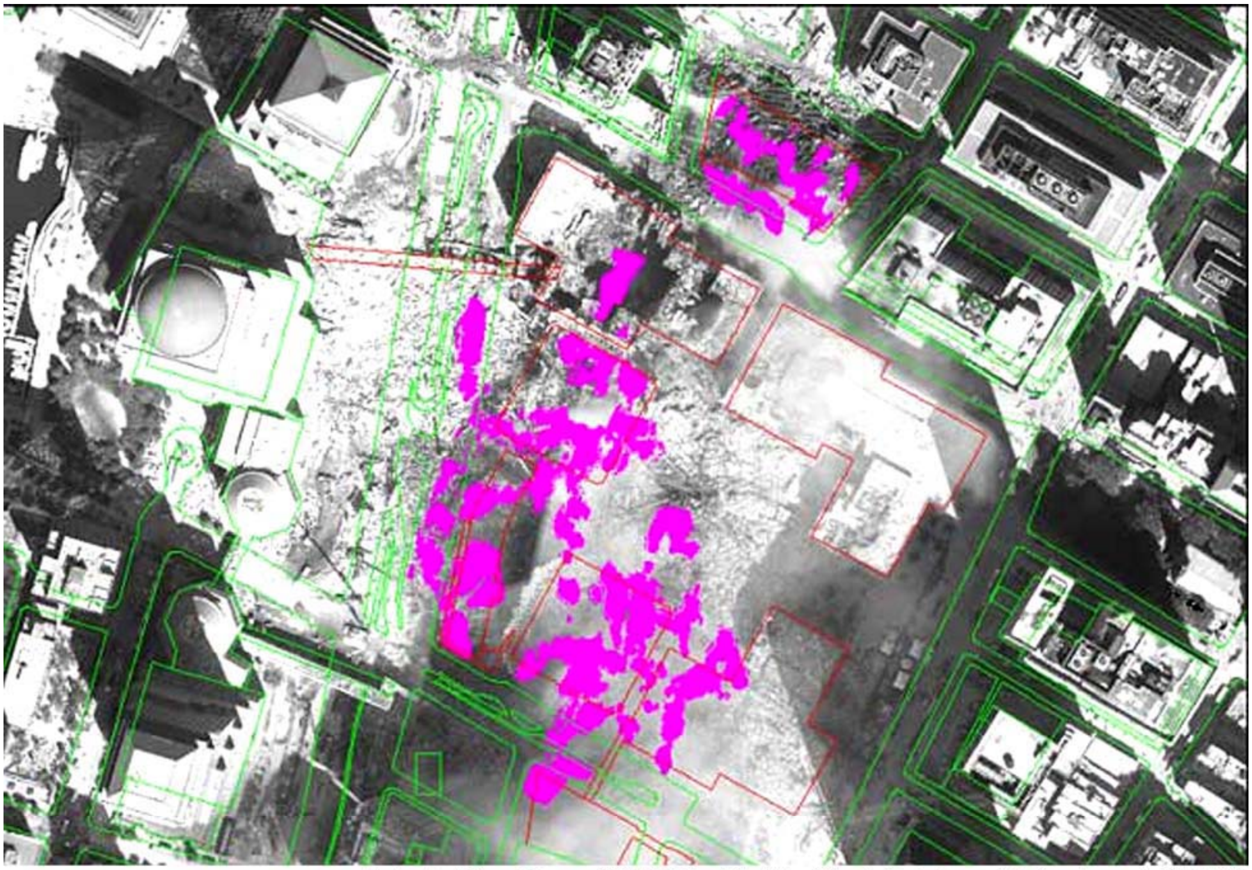
OSHA selectively deleted key pH-related data from its public data releases.[134] OSHA deleted all results for calcium compounds, which would indicate the probable presence (and need for further testing) for the OSHA-regulated alkaline substances calcium oxide (CaO), calcium hydroxide ($Ca(OH)_2$) and calcium carbonate ($CaCO_3$).

OSHA cannot claim that it deleted calcium data by asserting their tables only included "heavy metals." Their tables included metals that are not even as "heavy" as calcium. Calcium has a molecular weight of 40. But magnesium only has a molecular weight of 24, and was included. Magnesium oxide is not as caustic and alkaline as CaO, $Ca(OH)_2$ and $CaCO_3$, and thus of less concern. OSHA also tested and included discussions of its data for beryllium[135] which has a molecular weight of only 9, a much less "heavy metal" than calcium.

OSHA's laboratory test methods (either ICAP or AA) would simultaneously reveal a large range of metals, including calcium, sodium, and potassium.[136, 137] OSHA cannot claim that it did not find calcium, sodium, or potassium. Calcium, sodium and potassium compounds have always being found and reported in WTC dust and air by all other researchers, government and private, both near and far outside the boundaries of the Ground Zero epicenter, using the same laboratory methods. See the references for 8 studies showing calcium, sodium, and potassium compounds in settled dusts, air, and the fire plume from the WTC.[138]

No pH tests of more corrosive dust subjected to heat at Ground Zero

All the WTC dusts tested in the EPA-funded laboratory studies used samples from outside the perimeter of Ground Zero and the "Pile." WTC dust from the epicenter would have been much more alkaline than the dusts deposited outside the perimeter of Ground Zero by the initial collapse. This is because at the epicenter, surface and subterranean fires continued for months. High temperatures are known to convert carbonates from concrete, wood ashes and other combustion products to more alkaline oxides and hydroxides, and also release alkaline oxides from glass. Thus, even if the laboratory pH testing described earlier had been honestly reported or conducted, the results still would not approximate the much higher alkalinity of WTC dust at Ground Zero to which first responders were exposed.



Hot spots at Ground Zero on 9/16/01, © New York State, Office for Technology (http://www.loc.gov/exhibits/911/)

Establishing temperatures at Ground Zero from continuing fires

Temperatures at Ground Zero from the WTC fires that lasted until at least December can be established from several sources. The National Institute for Standards and Technology (NIST) stated that a normal open fire attains temperatures of 1100° C. The NIST acknowledged reports of molten steel at the base of the WTC after the collapse due to the subterranean fires, where the melting point of steel at 1500° C.[139] The USGS fly-over remote sensing of thermal hot spots at the WTC on September 16 showed temperatures as high as 704° C. on the surface, meaning the temperatures would have been even higher in earlier days and below the surface.[140, 141] One report found glass spheres from melted glass in the plume of WTC emissions up until 10/30/01.[142] Glass melts at about 1000° C.[143]

Conversion of carbonates to more caustic oxides at elevated temperatures

At high temperatures, calcium carbonate is converted to calcium oxide (CaO) which would then change to calcium hydroxide ($Ca(OH)_2$) on contact with moisture. Similarly, sodium carbonate (Na_2CO_3) converts to the more caustic sodium hydroxide (NaOH), and potassium carbonate (K_2CO_3) converts to potassium hydroxide (KOH). Eventually, reaction with atmospheric carbon dioxide and moisture convert these hydroxides back to the less caustic carbonates by a reaction called "carbonation." See the equations below:

$$CaCO_3 \xrightarrow{\text{heat}} CaO \xrightarrow{\text{water/moisture}} Ca(OH)_2 \xrightarrow{\text{water/moisture + carbon dioxide + time}} CaCO_3$$

$$Na_2CO_3 \xrightarrow{\text{heat}} Na_2O \xrightarrow{\text{water/moisture}} NaOH \xrightarrow{\text{water/moisture + carbon dioxide + time}} Na_2CO_3$$

$$K_2CO_3 \xrightarrow{\text{heat}} K_2O \xrightarrow{\text{water/moisture}} KOH \xrightarrow{\text{water/moisture + carbon dioxide + time}} K_2CO_3$$

Calcium carbonate ($CaCO_3$) levels from concrete, converted to calcium oxide (CaO) by heat at GZ

There were high concentrations of calcium carbonate ($CaCO_3$) in WTC dust that would have been converted to highly caustic calcium oxide by the elevated temperatures on the Pile at Ground Zero. There were also high concentrations of highly caustic calcium hydroxide ($Ca(OH)_2$) to begin with in WTC dust from concrete pore water as well, which would also convert to calcium oxide (CaO) at elevated temperatures.

The ATSDR/NYC study[144] included 243 analyses of airborne and settled WTC dust from samples taken near Ground Zero, but still outside the perimeter. Calcium carbonate ranged from an estimated 0.8% to 19% in WTC dust in outdoor areas, and from 0.02% to 21% in indoor areas. Calcium hydroxide ($Ca(OH)_2$, "portlandite") ranged from an estimated 0.07% to 6% in outdoor areas and from 0.04% to 8% in indoor areas. USGS used less exact methods for WTC dust, finding much greater concentration ranges.[145] USGS found calcium carbonate in some samples greater than 20%, and calcium hydroxide from 5 to 20% in some samples.

A USGS monograph describes the manufacture of portland cement.[146] At temperatures between 750 – 1000° C., limestone (primarily $CaCO_3$) is converted to calcium oxide (CaO). The extremely caustic bases sodium oxide and potassium oxide (Na_2O and K_2O) are also produced in at these temperatures due to salt impurities (sodium chloride and potassium chloride) in limestone and other raw materials. Temperatures at Ground Zero far exceeded 750° C, and were more than sufficient to convert the abundant calcium carbonate in WTC dust to calcium oxide.

The intense heat at Ground Zero above 1500° C. may also have been sufficient to convert the crystalline complexes of aluminum silicates from the more complex mineral forms in concrete back to calcium oxide, sodium oxide, and potassium oxide (CaO, Na_2O, K_2O).

Drywall sources of calcium carbonate ($CaCO_3$) and potassium sulfate (K_2SO_4), conversion to calcium oxide (CaO) and potassium oxide (K_2O)

Although the main source of calcium carbonate in WTC dust was probably from concrete, drywall might also be a source. Drywall is sometimes made with calcium carbonate in addition to the main ingredient, calcium sulfate ($CaSO_4$, gypsum, or plaster of Paris). A manufacturer's MSDS warns of the formation of CaO fumes from $CaCO_3$ in its drywall at temperatures over

825° C.[147] As discussed earlier, the elevated temperatures on the Pile at Ground Zero were sufficient to convert calcium carbonate to calcium oxide.

Potassium sulfate (K_2SO_4) is intentionally added to drywall mixtures as a crystallization modifier.[148] Elevated temperatures would result in conversion to potassium oxide.[149, 150]

Window glass and fiberglass as sources of alkali oxides CaO, Na_2O and K_2O

WTC dust contained both pulverized glass as well as fiberglass. Window glass contains up to 30% sodium oxide (Na_2O).[151] Glass also contains potassium oxide (K_2O) and calcium oxide (CaO). Na_2O, K_2O, and CaO can be released from glass particularly at elevated temperatures. First, Na_2O will directly vaporize out of glass.[152] Second, elevated temperatures, particularly above 700° C., but also over extended periods of times in moist environments at ambient temperatures, will lead to a process called "devitrification." During devitrification, silicon oxide crystals separate out of the glass, leaving behind a glassy substance with even higher concentrations of Na_2O.[153, 154] This remaining Na_2O enriched glass is more soluble in water (or contact with moist tissues), leaching Na_2O and NaOH.

There are three reports establishing melted glass spheres in WTC dust and plume emissions.[155, 156, 157] This indicates high enough temperatures to both volatilize NaOH from glass components of WTC dust as well as devitrify the glass components.

Cellulosic sources of potassium/sodium/calcium oxides, hydroxides, and carbonates

Burning wood or any other cellulose materials (paper, fiberboard) produces ashes which are alkaline.[158] This is a well known and the basis of the early manufacture of the first alkali, "potash."[159] Potash is a combination of potassium carbonate (K_2CO_3) and sodium carbonate (Na_2CO_3), both of which have a pH of 11.6 in water solutions.[160] Calcium carbonate ($CaCO_3$) is also present in cellulosic ashes.

At elevated temperatures, both potassium and sodium carbonate, as well as calcium carbonate, could converted to the more caustic oxides (potassium oxide (K_2O), sodium oxide (Na_2O), and calcium oxide (CaO)). The Merck Index, states that Na_2CO_3 starts decomposing to Na_2O at temperatures as low as 400° C.[161] A study of the controlled heat decomposition of wood showed conversion of Na_2CO_3 (and the presumed decomposition of K_2CO_3) above 900° C to sodium oxide (Na_2O).[162] Material Safety Data Sheets also describe the thermal decomposition of Na_2CO_3 and K_2CO_3 to the respective more caustic compounds Na_2O and KOH.[163, 164]

9/13/01 – EPA's Whitman claims tests showed "below background levels"

On 9/13/01, EPA Administrator Whitman stated on camera while in New York City that all the monitoring data from EPA testing showed hazardous substances "***below background levels***."[165]

> We've had concern, we're going to continue to monitor. But right now, as I will tell you, everything we're getting back from the sampling that we're doing, is below background levels.


EPA Administrator Christie Todd Whitman in NYC after 9/11 (www.epa.gov)

Ms. Whitman's on-air television statements contributed to the New York Times article of 9/14/01 which stated that exposures were no worse than that of a "typical smoggy day"[166] and similar reassuring statements by the press.

As a prominent state governor before her appointment as EPA Administrator, Ms. Whitman would have known the meaning of "background level." "Background level" is an unambiguous term, meaning that there is adequate data to establish that conditions are the same as normal. Both EPA[167] and other sources[168] provide clear definitions of this term. "Background level" means not only that there was enough data to establish this to a reasonable statistical certainty, but also that the test methods used were sensitive enough to measure the low concentrations that constitute normal or background levels.

Neither was the case on 9/13/01. The only toxics that had been tested at this time were asbestos, lead and organic compounds, according to the EPA IG, which fact itself establishes that no statement could be made about any background levels. Ms. Whitman did not in any way restrict her "below background levels" claim to asbestos, lead, and organics. She was making this claim across-the-board with the implication that a broad range of substances had been tested and were at "background levels."


Nikki Tinsley, former EPA Inspector General (www.washingtonpost.com)

Furthermore, that testing which was available showed that levels were nowhere near background levels. EPA's asbestos testing showed much higher levels than background in both dusts and air, and above all EPA health standards and removal criteria.[169] Similarly, volatile organic compounds were not at background levels, with a range of carcinogens found in air.[170] I was unable to locate any lead testing data for 9/11/01 or 9/12/01, but test data from 9/16/01 also showed elevated lead levels above background in settled dusts, the same dusts that would have been present outside Ground Zero on 9/11/01 and 9/12/01, the period covered by Ms. Whitman's statements.

The EPA Inspector General (IG) issued a report on 8/21/03 critical only to a limited extent of EPA's role in the aftermath of the WTC collapse.[171] In particular, the IG chose to investigate only the written EPA press release of 9/13/01, and not to what Ms. Whitman said on camera that day.[172] The 9/13/01 press release did not use the term "below background levels." The 9/13/01 press release only stated that asbestos, organics, and lead levels were "either not detectable or not of concern" or "acceptable."

The EPA IG found that the written press release of 9/13/01 was altered by the White House to add reassuring words, and the alteration by the White House only amounted to being "misleading." This was because a very careful reading of this press release revealed that it only applied to asbestos, volatile organic compounds, and lead. Therefore, the IG excused it from any finding of falsification of the data.

However, Ms. Whitman's on-air television statements on 9/13/01 went far beyond the 9/13/01 written press release altered by the White House. Ms. Whitman claimed that EPA's testing showed concentrations were "below background levels." Ms. Whitman did not say on camera "not of concern" or "acceptable." She said "below background levels."

Marianne Horinko, Esq. (www.law.virginia.edu)
Attorney Advisor to Don Clay, Assist. Admin.,
EPA OSWER: 1990-93
Don Clay Associates: 1993- June 2001
Assist. Admin. EPA OSWER: June 2001-04

If the IG had investigated the 9/13/01 television statements of Ms. Whitman in her 8/21/03 report, the IG would have been forced to conclude that Ms. Whitman had made deliberate, knowing false statements. In other instances, the EPA IG addressed the impact of Ms. Whitman's television statements on the public's perception of hazards. The EPA IG stated in her report that television statements along with written communications from EPA to the public were in fact the subject of the IG inquiry. Thus, the EPA IG cannot claim that she restricted the inquiry solely to written EPA press releases.

If the EPA IG found fault with the White House adding reassuring statements to the 9/13/01 press release, then she should have found an even higher level of fault for Ms. Whitman's going beyond the 9/13/07 press release to state that EPA found concentrations of toxics "below background levels." By avoiding addressing the 9/13/01 verbal statements of Ms. Whitman, as well as other fraud such as the pH fraud discussed in this complaint, the EPA IG was able to claim that she found no evidence of any false statements by EPA in the aftermath of 9/11.

PART 2

Long before 9/11/01 – EPA falsifies the pH level causing chemical burns (irreversible tissue damage)

Long before the World Trade Center collapse, precedents were already "cast in concrete" falsifying the health effects from high pH portland cement dust and pulverized concrete.

In May 1980, EPA's hazardous waste program falsified pH levels (changed the numbers) that the UN World Health Organization (WHO) International Labour Organization (ILO) determined would invariably result in corrosive permanent tissue damage (chemical burns). The ILO said the level was pH 11.5 for alkaline substances for both skin and eyes. But EPA claimed the ILO said this level was 12.5, falsifying what was in the 1971 edition of the ILO encyclopedia. In December 1980, this falsified pH 12.5 level was incorporated into the National Contingency Plan (NCP, Superfund) criteria for Hazardous Substances.[173] In 1993 and 1996, EPA's hazardous waste program strongly reasserted and expanded on their original 1980 falsifications, demonstrating a continuing intent and current knowledge of the original fraud.

After 9/11/01, EPA addressed the health consequences of the WTC collapse under the NCP authority (pursuant to Emergency Support Function #10 under FEMA).[174] Thus, the falsified pH 12.5 trigger level for alkaline corrosivity had a major impact on the hazard evaluation of the WTC. During the years preceding 9/11, the falsified pH 12.5 trigger level also resulted in no action to protect citizens from building demolition dust and airborne emissions from portland cement manufacture.

A pH level of 12.5 has no correlation to any human health endpoint. However, it does correlate almost exactly to the pH level that exempts the portland cement manufacturing industry and demolition industries from responsibility for uncontrolled releases (usually airborne). This is because calcium hydroxide is present even in aged, weathered concrete at concentrations capable of producing up to pH 12.5 leachates for extended periods of time.

While EPA's hazardous waste and Superfund programs were falsifying pH levels for corrosive chemical burns, other parts of EPA were not. In 1984, EPA's Office of Prevention, Pesticides and Toxic Substances (OPPTS) set the pH level at 11.5 for presumed corrosivity for both skin and eyes. In 1998, OPPTS issued new test guidelines for skin and eye corrosivity, again stating that for alkaline chemicals, a pH level of 11.5 is presumed to be corrosive.

The international community has also consistently used the pH 11.5 level. As early as 1971, the UN International Labour Organization concluded that a pH of 11.5 would invariable cause alkaline chemical burns to the skin as well as eyes. In 1981 test standards under the Organization for Economic Cooperation and Development (OECD) adopted this same pH 11.5 presumptive trigger level for both skin and eyes. In 1992 many nations (not including the U.S.) ratified the UN Basel Convention treaty, which incorporated the same pH 11.5 presumptive trigger level for corrosive wastes shipped across borders. See the chart below for a comparison of EPA's hazardous waste/Superfund programs, other parts of EPA, and the UN, remembering that a pH level of 12.5 is 10 times more corrosive than a pH level of 11.5.

	HAZARDOUS/ CORROSIVE Acidic pH range	pH RANGE requiring animal testing (May still be classified as corrosive under EPA OPPTS rules, OSHA and EPA First Responder regulations, and UN Globally Harmonized Guidelines)	HAZARDOUS/ CORROSIVE Alkaline pH range
NCP/Superfund "Hazardous Substances" and RCRA "Corrosivity Characteristic"	**0 — 2**	**2 — 12.5**	**12.5 - 14**
EPA OPPTS UN test guidelines UN Basel Convention	**0 — 2**	**2 — 11.5**	**11.5 — 14**

1980 – EPA's hazardous waste office falsifies World Health Organization document to support a lenient "Corrosivity Characteristic" under RCRA

In 1980, EPA's Office of Solid Waste (OSW) finalized a series of hazardous waste regulations pursuant to the Resource Conservation and Recovery Act (RCRA).[175] One of these regulations addressed corrosive hazardous wastes – those that would cause chemical burns to human tissues as well as corrode metal containers during transport. The regulatory language of the Corrosivity Characteristic under RCRA at 40 CFR §261.22 is given below: [176]

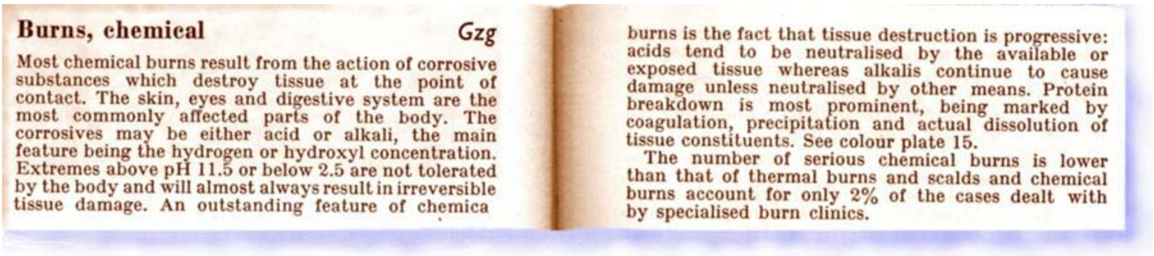
> § 261.22 Characteristic of corrosivity. ...
> (a) A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:
> (1) It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5 ...
> (2) It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F) ...

The reason for the pH level of 12.5 was explained in the Listing Background Document that supported the 1980 RCRA Corrosivity Characteristic:[177]

> **Studies indicate that pH extremes above 11.5 and below 2.5 generally are not tolerated by human corneal (eye) tissue [*Reference*] (3).** ... These limits were chosen in an attempt to balance the following considerations: sensitive human tissue may be damaged when contacted with substances exhibiting pH levels below 2.5 or above 11.5:
> ...
> Upon consideration of these comments and after further deliberation, the Agency has decided to extend the range of acceptable pH levels by decreasing the lower limit from pH 3.0 to 2.0 and increasing the upper limit from pH 12.0 to 12.5. With respect to the upper limit, the Agency agrees with the commenters that otherwise non-hazardous lime stabilized sludges and wastes should not be designated as hazardous. Accordingly, the Agency has adjusted the upper limit to pH 12.5 to exclude such wastes from the system.
> ...
> **Although eye tissue is damaged when the pH is above 11.5, normal skin tissue is clearly less sensitive than eye tissue. Consequently, increasing the upper pH limit to 12.5 should not significantly increase the likelihood of damage to skin.**
> ...
> **[*Reference*] 3. Encyclopedia of Occupational Health and Safety. Volume 1. Geneva, International Labor Office, 1971-72. pp. 220-221.** ...

Notice from the above that EPA claimed that a pH level of 11.5 was only corrosive to the eyes, and not to the skin. It cited the United Nation's International Labour Office (ILO) 1971-72 edition of the Encyclopaedia of Occupational Health and Safety[178] as its scientific basis for making this claim.

However, EPA falsified the information in the ILO encyclopedia. A photographic scanned version is provided on the next page from the 1971-1972 edition of the ILO encyclopedia. The ILO encyclopedia stated both irreversible dermal (skin) as well as corneal damage occurs at pH levels above 11.5, not 12.5. The ILO never mentioned any level of 12.5 in any context.



Burns, chemical *Gzg*

Most chemical burns result from the action of corrosive substances which destroy tissue at the point of contact. The skin, eyes and digestive system are the most commonly affected parts of the body. The corrosives may be either acid or alkali, the main feature being the hydrogen or hydroxyl concentration. Extremes above pH 11.5 or below 2.5 are not tolerated by the body and will almost always result in irreversible tissue damage. An outstanding feature of chemica burns is the fact that tissue destruction is progressive: acids tend to be neutralised by the available or exposed tissue whereas alkalis continue to cause damage unless neutralised by other means. Protein breakdown is most prominent, being marked by coagulation, precipitation and actual dissolution of tissue constituents. See colour plate 15.

The number of serious chemical burns is lower than that of thermal burns and scalds and chemical burns account for only 2% of the cases dealt with by specialised burn clinics.

The ILO encyclopedia cited 2 studies from 1965 and 1967 for the pH 11.5 level for skin and eye chemical burns. The 1965 study was the application of strong acids and bases to rabbit skin, not the eye, which is readily apparent to a casual reader just from the title of the study.[179] The 1967 study concerned chemical burns to the eye.[180] There are many other studies that also establish that alkaline pH levels of 11.5 (or even lower) are corrosive to the skin as well as the eye. A recent predictive model projects even a much lower presumptive skin corrosion level at pH 10.5, based on test data from a range of different alkaline substances.[181]

Furthermore, substances may be less, not more corrosive, to the eye at extreme pH levels. This is because of the buffering capacity of the tears in eye, and the fact that tears can flush away and dilute corrosives. Almost all of the historical animal tests that established the presumptive pH levels were performed on the skin of animals, not the eyes. This was to avoid cruelty. If the substance corroded the skin, it was presumed to corrode the eyes. If anything, the presumptive level is better established for the intact skin than the eyes.

The 1971-72 version of the ILO encyclopedia was not readily available to the public. It is a large 2-volume set, obviously expensive new, and was not even available in either of the two EPA headquarters libraries in 1980. Thus, EPA's falsifications could not easily be caught by staff or the public.[182]

Where did EPA get the level of 12.5 as being protective of the skin? This is 10 times more corrosive than a pH level of 11.5. There is no cited reference in the Background Document itself connected to a pH level of 12.5 to any type of corrosive effect on living tissues. The only correlation of a pH level of 12.5 is to wastes from the portland cement manufacturing industry itself (cement kiln dust, CKD) and concrete demolition wastes (buildings and highways).

2001-present: Advisor, OSWER Assist. Admin.
1995-2001: Don Clay Assoc.
1974-1995: EPA OSW

Key OSW staff responsible for the development of the 1980 RCRA Corrosivity Characteristic, the 1996 reaffirmation of the fraudulent basis for the Corrosivity Characteristic, the 1993 Report to Congress expanding on the fraudulent claims (discussed later), and those who participated in the UN international treaty negotiations (discussed later) are listed in the references.[183]

False claim that lime stabilized sludges and waste lime require this pH 12.5 level exemption

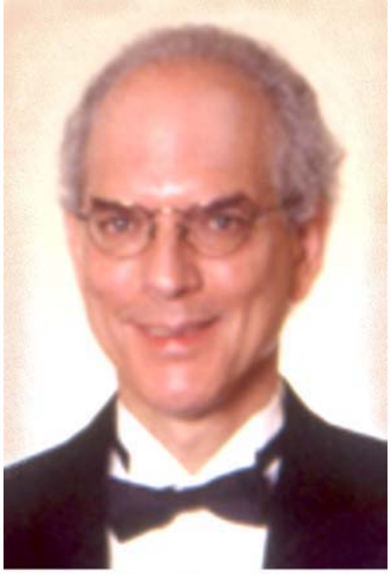
The other rationale given in the 1980 Background Document for the Corrosivity Characteristic to justify the pH 12.5 level was to exempt "lime stabilized sludges" and "waste lime."[184] This is a fictitious pretext. The Background Document contained the following statements:

> ... With respect to the upper limit, the Agency agrees with the commenters that **otherwise non-hazardous lime stabilized sludges and wastes** should not be designated as hazardous. Accordingly, the Agency has adjusted the upper limit to pH 12.5 to exclude such wastes from the system.
> ...
> A number of commenters argued that **the proposed upper pH limit of 12.0 would include waste lime** [*"waste lime" is actually a euphemism for cement kiln dust, discussed later in this complaint*] and many lime treated wastes and sludges which generally have a pH between 12.0 and 12.5 and which can be **put to agricultural and other beneficial uses**. Many of these commenters suggested raising the upper pH limit to 12.5 while others suggested raising the limit to 13.0.

There were no discussions in the Background Document either explaining what was meant by "waste lime" or the sources of the "lime stabilized sludges." Their identification is provided below.

"Waste Lime" an oblique reference to cement kiln dust (CKD)

Undoubtedly, the term "waste lime" as used in the Background Document refers to cement kiln dust (CKD), the captured stack emissions from portland cement manufacture. Although cement kiln dust can be put to beneficial use like any other corrosive acid or base, it can also cause substantial damage by direct contact to humans, other living organisms, and the environment if mismanaged. But "Waste lime" (or cement kiln dust) would never be regulated as a hazardous waste in the first place if it is recycled and used beneficially. It would never cross the RCRA regulatory threshold, because it would be exempt from the definition of a waste and instead classified as a raw material. Thus, there is absolutely no need to set the pH level at 12.5 in the Corrosivity Characteristic to allow its continued beneficial use for other purposes, since it never was a waste in the first place.



Steven Silverman, Esq., EPA OGC
(www.arcovoce.com)

For OSW to exempt waste lime (cement kiln dust) for the false reason that it has the potential to be used beneficially, without any consideration of the harmful consequences of improper disposal, is egregious. Cement kiln dust is a dangerous material and has cause many incidents of environmental contamination and harm to humans. It is now specifically regulated under RCRA (albeit by weak standards).

"Sludges with pH 12 – 12.5 used for agriculture" means sewage treatment sludges

The Background Document also claims that a pH level of 12.5 is necessary to allow the continued use of "lime stabilized sludges" for agricultural and other beneficial uses. This is a false. The only lime-stabilized sludges with a pH over 12 are municipal wastewater/sewage sludges that have been treated with enough lime[185] to kill pathogens. A pH level of 12 or higher is required as an accepted method to kill pathogens in sewage sludges under both the RCRA regulations first promulgated in 1979[186], [187] as well as the Clean Water Act (CWA) regulations.[188]

Lime-stabilized sludges from any other type of industrial processes would never have a pH over 10.[189], [190], [191], [192], [193] This is because the only purpose of adding lime in these cases would be to neutralize acids. Adding excessive amounts of lime is not only costly and unnecessary, it is also self-defeating because it results in excessive sludge volumes as well as a sludge that now hazardously alkaline and potentially a reactivity hazard.

The 5/19/80 *Federal Register* notice that finalized the RCRA Corrosivity Characteristic was only part of a major group of many other hazardous waste listings and exemptions under 40 CFR § 261.[194] If EPA wished to exempt lime-stabilized sewage sludges to facilitate their use in agriculture, then all that was required was to include it the already long list of exemptions from RCRA for hazardous wastes being used as fertilizers that was included in this same 5/19/80 *FR* notice.[195] Further, even before the 5/19/80 *FR* notice, EPA had already made the definitive conclusion in a 9/13/79 *FR* notice that these same lime stabilized sewage sludges posed no environmental threats if used in agriculture.[196]

There are many other inconsistencies and contradictions in the 5/19/80 *FR* notice discussed in the references.[197]

1996 – EPA's OSW reinforces false claims from 1980 that pH of 11.5 only damages eyes, not skin, and reasserts pretext that pH 12.5 level needed to exempt use of lime stabilized sludges

In 1996, EPA's OSW published a Hazardous Waste Characteristics Scoping Study,[198, 199] in which it repeated and reinforced the 1980 false claim that a pH level of 11.5 and above would only damaged the eyes, not the skin:

> EPA originally proposed pH limits of 12.0 or greater and 3.0 or less, and a majority of commenters argued that these limits were too stringent. ... EPA agreed with these commenters and promulgated pH limits of 12.5 or greater and 2.0 or less in the 1980 final rule.
>
> **The more stringent proposed pH limits were based on studies of eye tissue damage. These studies indicated that pH extremes above 11.5 and below 2.5 generally are not tolerated by human corneal tissue. [*Reference*]8 EPA decided that basing pH limits on eye tissue damage was unnecessarily conservative. Thus, eye damage is a hazard not fully addressed by the corrosivity characteristic.**
>
> ...
>
> **[*Reference*] 8** U.S. Environmental Protection Agency, Office of Solid Waste, Background Document: Resource Conservation and Recovery Act, Subtitle C-Identification and Listing of Hazardous Wastes, Section 261.22-Characteristic of Corrosivity, May 2, 1980, p. 5. [*This EPA background document cited the **ILO Encyclopaedia of Occupational Safety and Health**, discussed and cited earlier, as its source for information on the pH of corrosive materials.*]


Greg Helms, EPA
Chief, Characteristics Section/Team Leader
Waste Identification Branch, HWID, OSW

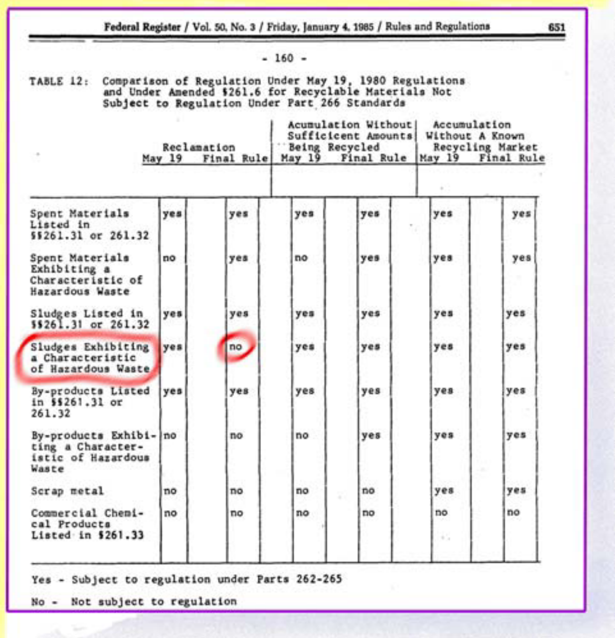
These statements in the 1996 Scoping Study are even stronger and clearer than those in the 1980 Background Document in claiming that a pH level of 11.5 was only needed to protect the eyes, not the skin. This demonstrates a continuing intent and current knowledge of the original fraud.

By 1996, staff in OSW's Hazardous Waste Identification Division (HWID) responsible for the Scoping Study had an even greater knowledge of the effects of different pH levels on the skin than they did in 1980. The same OSW HWID staff were participating as representatives on United Nations (UN) and Organization for Economic Cooperation and Development (OECD) workgroups and meetings. The UN and OECD efforts resulted in international consensus guidelines in 1981 and treaties in 1992 which stated that a pH of 11.5 was the presumptive level for corrosive effects on both skin as well as eyes. The EPA OSW 1996 Scoping Study even cited the UN Basel Convention treaty that incorporated the pH 11.5 presumptive


William "Rick" Brandes, EPA
Chief, Waste Identification Branch, OSW: 1991 - 2001

trigger level for hazardous wastes. Further, the same OSW staff would have reviewed and seen the regulations published in 1984 by EPA's Office of Pesticide Programs, which also set the presumptive level for alkaline corrosivity for both skin as well as eyes at a pH of 11.5.

The 1996 Scoping Study also repeated and compounded the false claim in the 1980 Background Document that the pH level needed to be set at 12.5 to enable the continued agricultural use of lime-stabilized sewage sludges. The pretext of this claim during the 1980 time period was discussed earlier. However, by 1996 there were 2 new events to establish this as a false pretext. The first was the promulgation of a new regulations in 1985 that exempted all sludges that were reclaimed from the RCRA Characteristic Listings (which includes any Corrosivity Characteristic sludges). See the table scanned from the 1985 *FR* notice and further discussions in the reference section.[200], [201]



Federal Register / Vol. 50, No. 3 / Friday, January 4, 1985 / Rules and Regulations 651

- 160 -

TABLE 12: Comparison of Regulation Under May 19, 1980 Regulations and Under Amended §261.6 for Recyclable Materials Not Subject to Regulation Under Part 266 Standards

	Reclamation		Acumulation Without Sufficient Amounts Being Recycled		Accumulation Without A Known Recycling Market	
	May 19	Final Rule	May 19	Final Rule	May 19	Final Rule
Spent Materials Listed in §§261.31 or 261.32	yes	yes	yes	yes	yes	yes
Spent Materials Exhibiting a Characteristic of Hazardous Waste	no	yes	no	yes	yes	yes
Sludges Listed in §§261.31 or 261.32	yes	yes	yes	yes	yes	yes
Sludges Exhibiting a Characteristic of Hazardous Waste	yes	no	yes	yes	yes	yes
By-products Listed in §§261.31 or 261.32	yes	yes	yes	yes	yes	yes
By-products Exhibiting a Characteristic of Hazardous Waste	no	no	no	yes	yes	yes
Scrap metal	no	no	no	no	yes	yes
Commercial Chemical Products Listed in §261.33	no	no	no	no	no	no

Yes - Subject to regulation under Parts 262-265

No - Not subject to regulation

Note that the use of municipal wastewater/sewage treatment sludges as agricultural amendments has clearly been defined by EPA, the National Research Council, and the World Health Organization as "sludge reclamation" *per se*.[202], [203], [204], [205]

There was a second event that would have exempted lime stabilized sewage sludges from the RCRA Corrosivity Characteristic by the time EPA's OSW drafted its 1996 Scoping Study. The 5/19/80 preamble to the *Federal Register* notice stated that as soon as comprehensive standards were in place under the Clean Water Act (CWA) for the disposal, reclamation and use of sewage sludge as an agricultural amendment, it would transfer authority from RCRA to CWA.[206] Such comprehensive regulations did in fact come into effect in 1993 under 40 CFR § 503 of the CWA.[207] The 1996 Scoping Study should have taken this into account, stating there was no longer any reason to have the pH level at 12.5 to accommodate the agricultural use lime-stabilized sewage sludges, since now RCRA would defer regulation to the CWA.[208]

Elizabeth Cotsworth (1/16/07 Radon Awards)
Deputy Director, OSW: 1994-1997
Acting Director, OSW: 1997-1999
Director, OSW: 1999-2003

1980 – National Contingency Plan/Superfund incorporates falsified pH 12.5 trigger level into criteria for "Hazardous Substances" – impact on WTC

EPA's most compelling reason for setting the alkaline corrosivity at pH 12.5, rather than the health-based pH level of 11.5, was to protect key industries from reporting uncontrolled environmental releases under the new 1980 NCP/Superfund legislation. On 12/11/80, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) was enacted, which broadened the scope of the existing National Contingency Plan (NCP).[209] This was just 7 months after the finalization of the Corrosivity Characteristic under RCRA, described in the preceding section, which first used the falsified 12.5 pH level.

Immediately as of the enactment date, 12/11/80, any environmental release without a permit of CERCLA-defined Hazardous Substances required reporting to the National Response Center.[210, 211, 212] Corrosive "Hazardous Substances" were defined by reference to any substances meeting the RCRA Corrosivity Characteristic under 40 CFR § 261.22:

40 CFR §300 - National Oil and Hazardous Substances Pollution Contingency Plan

...

§300.3 Scope.

(a) The NCP applies to and is in effect for: ...

(2) Releases into the environment of hazardous substances, and pollutants or contaminants which may present an imminent and substantial danger to public health or welfare of the United States. ...

§300.5 Definitions. ...

Hazardous substance as defined by section 101(14) of CERCLA, means: Any substance designated pursuant to section 311(b)(2)(A) of the CWA; any element, compound, mixture, solution, or substance designated pursuant to section 102 of CERCLA; any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act ...

Subpart E -- Hazardous Substance Response -- §300.400 General.

(a) This subpart establishes methods and criteria for determining the appropriate extent of response authorized by CERCLA and CWA section 311(c): (1) When there is a release of a hazardous substance into the environment; ...

§300.410 Removal site evaluation.

(b) A removal site evaluation of a release identified for possible CERCLA response pursuant to §300.415 shall, as appropriate, be undertaken by the lead agency as promptly as possible. The lead agency may perform a removal preliminary assessment in response to petitions submitted by a person who is, or may be, affected by a release of a hazardous substance, pollutant, or contaminant pursuant to §300.420(b)(5). ...

§ 302.4 Designation of hazardous substances.

(a) Listed hazardous substances. The elements and compounds and hazardous wastes appearing in table 302.4 are designated as hazardous substances under section 102(a) of the Act.

(b) Unlisted hazardous substances. A solid waste, as defined in 40 CFR 261.2, which is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b), is a hazardous substance under section 101(14) of the Act if it exhibits any of the characteristics identified in 40 CFR 261.20 through 261.24. ...

Table 302.4--List of Hazardous Substances ...

...

Characteristic of Corrosivity.

...

If the RCRA Corrosivity Characteristic had been set to a pH level of 11.5, many common unregulated concrete-related environmental releases would have become subject to the new CERCLA reporting requirements. Stormwater runoff from cement kiln dust (CKD) piles at portland cement manufacturers and dust from building demolitions would need to be reported to EPA and assessed for environmental impacts.

The falsified pH level of 12.5 had an enormous impact on the WTC emergency response. The WTC site cleanup, monitoring and assessment were pursuant to the National Contingency Plan (NCP). EPA's involvement under the NCP was triggered by Emergency Support Function #10 of FEMA. A pH level of 11.5 for WTC dust was not be defined as hazardous under the NCP, and thus did not immediately trigger any evaluation or response, since the RCRA Corrosivity Characteristic (and subsequently the NCP Hazardous Substances criteria) had been set at pH 12.5 or higher.

It is probable that EPA and OSHA did have immediate field data for the pH of WTC dust, and pH levels were higher than 11.5, but not higher than 12.5. The OSHA, EPA, and NYC On Scene Coordinators would have compared the pH levels they were finding to the criteria in the list of Hazardous Substances under the NCP. They would have seen the pH level of 12.5, and no regulatory requirement to assess further.

Health professionals in EPA, ATSDR, and elsewhere would realize the health implications of pH levels approaching or over 11.5 for WTC dust. The disparity between the NCP Hazardous Substances pH level of 12.5 and the health based pH level of 11.5 established by other parts of EPA and the United Nations was known. It would not be credible to claim that a pH level over 11.5 was safe.

The same personnel responsible for the 1980, 1993 and 1996 falsifications were either still at or had returned to EPA. There were precedents and economic interests to protect. It was necessary to divert attention away from any high pH levels being found, as well as to alter the laboratory test data in any studies of WTC dust. Later sections of this complaint document the failure to address exposures to caustic dust from the planned demolitions of concrete structures long before the collapse of the World Trade Center.

Inner city implosion demolition, unidentified location (www.jhsph.edu)

1993 – Cement Kiln Dust Report to Congress expands fraud by claiming pH 12.5 not corrosive to even eyes/lungs, much less skin


cement kiln dust pile at portland cement plant in Maine (www.umaine.edu)

In 1993, EPA further falsified and expanded upon the pH levels associated with human health effects in its 1993 Report to Congress on Cement Kiln Dust (CKD). CKD is a fine dust captured from air scrubbers from the portland cement manufacturing industry, a large volume waste. In this 1993 report, EPA claimed that a pH level of 12.5 was not only safe for the skin, but to all human tissues (including the eyes and lung).[213] EPA also acknowledged in the report that CKD leachates had pH levels from 11 to 13, and that ground water had been and could be contaminated at these levels.[214]

> Major results and conclusions from the evaluation of potential danger to human health and the environment from the management of CKD are presented below. ... **The pH of CKD leachate measured in laboratory tests typically ranged from 11 to 13**. High pH levels in ground water and surface water may result in a variety of adverse effects, including the mobilization of certain metals and other constituents that could pose toxicological problems, **human tissue burns (at pH levels above 12.5 or more)**, corrosion in pipes, and objectionable taste in drinking water. In addition, high pH levels could cause a wide variety of adverse ecological effects.


Bill Schoenborn, EPA
Team Leader, cement kiln dust

It was necessary for OSW to assert the claim that a pH level of 12.5 would protect the eyes and lung tissues, as well as the skin, from irreversible tissue corrosivity at this time in the context of the CKD regulations. This is because the major route of exposure to CKD dust is airborne, and therefore to the respiratory system. The 1993 Report to Congress effectively wiped off the slate any considerations by EPA of concerns for lung tissue corrosivity (chemical burns) from CKD. After EPA's 1993 Report to Congress asserting that only pH levels over 12.5 were hazardous, EPA's 1997 risk assessment for CKD never even mentioned corrosive inhalation or skin contact hazards.[215, 216] The risk assessment only addressed exposures to inert particulates (dust), heavy metals, and dioxins.

It is not credible that EPA would believe that only pH levels over 12.5 were hazardous from CKD or any other substance. First, it is a well known that portland cement and CKD has a pH typically in the 11 to 13 pH range, just from industry Material Safety Data Sheets and warning information from manufacturers.[217] These would have been readily available to EPA staff. It is also well known that portland cement and CKD is highly corrosive to the skin at these pH levels, causing severe chemical burns.[218, 219] In addition, there are many studies showing respiratory effects from low levels from CKD on industrial workers.[220, 221] Other studies have shown respiratory effects on residential populations exposed to natural alkaline dusts from dried lake beds, dusts far less alkaline than CKD.[222]


Michael Shapiro, Ph.D. (www.epa.gov)
Director, OSW: November 1993-1997
Acting Deputy Assist. Admin. OSWER: 1997-99
Deputy Assistant Administrator, OSWER: 1999-

It is of particular interest that EPA's CKD regulations/exemptions also had their root in 1980. In 1980, the Solid Waste Disposal Act (SWDA) amendments to RCRA included special temporary exemptions from regulations for 3 wastes.[223] These wastes were called the Bevill Amendment wastes, and included CKD from portland cement manufacture. EPA would have worked closely with the industry as well as Congress in crafting these special-interest temporary exemptions, agreeing they could meet the deadlines for submitting a report to Congress and finalizing any regulations for these temporary exemptions.[224, 225, 226] 1980 was the same year that EPA falsified the United Nations ILO encyclopedia to support a lenient Corrosivity Characteristic under both RCRA as well as the criteria for Hazardous Substances under Superfund and the National Contingency Plan, described in the preceding sections.

National Gypsum, Alpena, MI (www.michigan.gov/deq)

"The site is an abandoned historical disposal area for cement kiln dust (CKD) which is a by-product of the cement manufacturing process. The entire site consists of 85 acres of CKD piled up to 60 feet above the level of Lake Huron as well as an estimated 80 acres of the Thunder Bay bottom land which is covered with CKD. The wave action of Lake Huron has undercut the 30-foot high banks of CKD causing the dust to break off and fall into Thunder Bay. In addition to the eroding banks of CKD, rain and snowmelt water have carved erosion ditches across the surface of the site, thereby transporting CKD into Thunder Bay. Laboratory results have identified 14 heavy metals including mercury in the CKD above direct contact values. The groundwater has been identified to contain mercury at concentrations ranging from 0.8 to 3.5 ppb as well as a pH over 13 standard units."

1971 to present – UN sets pH 11.5 as presumptive trigger for alkaline corrosivity to skin/eyes/lungs; mandates adoption by member nations

While EPA's Office of Solid Waste and Emergency Response (OSWER) was falsifying the pH levels that would cause irreversible chemical burns under the NCP/Superfund and RCRA programs, the United Nations (UN) in conjunction with the Organization for Economic Cooperation and Development (OECD) were issuing standards, guidelines, and negotiating treaties that incorporated the true pH levels associated with corrosive tissue damage. A chronology follows:

1971 – UN International Labour Organization sets presumptive trigger level at pH 11.5 for alkaline corrosive substances, skin and eyes

The first readily available documentation of the "rule of thumb" that it should be presumed that an alkaline pH level of 11.5 causes corrosive chemical burns to both the skin and eyes comes from the United Nations' (UN) World Health Organization (WHO) International Labour Organization (ILO) in its 1971 edition of the *Encyclopaedia of Occupational Health and Safety*.[227] A scanned photographic version appeared earlier in the section on EPA's 1980 falsification of this reference. The relevant language from the ILO encyclopedia is again given below:

> Burns, chemical
> Most chemical burns result from the action of corrosive substances which destroy tissue at the point of contact. The skin, eyes and digestive system are the most commonly affected parts of the body. The corrosives may be either acid or alkali, the main feature being the hydrogen or hydroxyl concentration. **Extremes above pH 11.5 or below 2.5 are not tolerated by the body and will almost always result in irreversible tissue damage.** An outstanding feature of chemica [*sic*] burns is the fact that tissue destruction is progressive: acids tend to be neutralised by the available or exposed tissue whereas alkalis continue to cause damage unless neutralised by other means.

1981 – OECD sets presumptive pH level of 11.5 and higher for corrosivity to skin and eyes

In 1981, the Organization for Economic Cooperation and Development (OECD), an independent international organization with 30 member countries (including the U.S.), published Test Guidelines 404 and 405 for acute dermal irritation/corrosion as well as acute eye irritation/corrosion.[228], [229] These test guidelines contained the presumptive ranges of pH extremes (high acidity and high alkalinity) of pH 2 or less and pH 11.5 or greater. For intermediate pH ranges, animal testing was required, because pH is not always a good indicator of corrosive chemical burns.

> DEFINITIONS
> Dermal irritation is the production of reversible inflammatory changes in the skin following the application of a test substance.
> **Dermal corrosion is the production of irreversible tissue damage in the skin** following the application of a test substance.
> PRINCIPAL OF THE TEST METHOD
> The substance to be tested is applied in a single dose to the skin of several experimental animals, each animal serving as its own control. The degree of irritation is read and scored at specified intervals and is further described to provide a complete evaluation of the effects. The duration of the study should be sufficient to evaluate fully the reversibility or irreversibility of the effects observed. ...
> **Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 or less or 11.5 or greater, need not be tested for primary dermal irritation, owing to their predictable corrosive properties**.

These OECD guidelines were amended in 1992, with participation and input from EPA OPPTS representatives, retaining the same presumptive trigger levels for acidic or basic substances:[230]

> ... materials that have predictable corrosive potential based on structure-activity relationships and/or **physicochemical properties such as strong acidity or alkalinity, e.g., when the material to be applied has a pH of 2 or less or 11.5 or greate**r (alkaline or acidic reserve ... should also be taken into account) ...

1982 – 1998: UN Basel Convention treaty sets presumptive alkaline corrosive pH level at 11.5

In 1982, the UN Environment Programme (UNEP) began negotiations to control international shipments of hazardous waste. The Cairo Guidelines and Principles for the Environmentally Sound Management of Hazardous Wastes were adopted by the Governing Council of UNEP on 6/17/87.[231]

In 1992, twenty nations (the pre-requisite number) ratified the Basel Convention, a formal treaty under the United Nations,[232] based in part on the 1987 Cairo Guidelines. The Basel Convention treaty was amended in 1998 to include a presumptive trigger level for alkaline corrosivity at a pH level of 11.5.[233] Previously, the Basel Convention only stated that corrosive acidic and alkaline substances were subject to the treaty, without defining the pH levels.

The United States has not ratified the Basel Convention. The US signed the convention in 1992, but this is not the same as ratification. This only indicates that they agreed with the goals and would work towards ratification. Starting in 1983, the same division in OSW responsible for the Corrosivity Characteristic under the NCP/Superfund and RCRA (the Hazardous Waste Identification Division) was sending its staff as representatives to the OECD and United Nations Environmental Programme conventions.[234] If the U.S. ever does ratify the Basel Convention, then it would be subject to the more stringent standards, including the lower pH level of 11.5 for corrosive alkaline wastes, as well as not being able to exempt wastes from any oversight if they are shipped across borders for "reclamation," which is defined as a type of disposal under the Basel Convention. (See later discussions.)

1992 – 2002: UN globally harmonized guidelines set pH at 11.5 as presumptive trigger level for alkaline corrosivity for skin and eyes, mandates adoption by member nations

In 1992, UN mandated the development of a unified system for the classification of hazardous chemicals. This is not the same as the 1992 UN Basel Convention treaty for the trans-boundary shipment of hazardous wastes, described above. The UN tasked the OECD to develop these guidelines.[235], [236] OECD had already issued its test guidelines for both skin and eye irritation/corrosion, setting presumptive pH levels for corrosion at pH levels less than 2 or greater than 11.5 back in 1981.[237]

The OECD issued a review of existing regulations in other countries in a 1999 document.[238] OECD indicated that OECD itself, the European Union, Norway, Canada and EPA's OPPTS all considered pH extremes of 2 or below and 11.5 and above presumed corrosive to both skin as well as the eye. OECD did not mention the different pH 12.5 trigger levels for Hazardous Substances under EPA's NCP/Superfund and the Corrosivity Characteristic under RCRA.

EPA's OPPTS represented the U.S. on the OECD workgroup developing the new UN globally harmonized guidelines. These standards were first endorsed in 1998 by the OECD work group, and then finalized at the OECD level in May 2001.[239] In 2002, the UN ratified the OECD Globally Harmonized System of Classification and Labeling of Chemicals (GHS), mandating worldwide-adoption by member countries by 2008.[240]

Question of record discussing discrepancy between UN and EPA pH trigger levels for corrosivity

There is a factor of 10 difference between the EPA criteria for alkaline corrosive hazardous waste within its own borders and the UN Basel Convention criteria. Within the U.S. borders, wastes are classified as non-hazardous if they are between the intermediate pH range between 2 and 12.5. Under the Basel Convention, however, alkaline wastes become hazardous if they are shipped across a country's border if the pH is higher than 11.5.[241] See the chart below:

	HAZARDOUS/ CORROSIVE Acidic pH range	pH RANGE requiring animal testing (May still be classified as corrosive under EPA OPPTS rules, OSHA and EPA First Responder regulations, and UN Globally Harmonized Guidelines)	**HAZARDOUS/ CORROSIVE Alkaline pH range**
NCP/Superfund "Hazardous Substances" and RCRA "Corrosivity Characteristic"	**0 — 2**	**2 — 12.5**	**12.5 - 14**
EPA OPPTS UN test guidelines UN Basel Convention	**0 — 2**	**2 — 11.5**	**11.5 — 14**

The discrepancy may never have come into play for shipments of wastes from the U.S. to other countries. This is because EPA regulations exempt wastes from ever being classified as wastes to begin with, much less hazardous wastes, if they are destined for "reclamation." EPA instead defines them as a valued commodity, even if receiving country is paid $1000 or more a ton to accept these "non-wastes." EPA issued guidance to U.S. hazardous waste exporters that they did not have to report "Characteristic" wastes (including Corrosivity Characteristic wastes) if they were destined for "reclamation" in another country. See the excerpts in the references.[242] In addition, in 2000, EPA's Director of the Office of Solid Waste Elizabeth Cotsworth stated that all wastes being exported from the U.S. to other countries (with the exception of a few wastes going to Canada for disposal) is for the purpose of recycling (which is the same as reclamation).[243]

In 1999 EPA's OSW published a *Federal Register* notice[244] where the Basel Convention pH levels for acidic and alkaline hazardous wastes were included. This *FR* notice requested public input on how they would be affected if the U.S. ratified the Basel Convention, because the Basel Convention does NOT exempt wastes from the pH 11.5 trigger level even if they are destined for "reclamation" outside of the U.S. The Basel Convention classifies reclamation as a type of disposal.

Certain OSW personnel told me in February of this year that they were unaware of the difference between EPA's Corrosivity Characteristic pH level of 12.5 and the UN Basel Convention pH level of 11.5.[245] A review of nearly 5000 issue papers, drafts, memoranda, and final documents generated by the Hazardous Waste Identification Division, OSW on hazardous waste exports reveals some that do mention the difference in the alkaline corrosivity levels between the U.S. hazardous waste regulations (pH 12.5) and the Basel Convention levels (pH 11.5).[246]

1984 – 1998: EPA OPPTS and Congressional OTA set pH 11.5, skin, eyes

1984 – EPA pesticide program sets pH 11.5 for presumptive alkaline corrosivity, skin and eyes

In 1984, EPA's Office of Pesticide Programs (OPP) issued regulations including a presumption of irreversible corrosive tissue damage for both the skin and eye and its associated mucous membranes (lungs, bronchial tubes, etc.) for pH extremes 11.5 or higher (alkaline) or 2.5 and lower (acidic).[247] Test guidelines were published earlier in 1982.[248] These levels were to reduce unnecessary animal testing and remain in effect to this day.[249]

Earlier 1975 OPP regulations defined corrosivity solely on the basis of animal tests.[250] During the 1975 to 1981 time period, however, OPP was in the process of expanding these regulations to include the presumptive pH 11.5 level.[251, 252] OSW would have been aware of this effort as a member of an EPA-required Intra-Agency Work Group.

1986 – Congressional OTA states pH 11.5 presumptive corrosive level for skin and eyes

In 1986, Congress' Office of Technology Assessment (OTA) concluded that substances with a pH of 11.5 or higher were assumed caustic and corrosive both to the human eye and human skin,[253] and reiterated this in a 1995 document.[254] EPA's OSW would be aware of this fact.

1998 – EPA toxic substances/pesticide programs issues test guidelines with pH 11.5 trigger

In 1996, EPA's Office of Prevention, Pesticides and Toxic Substances (OPPTS)[255] proposed new test guidelines to be consistent with, but more rigorous than, the harmonized guidelines developed by the UN. This 1996 proposal again stated that for both the skin, eyes and associated mucous membranes, pH levels of 11.5 and higher, or 2 and lower, were predictably corrosive.[256] This proposal underwent review and approval by EPA's Science Advisory Board, and was finalized in 1998.[257, 258] This highly visible effort would also have been known to OSW.

Animal testing for pH required by EPA and OSHA first responder regulations and by CPSC

For first responders, EPA includes corrosivity under its definition of an "immediate (acute) health hazard." EPA then defines corrosive substances as being the same as those meeting the OSHA Hazard Communication Standard under 40 CFR § 1910.1200.[259]

The OSHA definition of corrosive does not use presumptive pH levels, but instead relies on animal testing for all pH levels.[260, 261] OSHA acknowledges the problem when the pH cannot be measured because it is a solid. OSHA gives the example of titanium tetrachloride, a solid material which decomposes in water, but is extremely corrosive to tissues in its solid form. This is relevant to WTC dust which contains calcium hydroxide, which has very limited solubility, but nonetheless generates saturated solutions of pH 12.5 over extended time periods.[262] OSHA defines corrosive air hazards to firefighters and other first responders as being "immediately dangerous to life or health" (IDLH) even if the corrosive effects are delayed.[263]

Under the Federal Hazardous Substance Act (FHSA), administered by the Consumer Product Safety Commission (CPSC), corrosivity is defined as any material in contact with living tissue that causes destruction by chemical action, regardless of the pH. The FHSA requires animal testing to determine corrosivity.[264, 265, 266]

Pulverized aged concrete generates pH levels over 11.5

USGS knowledge prior to 9/11/01 that aged concrete generates pH over 11.5, failure to warn

It is likely that the United States Geological Survey (USGS) was asked to "assist" EPA after 9/11 because it is the nation's premier agency with knowledge about cement and concrete. This section summarizes what (USGS) already knew about high pH levels from newly pulverized, aged, weathered concrete long before the WTC collapse. They had more than sufficient knowledge to warn the public of the caustic hazard after 9/11 without even doing the most rudimentary pH tests. However, as documented in Part 1 of this complaint, the USGS instead chose to falsify its pH data, withhold even this data from first responders and the public for months, and then obfuscate their high pH findings with false comparisons to irrelevant and misappropriated alternative tests.

USGS[267] and numerous other technical sources[268], [269], [270] state that concrete pore water typically has a pH over 12 and sometimes higher than 13, even in aged weathered concrete structures. USGS states that in order to protect steel reinforced concrete from corrosion, concrete must be designed to maintain these high pH levels over the lifetime of the structure.[271] Steel in concrete will begin to corrode at pH levels lower than 11.5.[272] Other sources also describe the need for maintaining a high pH in concrete over the lifetime of a structure to prevent steel corrosion.[273], [274] Concrete only needs to be 1.5 inches thick to prevent the neutralization of the pore water (a chemical reaction called "carbonation," the reaction of calcium hydroxide with atmospheric carbon dioxide).[275], [276] One of USGS's most sophisticated modeling programs is used to predict high pH leachates from hardened concrete.[277]

In 1998 and 2001, USGS published 2 reports discussing the caustic high pH levels from concrete from highway demolitions. The 1998 USGS report referenced a study by the Minnesota Department of Transportation showing crushed recycled concrete from highways had the potential to contaminate groundwater by raising its pH. The 2001 USGS report cited this same Minnesota study as support for their statements that leachates from recycled concrete had pH levels from 11 to 12. USGS cited two additional studies showing pH levels from old crushed concrete ranging from slightly less than 11.5 to 12.3.

The table on the next page summarizes readily available studies on the internet showing pH levels from old concrete pavement and demolished buildings. Ten of the studies in the table were available prior to 2000, thus available to USGS long before 9/11/01.

2000 – USGS failure to warn, caustic dust from Kingdome implosion

The USGS silence after 9/11 about its extensive in-house expertise on the corrosive high pH of pulverized concrete from old structures was not unprecedented. In 2000, local air pollution authorities and the USGS were involved in planning and monitoring the health and environmental impacts from the implosion demolition of a structurally unsound stadium in Seattle, Washington, the "Kingdome."

The USGS was responsible for conducting seismic measurements in Puget Sound from the subterranean shock waves.[278] Although not having titled responsibility for public safety, there is no evidence that USGS transmitted any concern over the inevitable corrosive high pH dust that

pH of LEACHATE	**CONCRETE SOURCE AND TEST CONDITIONS**	**RESEARCHERS**	**Reference No.**
"elevation of ground water pH"	Leaching of calcium hydroxide from recycled concrete, contaminating ground water, and solving problem by washing first to remove concrete fines. USGS citing Snyder *et al*., 1995, Minnesota Highway Dept.	USGS (1998)	279
Slightly less than 11.5	Fine concrete aggregate (4.75 to 75 mm, No. 4 sieve). USGS citing Kueddelsmann, *et al.* (1999) Rhode Island Univ.	USGS (2001)	280
11 – 12.3	Aggregate-containing concrete bed depths of 1.5, 3, and 6-inches exposed outdoors near roadways. USGS citing Robbins, *et al.* (2001) Rhode Island Univ.		
11 – 12 by field method, above 11.5 other tests	Concrete dust from demolition of buildings one month after 1995 earthquake in Japan	Gotoh, *et al.* (1999, 2000) Kobe Univ.	281, 282
11.6, 12.0, 12.1	Concrete dust (0.053 mm) from 14-year old concrete block, 1:1 ratio water	Gotoh, *et al.* (2000) Kobe Univ.	283
12.2, 12.3, 12.6	Concrete dust (0.053 mm) from new concrete block, 1:1 ratio water		
Above 12 after a few weeks	Salvaged concrete from pavement stockpiles. Runoff from aggregate fines (4.75 to 75 mm, No. 4 sieve) in stockpile exposed to rain. Stockpile Runoff Project, Shakopee Truck Station. This study was fundamentally flawed since it kept leachate samples for up to a week at room temperature before testing, known to result in the conversion of calcium hydroxide to calcium carbonate (carbonation). See discussions of the Lioy (2002) and Poon (2006) studies elsewhere in this complaint.	Sadecki, *et al.* (1996) Minnesota Dept. Trans.	284
11 – 12 initially, decreasing to 9.5 after 3 months	Salvaged concrete pavement stockpiles. Runoff from recycled concrete aggregate fines (4.75 to 75 mm, No. 4 sieve) in stockpile outdoors. This study also summarizes other data from Stockpile Runoff Project-Shakopee Truck Station (above), and others. al., cited above	Snyder, *et al.* (1995) Minnesota Dept. Trans.(1995) [*cited in 1998 USGS report*]	285
As high as 12 in first year	Salvaged concrete pavement stockpiles. 7 test beds. Recycled concrete leachates, initial high peak within 1st year in stockpiles outdoors (Lakeville)		
11.5 – 12.5	Laboratory study using 5 gallon bucket with sand filter and bottom drain. Aggregate blends with as little as 25% recycled concrete water soak values had pH as high as 12.2 – 12.5		
Greater than 11 initial tests	Laboratory study. 500 gram samples with size range 4.75 to 75 mm (No. 4 sieve). Soaked in distilled water for 1 week, then allowed to dry, then re-soaked.		
Greater than 11 after 24 hours	Laboratory study, soaking in distilled water. Citing 1993 Ohio Dept. Trans. study.		
11 – 12	Recycled concrete aggregate in general as source of aggregate for new highway construction	Federal Highway Administration	286, 287
12.2 – 12.5	Crushed pavement from 34-year old highway stockpiled in the open 1 year before conducting tests. Crushed recycled concrete used as road base material. Leachate collected from longitudinal drains under new highways.	Iowa Dept. of Transportation (1999)	288, 289
12.5 gradually decreasing to 11.5 after 10 weeks, remaining at 11.5 for next 20 weeks	Laboratory leaching of same recycled concrete aggregate, using 1 to 2 inch pieces,		
11 – 12 "consistently over 11"	Concrete from construction and demolition waste landfill, lysimeter study over 72 day period, unsaturated conditions.	Townsend, *et al.* (1998) Florida Center Solid Hazardous Waste Mgt, Univ. FL	290
Above 11.68	Concrete from construction and demolition waste landfill, batch test using EPA's synthetic leaching procedure, 20:1 water solution to concrete, pH tests after 18 hours soaking	Townsend, *et al.* (2000) Florida Center Solid Hazardous Waste Mgt, Univ. FL	291
12.8 decreasing to 11.5 after 14 months	Crushed concrete from roadway in service 25 years. Concrete test beds covered with asphalt. Leachate from natural precipitation captured in the field and analyzed in the field.	Engelson, *et al.* (2005) (includes Norwegian Public Roads Admin)	292
12.8 decreasing to 9.5 after 14	Crushed concrete from roadway in service 25 years. Uncovered concrete test beds. Leachate from natural precipitation captured in the field and analyzed in the field.		
11.4 for up to 3 hours, dropping to 10 after 3 days	Concrete fines from a commercial concrete recycling facility, 0.3–0.6mm fraction. Tested sequentially over time, 1 to 5 ratio concrete to distilled water, sealed containers.	Poon, *et al.* (2006) Hong Kong Polytechnic Univ.,	293

would result. USGS has an historical institutional involvement with other implosion demolitions, apparently not warning the public in these instances as well.[294], [295]

Local health officials conducted sophisticated testing of the Kingdome dust plume for PCB's, mercury (the transitory elevations were deemed non-hazardous), and total suspended dust. However, the extremely simple inexpensive testing for pH apparently was not performed.[296] It is interesting that elevated levels of mercury were detected after the Kingdome implosion, even though all fluorescent light tubes and thermostats were removed.[297] Yet remarkably after the WTC implosion, EPA did not find elevated mercury!

The Kingdome implosion was well advertised, attracting spectators. Only a few blocks surrounding the Kingdome (about a 2000 foot distance) were restricted.[298] Photos show large drifting clouds of dust covering spectators at the barricades, and people covering themselves for protection. Dust from the implosion requiring active cleanup was reported to include a 5 mile radius.[299] See references for a link to a video[300] and photo essays.[301, 302]

Apparently, the only health hazard warnings issued to citizens before the implosion by local authorities was that "people with asthma or pre-existing breathing problems should stay away" and "even people who are healthy should stay back because it will cause you to gag."[303]

> "People with asthma or pre-existing breathing problems should stay away," said Jim Nolan, a compliance officer with the Puget Sound Clean Air Agency. "Even people who are healthy should stay back because it will cause you to gag," he said.

These words are remarkably similar to those uttered on camera by the EPA Administrator Whitman[304] on 9/13/01 and repeated in the New York Times[305] on 9/14/01 and by other news sources:

Harley Soltes © The Seattle Times

"Two people who had watched the Kingdome implosion from Third Avenue and Jackson Street try to protect their eyes from the dust cloud that blocked out the sun and covered downtown with a layer of cement particles."

> [*Whitman*] We've had concern, we're going to continue to monitor. But right now, as I will tell you, everything we're getting back from the sampling that we're doing, is below background levels. There is not a reason for the general public to be concerned. It's not going to be a particular hazard unless you have breathing difficulties, heart condition, then you shouldn't be out here walking around and trying to get exercise. So that's not appropriate, obviously.
>
> [*New York Times*] The persistent pall of smoke wafting from the remains of the World Trade Center poses a very small, and steadily diminishing, risk to the public, environmental officials and doctors said yesterday. ... There could be a slight health threat, they said, to city residents with weakened immune systems, heart disease or asthma ...

Kingdome implosion, beginning blast followed by spectators engulfed in dust cloud (www.coffeeczar.com/kingdome/)

1995 Japan earthquake – pH 11.5 – 12 from concrete dust from demolitions

On 1/17/95, a devastating earthquake hit the city of Hyogo, Japan, called the Great Hansin Earthquake or Kobe Earthquake. Fires broke out simultaneously all over the city. More than 5500 people were killed. See the references for links to a moving video[306] and a pictorial essay.[307]

A study first released in 1999 and published again in 2002 determined both total suspended particulates (TSP) and the pH of dust generated during building demolitions one month after the disaster.[308, 309] The buildings were over 5 stories high and situated around a railway station. A few hundred thousand people had to walk by these demolition sites every day to change trains. The pH of all the dust samples exceeded 11.5. The highest TSP concentration was 150 µg/m^3. Twenty-five percent of those who replied to a questionnaire reported a worsening of health after the earthquake, and 67% complained about respiratory problems.

The following photographs show debris from the demolition of buildings after the earthquake, its segregation into different types, the loading of debris onto barges, and the initial fires the morning of the earthquake.[310]

sorted debris piles during cleanup after the 1995 Japan earthquake
http://www.crid.or.cr/digitalizacion/pdf/eng/doc8339/doc8339.htm

concrete rubble from 1995 Japan earthquake cleanup being loaded into barges
http://www.crid.or.cr/digitalizacion/pdf/eng/doc8339/doc8339.htm

Urban area in Kobe catching fire on the morning of 1/17/95
http://www.crid.or.cr/digitalizacion/pdf/eng/doc8339/doc8339.htm

2000 Baltimore demolition study funded by EPA ignores high pH dust

One of the EPA-funded researchers of health effects from WTC pollutants was Dr. Allison Geyh, Assistant Professor, Johns Hopkins School of Public Health.[311] Previously, she participated in a study on the health effects of dust from the implosion demolitions of a large apartment building in Baltimore in the year 2000, also funded by EPA.[312, 313] Dr. Geyh's study on the apartment building only monitored the air for total suspended particulates and tested dust for elemental composition. Tests for the pH of the particulates were never undertaken.

Dr. Allison Geyh, Johns Hopkins School of Public Health (http://faculty.jhsph.edu)

After the limited study on the apartment building implosion, Johns Hopkins issued an advisory for building implosions in general.[314] The advisory was almost the same that EPA issued to residents in New York City after the WTC collapse. The Johns Hopkins advisory said that staying indoors for only one hour with the windows closed would be adequate for protection, and that if someone wanted to watch an implosion in person they would only need to stay away a distance of only 2 blocks. They recommended watching on TV "especially if you are very young, elderly, have a weakened immune system, or have lung or heart disease." And of course, they recommended simply using a damp cloth and mop for indoor cleanups:

> Watch building implosions on TV rather than in person, especially if you are very young, elderly, have a weakened immune system, or have lung or heart disease. If you are determined to watch the implosion in person, do so from at least two blocks away and from a position that is upwind.
>
> If you live near and downwind of the implosion, stay indoors with your doors and windows closed for at least an hour after the building has fallen. If you are among one or more of the vulnerable groups described above, leave the area if possible and stay away for at least one hour after the implosion. Some of the dust from the implosion will get indoors and settle on surfaces. Use a damp cloth or mop to clean these surfaces. Vacuuming is not as effective since it sometimes merely stirs up the dust.

2000 Baltimore implosion study fails to test pH; also ignores implication of other studies finding corrosive high pH levels (Japanese earthquake and WTC studies)

Because Dr. Geyh's study of the Baltimore implosion was not published until the year 2003, she and her colleagues had the opportunity to include discussions of the data from several WTC studies showing high pH levels in dust.[315, 316] However, their only reference to WTC studies was to say that they also should have measured respirable size dust particles for the Baltimore implosion. Dr. Geyh and her colleagues omitted mentioning that high pH levels were found for WTC dust, and the obvious conclusion that they also should have measured pH for the Baltimore apartment implosion. Dr. Geyh's group also did not mention the study published a year earlier on the Japan earthquake (discussed above) showing highly corrosive pH levels in concrete demolition dust.[317]

In addition, the Baltimore implosion study stated that 57% of the elemental compounds in the dust were calcium compounds, and made the assumption for calculation purposes that calcium would be present as calcium oxide (CaO).[318] Even mentioning calcium oxide should have raised red flags, and prompting further discussion about the probable corrosivity of the dust. Their "presumed levels for calculation purposes" could correspond to an air concentration of up to 12 mg/m^3 of calcium oxide at locations 100 meters from the Baltimore implosion.[319] The NIOSH Recommended Exposure Limit for healthy workers is only 2 mg/m^3 for calcium oxide.

Concerns raised to EPA IG over Dr. Geyh's conflicts of interest

On 7/16/03, I submitted a complaint to the EPA Inspector General (IG) providing evidence that Dr. Geyh had made prejudicial statements regarding the health impacts of WTC dust. She had denied to the press any significant risk to the public or Ground Zero workers. My complaint stated that Dr. Geyh thus had potential conflicts of interest serving on an EPA panel evaluating the health impacts from the WTC collapse, since she had already stated her conclusions. The EPA IG found "the fact that such opinions were expressed [*by Dr. Geyh*] provided a basis for the perception that there may have been a bias, and supports the need for EPA or its Contractor to improve their efforts to ensure that peer review panels as a whole are balanced."[320]

My concerns over the lack of impartiality of Dr. Geyh are also supported by an examination of her research on truck drivers and other union trades present at Ground Zero, also funded through EPA. Not surprisingly, her air monitoring studies did not include any measurements of the pH of WTC dust. Only particulates, metals (elements), organic compounds, and asbestos were tested.[321, 322] Volatile organic compounds were described as "low" in her study, but the study only measured a limited number of compounds, not including any semivolatile organic compounds like PAH's, PCB's or dioxins. Her study dismissed concerns over asbestos exposures. The truck drivers refused to wear personal monitors in April 2002 to accommodate her study, but the researchers forged ahead, mounting the monitors to the rear-view mirrors, and claimed that the results represented the actual exposures of the truck drivers themselves.

Her research group did find airway obstruction in some workers, but described it as "mild" and added the excuse that these symptoms could have been present in the same workers before arrival at the WTC.[323] Dr. Geyh and her research team also conducted a questionnaire survey of these same workers about personal perceptions of their health.[324] The only health symptoms her team found significant enough to report from the worker's responses were (a) psychological impacts and (b) increased "drug use."

Overall, her group took too few samples and examined too few workers to draw any conclusions in any regard whatsoever. Furthermore, the results of her airway obstruction study are directly contradicted by research conducted by the Mt. Sinai School of Medicine.[325]

2005 and 2006 Calgary and Chicago demolition studies fail to test pH

There were two other recently published studies (2005 and 2006) which tested emissions from the planned demolitions of buildings. The first study tested during the implosion demolition of a hospital in Calgary, Canada in 1998.[326] The second study was of non-implosion mechanical demolitions of 3 public housing projects in Chicago during the 2002 to 2004 time period.[327] Neither of these studies tested the pH of either airborne or settled dusts.

Both of these studies compared their findings with the results in one particular EPA-funded WTC study.[328] Even though the WTC study found high pH levels, neither the Calgary nor the Chicago demolition studies made the obvious conclusion that the dusts from the Calgary or Chicago demolitions may also have been alkaline and corrosive if they had only tested pH.[329]

Furthermore, neither the Calgary nor Chicago studies referenced any of the other widely accessible studies showing high pH leachates from broken and crushed concrete, listed earlier in this complaint. Significantly, neither the Calgary nor Chicago studies mentioned the pH studies on demolition dusts after the 1995 Japan earthquake.[330, 331] Highly alkaline (pH 11 to 12) demolition dust was found, along with respiratory health effects in the exposed population. The Japan earthquake demolition dust study was published in a widely available journal, where the full contents are accessible to the public at no charge. Its existence is apparent to anyone doing a literature search by entering the obvious search string "concrete dust" (using quotation marks) into the National Library of Medicine's search engine.[332]

Calgary General Hospital demolition
www.elliottsr.com
www. cdnarchitect.com

DISCUSSION

First responders, residents, office workers, and laborers exposed to WTC dust would not necessarily detect (with their senses) any chemical burns (tissue corrosion) of their respiratory tract and lungs.[333] This is because corrosive substances will deaden the senses. As a result, exposures to other toxic substances may also not be noticed. OSHA states the following:[334]

> Irritant (Corrosive) Atmospheres ... Prolonged exposure at irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This may result in a general weakening of the defense reflexes from changes in sensitivity. The danger in this situation is that the worker is usually not aware of any increase in his/her exposure to toxic substances.

Alkaline corrosive substances (as well as acidic corrosive substances) will inactivate and/or kill the ciliary cells that line the respiratory tract. Cilia are tiny hair-like structures that move mucus up and out of the respiratory passages (mucociliary escalator). These ciliary cells are the first line defense for the clearance of toxic substances from the throat, bronchial tubes and lungs.[335]

An alkaline pH as low as 9.76 has been shown to inactivate ciliary cells, and a pH of 10.15 has been shown to destroy the ciliary cells in respiratory tissues.[336, 337] In one study on human lung tissues, a pH of 10.5 inactivated ciliary cells, and a pH of 11 killed them.[338] Compare these pH levels to the presumptive pH level of 11.5 for corrosivity to skin and eyes. A pH level of 10.5 is ten times less alkaline than a pH level of 11.5. In other words, a pH level of 11.5 is not a protective level for the destruction and/or immobilization of ciliary cells in the respiratory tract.

Alkaline and acidic corrosive substances are linked to human pulmonary fibrosis.[339, 340] Because of the unusually small size distribution of corrosive WTC particles, and the finding of pulverized cement particles in the smallest respirable particles,[341] penetration to the lower airways can be assumed.

What is skin, eye and respiratory tract corrosion? These are the UN Environment Programme (UNEP) definitions:[342]

> Corrosion of the respiratory tract is defined by destruction of the respiratory tract tissue after a single, limited period of exposure analogous to skin corrosion; this includes destruction of the mucosa.
> ...
> Skin Corrosion is the production of irreversible damage to the skin; namely, visible necrosis through the epidermis and into the dermis ... Corrosive reactions are typified by ulcers, bleeding, bloody scabs, and, by the end of the observation at 14 days, by discolouration due to blanching of the skin, complete areas of alopecia, and scars.
> ...
> Serious eye damage is the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the anterior surface of the eye, which is not fully reversible ...

These are the health effects for which EPA chose to falsify the pH trigger levels by a factor of 10 in its 1980 NCP/Superfund regulations. After the WTC collapse, EPA, USGS, EPA-funded scientists and local authorities then falsified the results of the pH tests of WTC dust. This resulted in continued uncontrolled exposures. This also resulted in health practitioners not knowing the causative agent for many of the symptoms they were observing, preventing appropriate treatment.

cc: Affected parties and responsible officials

References

All bold-faced text is emphasis added by author.

If a cited report does not have a link to a website, there was no free access to the full report posted on the internet. However, if the title of the report is put into an internet search engine, the abstract of the article may be available.

Some web pages become unavailable over time. It is possible that these internet pages may still be retrieved through "The WayBack Machine" (funded in part by the U.S. Library of Congress). The availability depends on how many historical hits the web page got. See: www.archive.org

---

[1] Cate Jenkins (August 22, 2006) SUBJECT: EPA-funded fraudulent pH reporting of WTC dust. Sent jointly to two different groups: Senator Hillary Rodham Clinton, Congressman Jerrold Nadler, Congresswoman Carolyn Maloney, as well as addressed to Bill Roderick, Acting EPA Inspector General.

[2] Cate Jenkins (October 25, 2006) Addressed to Bill Roderick, Acting EPA Inspector General,
COMPLAINT: – Cover-up, corrosive alkalinity of WTC dust by EPA, OSHA and NYC
–Falsification of the health implications of the alkaline pH data
–Fraudulent reporting of pH levels for smallest WTC dust particles
Currently posted on the RawStory website at: http://www.rawstory.com/news/2006/epamemocomplaint.pdf

[3] By letter dated 4/9/07 the EPA Office of the Inspector General (OIG) has declined investigating my 8/22/06 and 10/25/06 complaints. They state that EPA's follow-up on the recommendations contained in the EPA IG report of 8/21/03 is currently being investigated by the Government Accountability Office (GAO). However, this is not a valid excuse, because the substance of my 8/22/06 and 10/25/06 complaints were not covered in the EPA IG report of 8/21/03. This new complaint also contains allegations of fraudulent falsification of pH levels related to health concerns going back to 1980 and 1993, which predates 9/11/01. The text of the EPA OIG 4/9/06 letter to is provided below:

> April 9, 2007
> Dear Dr. Jenkins:
>
> The Office of Inspector General (OIG) Hotline is acknowledging receipt of your complaints dated August 22, 2006, and October 25, 2006, addressed to the Acting Inspector General on the subject of Environmental Protection Agency, Occupational Safety and Health Administration, and New York City activities related to the World Trade Center dust.
>
> The Government Accountability Office, acting on a Congressional request, has an ongoing evaluation to follow-up on EPA's actions in response to the OIG's World Trade Center report recommendations. Therefore, the OIG will not take action at this time.
>
> Eileen McMahon
> Assistant Inspector General
> Office of Congressional and Public Liaison

[*The EPA IG report referred to in the above letter*]
EPA Office of Inspector General (August 21, 2003) Evaluation Report EPA's Response to the World Trade Center Collapse: Challenges, Successes, and Areas for Improvement Report No. 2003-P-00012. http://www.epa.gov/oig/reports/2003/WTC_report_20030821.pdf

The EPA IG did not even acknowledge receipt of my 7/4/04 complaint showing the alteration of asbestos test levels.
Cate Jenkins (July 15, 2004) NYC data concealed by EPA and NYC after 9/11, subsequently altered/selectively deleted by NYC
-- Reverses IG finding of "no evidence … EPA attempted to conceal"
-- Evidence not considered or evaluated in 8/21/03 EPA IG report

[4] Compendiums and discussions of toxic substances in WTC dust may be found in many reports, including those listed below:

Cate Jenkins (July 4, 2003) Comments on the EPA Office of Inspector General's 1/27/03 interim report titled: "EPA's Response to the World Trade Center Towers Collapse." A DOCUMENTARY BASIS FOR LITIGATION
www.nycosh.org/environment_wtc/Jenkins-7-4-03-documentary-d.pdf
http://www.nyenvirolaw.org/PDF/Jenkins-7-4-03-documentary-d2.pdf

United States District Court, Southern District Of New York (February 2, 2006) Gail Benzman, *et al.*, *versus* Christine Todd Whitman, Marianne L. Horinko, Michael Leavitt, And The United States Environmental Protection Agency. 04 Civ. 1888 (DAB) OPINION, Deborah A. Batts, United States District Judge. http://www.nyenvirolaw.org/PDF/04Civ1888.pdf

EPA (2003) WTC Emergency Response. On Scene Coordinator. Data compilation by EPA contractor Lockheed Martin.
http://www.epaosc.org/doc_list.asp?site_id=WTC

[5] After a national emergency was declared by the President and the Federal Emergency Management Administration (FEMA) became involved on 9/11/01, FEMA invoked its "Emergency Response Function #10" which activated EPA to manage the response to releases of hazardous materials. EPA is allowed to delegate functions to local, state, and other authorities, but retains responsibility for coordinating and ensuring that standards at least as stringent as EPA's are adhered to in any cleanup.

FEMA. Federal Response Plan. http://www.fema.gov/rrr/frp/

> The FRP also may be implemented in response to the consequences of terrorism, in accordance with Presidential Decision Directive (PDD)-39 and PDD-62 that set forth U.S. counterterrorism policies. The FRP Terrorism Incident Annex describes the concept of operations for a unified response to a terrorism incident involving two or more of the following plans: the FRP, the Federal Bureau of Investigation (FBI) Weapons of Mass Destruction (WMD) Incident Contingency Plan, the Department of Health and Human Services (HHS) Health and Medical Services Support Plan for the Federal Response to Acts of Chemical/Biological Terrorism, the NCP, and the FRERP.
> . . .
> Emergency Support Function #10 Hazardous Materials Annex
> Primary Agency: Environmental Protection Agency ... Federal response to releases of “hazardous materials” is carried out under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations (CFR) 300). ... EPA will serve as the National Chair and lead agency for each activation of ESF #10 ...
> ...
> The NCP effectuates the response powers and responsibilities created by CERCLA, and the authorities established by Section 311 of the Clean Water Act (CWA), as amended by the Oil Pollution Act (OPA). Under the NCP, an On-Scene Coordinator (OSC), designated by EPA, the USCG, Department of Defense (DOD), or Department of Energy (DOE), would undertake Federal response actions. Appropriate response actions under the NCP include efforts to detect, identify, contain, clean up, or dispose of released hazardous materials.

[6] Wikipedia. pH. http://en.wikipedia.org/wiki/PH

[7] USGS (February 5, 2002) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

[*2/5/02 is the actual web posting date, the 11/27/01 or 11/15/01 date on report added in 2004 is falsified. See www.archive.org analysis in the reference below.*]

[8] A later reference includes an analysis using the www.archive.org resource reveals the different versions of the USGS report, its first release date to the public, and its back-dating in 2004. This analysis was also provided in my 10/25/06 complaint to the EPA IG.

[9] Plumlee, Geoffrey S., Hageman, Philip, Ziegler, Thomas, Meeker, Gregory P., Lamothe, Paul J., Theodorakos, Peter, Sutley, Stephen J., Clark, Roger N., Wilson, Stephen A., Swayze, Gregg A., Hoefen, Todd M., Taggart, Joseph, and Adams, Monique (October 28, 2002) The Geochemical Composition and Reactivity of Dusts Deposited by The September 11, 2001 World Trade Center Collapse. Published Abstract, Geological Society of America, 2002 Denver Annual Meeting (October 27-30, 2002) Denver, CO. http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_42098.htm

> Alkaline leachate solutions were produced due to rapid partial dissolution of calcium hydroxide (from concrete) and gypsum particles. Indoor dusts generated higher pH levels (11.8-12.4) than outdoor dusts (8.2-10.4), indicating that outdoor dust samples had reacted with rainfall or other waters prior to collection.
> ...
> Leach tests of the dusts with water (1 part dust added to 20 parts by mass deionized water; mixture shaken for 5 minutes; leachate filtered and analyzed) show the dusts are quite chemically reactive. Alkaline leachate solutions were produced due to rapid partial dissolution of calcium hydroxide (from concrete) ... **Although caustic, indoor dusts are not as caustic as drain cleaner or cement**. Leach tests with simulated lung fluids (SLF) (1 part dust added to 20 parts SLF at 37°C; mixed for 24 hours; leachate filtered and analyzed) produced smaller pH shifts due to the buffering capacity of SLF components.

[10] Apparently, the Geological Society of America only published abstracts of the presentations, and not any full publication. No full publication was located resulting from this presentation, although the same results were published later in a full paper in 2006 as a chapter in an American Chemical Society symposium series book.

[11] USGS Environmental Studies of the World Trade Center Area, New York City, after September 11, 2001. (October, 2002 date on fact sheet) According to www.archive.org, the first publication date shown is 4/4/03. http://pubs.usgs.gov/fs/fs-0050-02/fs-050-02_508.pdf

[12] Geoffrey S. Plumlee, Philip Hageman, Paul J. Lamothe, Thomas Ziegler, Gregory P. Meeker, Peter Theodorakos, Isabelle K. Brownfield, Monique G. Adams, Gregg A. Swayze, Todd M. Hoefen, Joseph Taggart, Roger N. Clark, Stephen A. Wilson, and Stephen J. Sutley (2006) Chapter 12. Inorganic chemical composition and chemical reactivity of settled dust generated by the world trade center building collapse. *In*: Urban Aerosols and Their Impacts: Lessons Learned from the World Trade Center Tragedy, Jeff Gaffney and N. A. Marley (eds), American Chemical Society, Symposium Series 919, Oxford University Press, pp. 238 - 267. Presented in part at the 226th National Meeting of the American Chemical Society, NYC, 9/7/03 – 9/11/03 www.us.oup.com/us/catalog/general/subject/Chemistry/EnvironmentalChemistry/?view=usa&ci=9780841239166

[13] In a table at the end of their 2006 report, USGS put the lower pH levels in one column, and put the higher levels in a column marked "duplicate analysis." USGS gave no explanation in the test as to why the duplicate analyses showed much higher pH levels, or why they only reported the lower pH levels to the public in their 2/5/02 report. USGS did not use the term "re-analysis" in its 2006 publication. If they were "re-analyses" at some later date, why were they higher, and why did USGS not release the results until 2006? Why would USGS scientists lack knowledge of common terminology for chemical testing?

[14] EPA Office of Solid Waste. Test Methods SW 846, Chapter 1, Quality Control. page 27: Definitions. ... DUPLICATE: An intralaboratory split sample which is used to document the precision of a method in a given sample matrix. http://www.epa.gov/epaoswer/hazwaste/test/main.htm

[15] Table was scanned from the original and inserted into the text of this complaint. Note that DIW stands for deionized water. Large volumes of water (20:1 ratio) relative to WTC dust resulted in dilution of the alkaline content. Furthermore, the water was mildly acid, pH = 5.5, resulted in partial neutralization of the WTC dust prior to any pH testing of the dust itself by USGS.

[16] See discussions later and in Part 2 of this complaint of the EPA as well as the United Nations Environmental Programme presumptive trigger level for alkaline corrosivity of pH 11.5.

[17] North Carolina State University. Alkalinity Control for Irrigation Water Used in Nurseries and Greenhouses. http://www.ces.ncsu.edu/depts/hort/hil/hil-558.html

> **The term "alkalinity" should not be confused with the term "alkaline,"** which describes situations where pH levels exceed 7.0. ... The term "total carbonates" (TC) may also be used by some testing laboratories to refer to the alkalinity of a solution.

[18] California State University at Sacramento, Office of Water Programs, Glossary. http://www.owp.csus.edu/glossary/glossarya.php

> ALKALINITY (AL-ka-LIN-it-tee). The capacity of water to neutralize acids. This capacity is caused by the water's content of carbonate, bicarbonate, hydroxide, and occasionally borate, silicate, and phosphate. Alkalinity is expressed in milligrams per liter of equivalent calcium carbonate. **Alkalinity is not the same as pH because water does not have to be strongly basic (high pH) to have a high alkalinity**. Alkalinity is a measure of how much acid must be added to a liquid to lower the pH to 4.5.

[19] USGS Environmental Studies of the World Trade Center Area, New York City, after September 11, 2001. (October, 2002 date on fact sheet) According to www.archive.org, the first publication date shown is 4/4/03. http://pubs.usgs.gov/fs/fs-0050-02/fs-050-02_508.pdf

> [*USGS explanation of the chart in their 10/2 fact sheet:*]
> The plot shows the alkalinity and pH of the WTC dust samples and common household materials when all are diluted by 20 parts water. The indoor WTC dusts, when added to water, can generate high pH values and caustic alkalinity (composed of caustic, reactive hydroxyl ions). However, the indoor WTC dusts do not generate as much caustic alkalinity as equivalent weights of cement, liquid drain cleaner, liquid bleach or solid lye drain cleaner.

[20] Plumlee, Geoffrey S., Hageman, Philip, Ziegler, Thomas, Meeker, Gregory P., Lamothe, Paul J., Theodorakos, Peter, Sutley, Stephen J., Clark, Roger N., Wilson, Stephen A., Swayze, Gregg A., Hoefen, Todd M., Taggart, Joseph, and Adams, Monique (October 28, 2002) The Geochemical Composition and Reactivity of Dusts Deposited by The September 11, 2001 World Trade Center Collapse. Published Abstract, Geological Society of America, 2002 Denver Annual Meeting (October 27-30, 2002) Denver, CO. http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_42098.htm

[21] Geoffrey S. Plumlee, Philip Hageman, Paul J. Lamothe, *et al.* (2006) *op. cit.*

[22] Established test methods for alkalinity of soils and particulates:

Ali Akbar Safari Sinegani* and Alireza Hosseinpour (2005) Factors affecting cellulase sorption in soil. African Journal of Biotechnology Vol. 5, No. 5, March, 2006, pp. 467-471. http://www.bioline.org.br/request?jb06080

US Army Corps of Engineers (1998) Dredged Material Characterization Tests for Beneficial Use Suitability. Replaces Technical Note DOER-C2. http://el.erdc.usace.army.mil/elpubs/pdf/doerc2.pdf

University of Florida, IFAS Extension. Lime and Liming -- A Florida Perspective. http://edis.ifas.ufl.edu/SS161

Clemson University. Soil acidity and liming. http://hubcap.clemson.edu/~blpprt/acid4.html

US Army Corps of Engineers. Dredged Material Characterization Tests for Beneficial Use Suitability. Replaces Technical Note DOER-C2 February 1998 (May 1999). http://el.erdc.usace.army.mil/elpubs/pdf/doerc2.pdf

Pflughoeft-Hassett, *et al*. ENGINEERING AND REGULATORY ISSUES FOR COAL COMBUSTION BY-PRODUCT CHARACTERIZATION AND UTILIZATION. Energy & Environmental Research Center, University of North Dakota. http://www.mcrcc.osmre.gov/PDF/Forums/CCB/1-4.pdf

[23] Hydroxyl alkalinity equivalents of WTC dust compared to $CaCO_3$ equivalents were determined for $Ca(OH)_2$ based on a relative a molecular weight comparison, and verified from published equivalency values for commercial slaked lime products containing up to 100% $Ca(OH)_2$. Because the USGS used a 1:20 dilution for its tests on household bleach and drain cleaners, the calculated alkalinity of WTC dust also used this same dilution factor. The alkalinity calculation used 8% as the $Ca(OH)_2$ concentration in the 2 indoor dust samples, and 6% as the concentration in the 3 high-end outdoor dust samples, based on the maximums obtained in the ATSDR/NYC study cited earlier. In order not to overestimate the alkalinity, the much higher presence of $CaCO_3$ was not included in the calculations. Any over-estimation due to the use of the high-end levels of $Ca(OH)_2$ could well be balanced by not including any estimation of the presence of NaOH, KOH, $CaCO_3$, or other caustic substances in the dust.

[24] New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan. http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

[25] USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

> Fe-bearing materials occur in the WTC area and appear to be distributed in and around the collapse zone. ... The ferric absorptions are interpreted to be due to hematite (Fe_2O_3 - iron rust), or goethite ($FeOOH$). ... Fe-bearing minerals are common in the aggregate in concrete. ... For example, walls are often constructed with a board containing gypsum, a sulfate. Gypsum has been identified in samples from the WTC area (see sample analysis section). Muscovite, carbonates, and **other hydroxyl-bearing minerals** have also been identified in the WTC samples (see the Integration of Results section).
>
> ...
>
> Other phases identified in small amounts include: muscovite, feldspar, magnesiohornblende, lizardite (non-asbestiform serpentine), dolomite, bassanite, illite, **portlandite**, larnite, polymorphs of calcium silicates, possible asbestiform chrysotile, and others. The results are reported as major (>20% by weight), **minor (>5% but <20%** by weight), and trace (<5% by weight).
>
> ...
>
> XRD Figure 1. X-ray diffractogram of World Trade Center dust sample WTC01-6. Note domination of peaks from calcite, quartz, gypsum, and anhydrite, the main minerals in most of the 33 samples collected. ...
> Calcite – $CaCO_3$
> Quartz – SiO_2
> Gypsum – $CaSO_4 \cdot 2H_2O$
> Anhydrite – $CaSO_4$
> Muscovite-1M1 – $KAl_2(Si_3Al)O_{10}(OH,F)_2$
> [*Note conspicuous absence of* $Ca(OH)_2$ *in this figure due to selective choice of a sample that did not contain it.*]
>
> ...
>
> Table 1 [*only selected samples with "minor" concentrations (>5% to <20%) portlandite included*]

Sample Number	Spectroscopy	XRD	Leach pH	Location
WTC01-20	gypsum, muscovite and/or portlandite (tr), CH, chrysotile (tr), Fe2+ (wk)	... *Very slight possibility of a trace of chrysotile ***Portlandite** and bassanite are **trace to minor** ...	11.8	Liberty & South End 2 World Financial Center: indoor sample
WTC01-36	gypsum, muscovite and/or portlandite (tr), CH, Fe2+, possible trace chrysotile	... **Portlandite - Minor** ... Chrysotile - Trace *possible trace chrysotile ...	11.8	South End & Albany (30th floor): Indoor sample
WTC01-37A	gypsum, muscovite, portlandite, Fe2+	... **Portlandite - Minor** Magnesiohornblende ...	[*no pH testing reported*]	concrete from WTC area
WTC01-37B	portlandite, Fe2+	Quartz - Major Orthoclase - Minor **Portlandite - Minor** ... Calcite – Trace ...	[*no pH testing reported*]	concrete from WTC area

[26] USGS gave the full chemical composition of essentially all the other mineral names in its report, including the many very complex chemical formulas for the different forms of asbestos and other mineralogical species like mica, hematite, gypsum, quartz, calcite, anhydrate, etc. But "portlandite" was mysteriously lacking any chemical identification.

"Portlandite" is a very obscure name for $Ca(OH)_2$, a name apparently developed by X-ray crystallographers to describe the particular crystalline form of $Ca(OH)_2$ found in concrete. The only time portlandite would ever occur as a natural mineral in nature is when it is associated with a heat source like volcanic activity, since it would convert to calcium carbonate ($CaCO_3$) by reacting with carbon dioxide in the atmosphere. See the following references:

Hendrik G. van Oss (2005) USGS. Background Facts and Issues Concerning Cement and Cement Data. U.S. Geological Survey, Open-File Report 2005-1152 http://pubs.usgs.gov/of/2005/1152/2005-1152.pdf

> In lime mortars, the actual lime species present is **hydrated or slaked lime (or portlandite) and is formed simply by the hydration reaction** $\mathbf{CaO + H_2O \rightarrow Ca(OH)_2}$**.** ... Hydrated lime - The compound $Ca(OH)_2$; also called slaked lime. In solid form, sometimes called portlandite. ... Portlandite - A mineral composed of hydrated lime $Ca(OH)_2$

Web Mineral. Portlandite. http://rruff.geo.arizona.edu/doclib/hom/portlandite.pdf

[27] Geoffrey S. Plumlee, Philip Hageman, Paul J. Lamothe, *et al.*, (2006) *op. cit.*

[28] Plumlee, Geoffrey S., Hageman, Philip, Ziegler, Thomas, Meeker, Gregory P., Lamothe, Paul J., Theodorakos, Peter, Sutley, Stephen J., Clark, Roger N., Wilson, Stephen A., Swayze, Gregg A., Hoefen, Todd M., Taggart, Joseph, and Adams, Monique (October 28, 2002) The Geochemical Composition and

Reactivity of Dusts Deposited by The September 11, 2001 World Trade Center Collapse. Published Abstract, Geological Society of America, 2002 Denver Annual Meeting (October 27-30, 2002) Denver, CO. http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_42098.htm

[29] Geoffrey S. Plumlee, Philip Hageman, Paul J. Lamothe, *et al.*, (2006) *op. cit.*, p. 258, 265.

[30] Mattson SM. 1994. Glass fiber dissolution in simulated lung fluid and measures needed to improve Consistency and Correspondence in In-Vitro Studies. consistency and correspondence to in vivo dissolution. Environ Health Perspect 102:87-90. http://www.ehponline.org/members/1994/Suppl-5/mattson-full.html

> The dissolution of a range of glass fibers including commercial glass and mineral wools has been studied using a modification of Gamble's solution in a flow system at pH 7.4 and 37°C. Dissolution has been followed by weight loss, effluent analysis, and morphology change of fibers and bulk glass. Flow per glass surface area can strongly affect both dissolution rate and morphology due to the effect of the dissolution process on the fluid. Effluent pH is shown to be a guide for choice of optimum flow/area conditions. These conditions provide measurable concentrations of dissolved glass in the effluent while maintaining their concentrations below the point at which they significantly affect the dissolution process. SiO_2 and Al_2O_3 vary widely in the extent to which they are involved in the leaching process, which removes alkalis, alkaline earths, and B_2O_3. This makes analysis of a single component in the effluent unsuitable as a means of comparing the dissolution rates of a wide range of compositions.
> ...
> Introduction
> A number of workers have measured the dissolution rates of various glass fibers under in vitro conditions thought to simulate those of a fiber in the extracellular space of the lung (1-6). There is considerable variation both in the magnitude of the measured rates and in the relative ranking of the different compositions in terms of rate. These studies have used different modifications of Gamble's solution passing around the fibers at different flow rates and have used different analytical methods to measure the dissolution. This article addresses the effect of flow rate and analytical method on the measured dissolution rate. It shows that these can be significant sources of error in dissolution measurements and suggests means to eliminate such error by appropriate experimental design. In addition, it presents dissolution data on a number of previously unmeasured compositions and, from these data, expands our understanding of the compositional effects of dissolution rate and morphology.
>
> In Vivo Extracellular Conditions
> Gamble's solution generally is regarded as an acceptable though approximate model of lung fluid, but there has been no consensus on flow rate. Kanapilly's review (7) of the environment within the lung indicates that simple soluble ions in the lung fluid are exchanged rapidly with the blood stream. This may not be the case for complexes or species with limited solubilities. Kanapilly's data, together with the low fiber loading expected in the lung suggest that in vivo dissolution occurs without significant alteration of the fluid by the glass dissolution products. An accurate in vitro model of extracellular fiber dissolution should therefore have flow rate sufficient to eliminate such alteration.

[31] USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

> For this leach test, deionized (DI) water (pH ~5.5) is used as the extractant. **Dust samples were leached at a 1:20 ratio** ... Each sample was then shaken for 5 minutes. Following shaking, the solution was allowed to settle for 5 minutes.
> ...
> In general, the **leachate solutions developed moderately alkaline to alkaline pH values (8.2 - 11.8)**, and high specific conductances (1.31 - 3.41 milliSiemens/cm, indicating high dissolved solids). Alkalinities of the leachate solutions were not measured due to insufficient sample volume, but are by inference from the pH and specific conductances, likely to be quite high. The leachate solutions are composed primarily of sulfate, bicarbonate, carbonate, and calcium, with lesser concentrations of the major cations sodium, potassium, and magnesium.
>
> **The alkaline pH of the leach solutions, coupled with the high concentrations of calcium, carbonate, and sulfate, are consistent with an origin resulting primarily from the dissolution of concrete, glass fibers, gypsum, and other material in the dusts. The leach fluids with the highest pH and highest specific conductance are from dust samples collected indoors** (including WTC01-20, collected indoors from the gymnasium across West Street from the World Trade Center, and WTC01-36, which was collected in a 30th-floor apartment in a building southwest of the WTC). The higher specific conductances and pH values of indoor dust samples indicate that the outdoor samples have already experienced some leaching by rainfall and water used for fighting fires and street cleaning between September 11 and the time that the samples were collected.

[32] EPA SW 846-On Line. Method 9045D SOIL AND WASTE pH (Revision 4, November 2004)
http://www.epa.gov/epaoswer/hazwaste/test/main.htm
http://www.epa.gov/epaoswer/hazwaste/test/pdfs/9045d.pdf

> 3.1 Samples with very low or very high pH may give incorrect readings on the meter. **For samples with a true pH of > 10, the measured pH may be incorrectly low.**
> ...
> 7.2 Sample preparation and pH measurement of soils:
> 7.2.1 To **20 g of soil** in a 50-mL beaker, **add 20 mL of reagent water**, cover, and continuously stir the suspension for 5 min. Additional dilutions are allowed if working with hygroscopic soils and salts or other problematic matrices.
> 7.2.2 Let the soil suspension stand for about 1 hr to allow most of the suspended clay to settle out from the suspension or filter or centrifuge off the aqueous phase for pH measurement.

[33] pH levels of common household products and WTC-related constituents:

pH OF CONCRETE-RELATED MATERIALS AND HOUSEHOLD PRODUCTS		
calcium oxide (CaO), unslaked lime, quicklime, 0.125% saturated solution (After converting to Ca(OH)2 in water; solubility based on the lower molecular weight of CaO, not Ca(OH)2)	pH = 12.49	http://www.graymont.com/msds/MSDS_High_Calcium_Quicklime.pdf http://www.ashgrove.com/pdf/msds/CALCOXID.pdf
calcium hydroxide ($Ca(OH)_2$), portlandite, slaked lime, hydrated lime	pH = 12.49, 0.185% saturated solution	http://en.wikipedia.org/wiki/Calcium_hydroxide http://cavemanchemistry.com/oldcave/projects/lime/
uncured reactive portland cement	pH = 12-13, slightly soluble, 0.1 to 1%	http://www.titanamerica.com/products/msds/pdf/titan_Portland_cement.pdf www.lafargenorthamerica.com/wps/wcm/resources/file/eb8a9045eb37551/Portland%20Cement%20MSDS%205.pdf
potassium carbonate (K_2CO_3)	pH = 11.6	http://www.merckbooks.com/mindex/cdrom.html
sodium carbonate (Na_2CO_3)	pH = 11.6, 1% solution	http://www.merckbooks.com/mindex/cdrom.html http://msds.fmc.com/msds/100000010373-MSDS_US-E.pdf
Drano® Clog Remover (Liquid)	pH = 11.5 to 13.4	http://www.scjohnson.com/msds_us_ca/US_brands/drano/126038005_Drano_Clog_Remover_Liquid.pdf
Drano® Max Gel	pH = 11.5 to 13.4	http://www.scjohnson.com/msds_us_ca/US_brands/drano/126025006_Drano_Max_Gel_Clog_Remover.pdf
Liquid Plumr® Drain Cleaner, sodium hydroxide 0.5 – 2%, sodium hypochlorite 5 – 10%	pH = 13.2	http://www.thecloroxcompany.com/products/msds/liquidplumr/liquid-plumr.pdf
Fantastik® Heavy Duty Oven Cleaner	pH = 12.3	http://msds.ogden.disa.mil/msds/owa/web_msds.display?imsdsnr=190879
Easy-Off® Fume Free Max Oven Cleaner (Aerosol)	pH = 12.25	http://www.fsafood.com/msds/vault/000/000628.pdf
Ashland Household Bleach, sodium hypochlorite 3.3 – 7 %	pH = 11.4	http://florawww.eeb.uconn.edu/msds/bleach_msds.pdf
Valley View Household Bleach, sodium hypochlorite 5.25%,	pH = 11.5 ± 0.5	http://www.stearnspkg.com/msds/bulk/BLEACH%205-25%25.pdf
Clorox® Bleach, sodium hypochlorite < 3%, sodium hydroxide < 1%,	pH ≈ 12.2	http://www.thecloroxcompany.com/products/msds/bleach/cloroxscentedbleach.pdf
Sodium hydroxide, lye, caustic soda, "solid lye drain cleaner"	pH = 14, 5% water solution (1:20 dilution with water)	http://www.prism.princeton.edu/PRISM_cleanroom/MSDS/naoh_sodium_hydroxide.pdf
Sodium hydroxide, lye, caustic soda, "solid lye drain cleaner"	pH = 13 -- 14, 0.5% water solution	http://www.injectorall.com/MSDSD3.htm http://www.prism.princeton.edu/PRISM_cleanroom/MSDS/naoh_sodium_hydroxide.pdf http://www.jtbaker.com/msds/englishhtml/s4034.htm
calcium carbonate ($CaCO_3$), pure limestone, calcite, component of cured concrete	pH = 9.4, 0.0014% saturated solution	http://www.graymont.com/msds/MSDS_PCC.pdf
Calcium sulfate ($CaSO_4$) gypsum, major drywall component	pH approximately 7	http://www.cgcinc.com/pdf/msds/52-100-POP_E.pdf http://www.dpiw.tas.gov.au/inter.nsf/WebPages/TPRY-5Z529T?open
neutral water	pH = 7	
human blood	pH = 7.3 – 7.5	
oranges	pH = 3 – 4	
vinegar	pH = 2.4 – 3.4	
concentrated hydrochloric acid (1 Normal)	pH = 0.1	

[34] International Labour Office (1971, 1972) Chemical Burns. *In:* Encyclopaedia of Occupational Health and Safety, Volume I – A – K, pages 220 - 221 International Labour Office, CH 1211 Geneva 22, Switzerland, 1971. Special McGraw-Hill Edition, 1972, Library of Congress Card Number: 74-39329, International Standard Book Number: 07-079555-X.

> Burns, chemical
> Most chemical burns result from the action of corrosive substances which destroy tissue at the point of contact. The skin, eyes and digestive system are the most commonly affected parts of the body. The corrosives may be either acid or alkali, the main feature being the hydrogen or hydroxyl concentration. **Extremes above pH 11.5 or below 2.5 are not tolerated by the body and will almost always result in irreversible tissue damage**. An outstanding feature of chemica [*sic*] burns is the fact that tissue destruction is progressive: acids tend to be neutralised [*sic*] by the available or exposed tissue whereas alkalis continue to cause damage unless neutralised by other means.

[35] OECD (May 12, 1981) Test Guideline 404 'Acute Dermal Irritation/Corrosion'

> A. INTRODUCTION, PURPOSE, SCOPE, RELEVANCE, APPLICATION AND LIMITS OF TEST.
> In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant or corrosive effects on skin of mammal is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of the skin to the test substance.
> DEFINITIONS
> Dermal irritation is the production of reversible inflammatory changes in the skin following the application of a test substance.
> Dermal corrosion is the production of irreversible tissue damage in the skin following the application of a test substance.
> PRINCIPAL OF THE TEST METHOD
> The substance to be tested is applied in a single dose to the skin of several experimental animals, each animal serving as its own control. The degree of irritation is read and scored at specified intervals and is further described to provide a complete evaluation of the effects. The duration of the study should be sufficient to evaluate fully the reversibility or irreversibility of the effects observed. ...
> Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 or less or 11.5 or greater, need not be tested for primary dermal irritation, owing to their predictable corrosive properties.

[36] OECD (July 17, 1992) OECD Guideline for Testing of Chemicals. 404. Acute Dermal Irritation/Corrosion. [*Not available on the internet*]

> This updated version of the original guideline 404 (adopted in 1981) is the outcome of a meeting of OECD experts held in Paris in May 1991. ... The main differences between this and the original version of the guideline are a) the inclusion of data from *in vitro* tests in the information on which a decision not to proceed to an *in vivo* test can be based; and b) the possibility to use one animal in a first step of the *in vivo* procedure allowing certain chemicals to be exempted from further testing. ...
> INITIAL CONSIDERATIONS
> 4. In the interests of animal welfare, it is important that the unnecessary use of animals is avoided, and that any testing which is likely to produce severe responses in animals is minimised [*sic*]. Consequently, test materials meeting any of the following criteria should not be tested in animals for dermal irritation/corrosion:
> **i) materials that have predictable corrosive potential based on structure-activity relationships and/or physicochemical properties such as strong acidity or alkalinity, e.g., when the material to be applied has a pH of 2 or less or 11.5 or greater (alkaline or acidic reserve (1) should also be taken into account)** ...

[37] OECD (August 14, 2001) Environment Directorate Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology. OECD Series on Testing and Assessment Number 33: Harmonized Integrated Classification System for Human Health and Environmental Hazards of Chemical Substances and Mixtures. http://www.epa.gov/oppfod01/harmonization/docs/harmointeg.pdf

> Several factors should be considered in determining the corrosion and irritation potential of chemicals before testing is undertaken. Existing human experience and data including from single or repeated exposure and animal observations and data should be the first line of analysis, as it gives information directly referable to effects on the skin. In some cases enough information may be available from structurally related compounds to make classification decisions. Likewise, **pH extremes like ≤ 2 and ≥ 11.5, may indicate dermal effects, especially when buffering capacity is known, although the correlation is not perfect. Generally, such agents are expected to produce significant effects on the skin**. It also stands to reason that if a chemical is highly toxic by the dermal route, a dermal irritation/corrosion study may not be practicable since the amount of test substance to be applied would considerably exceed the toxic dose and, consequently, would result in the death of the animals.
> ...
> Tiered testing and evaluation of **dermal corrosion** and irritation potential ...
> pH with buffering → **pH ≤ 2 and ≥ 11.5 →** **Classify as corrosive**
> ...
> **pH extremes like ≤ 2 and ≥ 11.5 may indicate strong local effects**, especially in combination with assessment of acid or **alkaline reserve**,
> ...
> Chapter 3.3: HARMONISED SYSTEM FOR THE CLASSIFICATION OF CHEMICAL MIXTURES WHICH CAUSE SKIN AND EYE CORROSION/IRRITATION ...
> A mixture is considered corrosive (Skin Category 1, Eye Category 1) if it has a pH of 2 or less or 11.5 or greater.

[38] OECD (1999) OECD SERIES ON TESTING AND ASSESSMENT Number 16. Detailed Review Document on Classification Systems for Skin Irritation/Corrosion in OECD Member Countries. http://www.olis.oecd.org/olis/1999doc.nsf/LinkTo/env-jm-mono(99)6

Agency	pH
OECD, EU, Norway	**≤2, ≥11.5, buffering**
UN transport	**-**
Canada workplace	**≤2, ≥11.5, buffering**
Canada pesticides	**Roughly ≤2, ≥11.5**
US CPSC	**-**
US EPA pesticides & industrial chemicals	**≤2, ≥11.5**
US FDA policy	**-**
US OSHA	**-**

> ...
> pH Extreme
> Extremes of pH are identified by Canadian pesticides and workplace, EU, OECD, and US EPA pesticides and industrial chemicals as indicating potential severe dermal effects (Table 1). All of these but Canadian pesticides point out that a **pH less than or equal to 2 or greater than or equal to 11.5 may be associated with serious dermal effects**.

[39] United Nations Economic Commission for Europe (2005) Globally Harmonized System of Classification and Labelling of Chemicals (GHS), First Revised Edition. 3.1.2.6 Specific considerations for inhalation toxicity at p. 112; Chapter 3.2 Skin Corrosion/Irritation, Chapter 3.3 Serious Eye Damage /Eye Irritation at p. 137; 3.2.1 Definitions at p. 123. http://www.unece.org/trans/danger/publi/ghs/ghs_rev01/01files_e.html

[40] European Union (2002) Implementing the Globally Harmonised System of Classification and Labelling of Chemicals (GHS). http://ec.europa.eu/enterprise/reach/ghs_en.htm

> It was agreed at the 2002 UN World Summit on Sustainable Development in Johannesburg that the GHS should be implemented worldwide, with a target date of 2008. The GHS will provide harmonised [*sic*] health and safety information for chemical substances and mixtures. The European Commission has stated (in the explanatory memorandum to the proposed amendment of Directive 67/548/EEC, which was adopted at the same time as the REACH proposal) that it would come forward with the necessary legislative proposal. It is the aim that the GHS implementing legislation is adopted at the same time as the final REACH legislation.

[41] United Nations Environment Programme (February 5, 1992, as amended to 2005) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. http://www.basel.int/text/documents.html

> Scope of the Convention
> 1. The following wastes that are subject to transboundary movement shall be "hazardous wastes" for the purposes of this Convention:
> (a) Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III
> ...
> ANNEX I CATEGORIES OF WASTES TO BE CONTROLLED ...
> Y34 **Acidic solutions or acids in solid form**
> Y35 **Basic solutions or bases in solid form**
> ...
> ANNEX III LIST OF HAZARDOUS CHARACTERISTICS ...
> 8 H8 Corrosives
> **Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue**, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.
> ...
> ANNEX VIII LIST A [*added in 1998*]
> Wastes contained in this Annex are characterized as hazardous under Article 1, paragraph 1 (a), of this Convention, and their designation on this Annex does not preclude the use of Annex III to demonstrate that a waste is not hazardous. ...
> A4090 **Waste acidic or basic solutions**, other than those specified in the corresponding entry on list B (note the related entry on list B B2120)
> ...
> ANNEX IX LIST B [*added in 1998*]
> Wastes contained in the Annex will not be wastes covered by Article 1, paragraph 1 (a), of this Convention unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic. ...
> B2120 Waste acidic or basic solutions with a pH greater than 2 and less than 11.5, which are not corrosive or otherwise hazardous (note the related entry on list A A4090)

[42] EPA Office of Pesticides (November 1982) Pesticide Assessment Guidelines, Subdivision F. Hazard Evaluation: Human and Domestic Animals. EPA Publication No. EPA 540/ 9-82-025. NTIS Doc. No. PB 83-153916NTIS Number PB83-153916. Available from the National Technical Information Service (www.NTIS.gov) by TELEPHONE ONLY (800/553-6847) because this document is before 1990, the earliest date that NTIS posts information on their web site.

> Subdivision F supports the data requirements of 40 CFR Part 158. ...
>
> § 81-4 Primary eye irritation. ...
> (b) Purpose. In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant and/or corrosive effects on eyes of mammals is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of the eyes and associated mucous membranes to the test substance.
> (c) Definitions.
> (1) "Eye corrosion" is the production of irreversible tissue damage in the eye ...
> (2) "Eye irritation" is the production of reversible changes in the eye ...
> (d) Standard of the test method. ...
> (2) **Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 of less or 11.5 or greater, need not be tested owing to their predictable corrosive properties.**

[43] EPA Office of Pesticide Programs (October 24, 1984) 40 CFR Part 158. Data Requirements for Pesticide Registration; Final Rule. *Federal Register* 49(207) 42856 – 42905. www.Heinonline.org

> Also, due to their predictable corrosive properties, strongly acidic or alkaline test substances need not be tested for primary eye and primary dermal irritation. For regulatory purposes, the Agency [*speaking for the whole of EPA, not just the Office of Pesticide Programs and Office of Toxic Substances*] assumes these substances are corrosive. ... Information derived from primary eye and primary dermal irritation studies serves to identify possible hazards from exposure of the eyes, associated mucous membranes and skin.
> ...

§ 158.135 Toxicology data requirements ...

Kind of data required	(b) Notes	...
Acute testing		...
Acute oral toxicity – rat	(1)	...
Acute dermal toxicity	(1), (**2**)	...
Acute inhalation toxicity – rat	(16)	...
Primary eye irritation – rabbit.	(**2**)	...
Primary dermal irritation	(1), (**2**)	...
...	...	...

...
(1) Not required if test material is a gas or highly volatile.
(2) **Not required if test material is corrosive to skin or has pH less than 2 or greater than 11.5**

[44] Office of Technology Assessment, U.S. Congress (February 1986) Alternatives to Animal Use in Research, Testing, and Education (Washington, DC: U.S. Government Printing Office, OTA-BA-273, . Library of Congress Catalog Card Number 85-600621. For sale by the Superintendent of Documents U.S. Government Printing Office, Washington, DC 20402. http://govinfo.library.unt.edu/ota/Ota_3/DATA/1986/8601.PDF
http://www.wws.princeton.edu/ota/disk2/1986/8601/8601.PDF

> Substances with certain properties-*e.g.*, a caustic pH-could be assumed to be eye irritants and not tested. ... A substance shown to be highly corrosive to skin will be highly irritating to the eye and thus might not be tested. Similarly, **a substance with a pH of 2 or less (strongly acid) or 11.5 or more (strongly alkaline) is assumed to be highly irritating or corrosive to skin or eye and need not be tested** (38,54). The cornea tolerates substances with a pH ranging from 3 to 11 variably, with the severity of a reaction depending in large part on a substance's ability to affect protein structure or function (17,35).

[45] EPA Office of Prevention, Pesticides and Toxic Substances (August 1998) Final Health Effects Test Guidelines OPPTS 870.2500 **Acute Dermal Irritation**
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Series/870-2500.pdf

> [*The following language is identical to the 1996 proposal.*]
> (c) Definitions. The definitions in section 3 of TSCA and in 40 CFR Part 792—Good Laboratory Practice Standards (GLP) ...
> **Dermal corrosion is the production of irreversible tissue damage in the skin** following the application of the test substance.
> Dermal irritation is the production of reversible inflammatory changes in the skin following the application of a test substance.
> ...
> (d) Principle of the test methods. (1) The substance to be tested is applied in a single dose to the skin of several experimental animals, each animal serving as its own control (except when severe irritation/corrosion is suspected and the stepwise procedure is used (see paragraph (f)(1)(iii) of this guideline)). The degree of irritation is read and scored at specified intervals and is further described to provide a complete evaluation of the effects. The duration of the study should be sufficient to permit a full evaluation of the reversibility or irreversibility of the effects observed but need not exceed 14 days.
> ...
> (e) Initial considerations. (1) Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 or less, or 11.5 or greater, need not be tested for primary dermal irritation, owing to their predictable corrosive properties.

[46] EPA Office of Prevention, Pesticides and Toxic Substances (August 1998) Final Health Effects Test Guidelines, OPPTS 870.2400, **Acute Eye Irritation**
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Series/870-2400.pdf

> (b) Purpose. (1) In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant and/or corrosive effects on eyes of mammals is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of **the eyes and associated mucous membranes** to the test substance.
> ...
> (e) Initial considerations. (1) Strongly acidic or alkaline substances, for example, with a demonstrated pH of 2 or less or 11.5 or greater, need not be tested owing to their predictable corrosive properties. Buffer capacity should also be taken into account.

[47] Andrew Schneider (01/13/02) Scientists pull out all stops to test NYC dust. St. Louis Post-Dispatch. http://www.stltoday.com/

> Clark, Swayze and Hoefen were in the Imaging Spectroscopy Lab. Meeker was running the scanning electron microscope and doing energy dispersive spectroscopy. Steve Sutley was conducting X-ray diffraction on his sample of dust. Joe Taggart was doing Xray Fluorescence. And Geoffrey Plumlee and Phil Hageman were doing chemical analysis and chemical leach testing. ... Within hours, some results started coming back. They did find the asbestos they were searching for. But they also found an alphabet soup of heavy metals. But the real surprise was the pH of the dust. **It registered a high of 12.1 on the samples taken indoors.** Ammonia has a pH of 10.

[48] Andrew Schneider (02/09/2002)Caustic dust blankets World Trade Center area. St. Louis Post-Dispatch.
http://www.stltoday.com/stltoday/news/special/asbestos.nsf/0/727E0EBECFD7DD0F86256CAD0076A1EE?OpenDocument
http://www.nyenvirolaw.org/PDF/StLouisDispatch-2-9-02-CausticDustBlanketsWTCarea.pdf

> Most of the samples taken by USGS' team had a **pH of 9.5 to 10.5**, about the same alkalinity as ammonia. **Two samples that were taken inside a high-rise apartment and in a gymnasium across from the wreckage of the World Trade Center had a pH of 11.8 to 12.1** - equivalent to what would be found in liquid drain cleaner. The degree of acidity or alkalinity in a material is expressed as a pH measurement.

[49] The USGS took dust samples from lower Manhattan on 11/17/01 and found highly alkaline pH levels as well as other toxics. USGS provided the pH data to EPA, OSHA, and FEMA by some unknown date (participating EPA staff would have known instantaneously), and then posted the results on an internal government website by 11/27/01. The first authentication of any release by USGS of its pH and other toxic test data to the public was February 2002. This is when environmental and health care professionals were alerted to the posting of the report on the USGS website, and also the date which the internet WebArchive resource indicates the report was first posted.

In 2004, USGS back-dated its report to 11/27/01, an obvious attempt to make it appear that they had informed first responders of the hazard in a more timely manner. Internet archive versions of the USGS report show a date was first inserted between April and June 2004. The USGS put the phrase "Published November 27, 2001" after the title at this time. Previously, there had never been a date on the report. This can be proven by the use of the Internet Archive "WayBackMachine" at: www.archive.org

The WTC report originally and continues to state that it is "Version 1.1" up until the present. It never had a date of any kind on the report itself, however, until 2004. Internet Archive shows that a date was inserted sometime between 4/5/04 and 7/4/04. The date inserted was 11/27/01.

There is an indication that USGS was intending to post the report in late November 2001. The USGS Spectroscopy Lab web page for 11/28/01 listed the WTC report as having a date of 11/25/01, and set up a link, but did not populate the link with any report or other document at this time. Then, the 12/17/01 USGS Spectroscopy Lab web page listed the WTC report as having a new date of 11/29/01. But again, the link was never actually populated with any WTC report.

Neither the 11/25/01 nor the 11/29/01 alleged publication dates match the alleged 11/27/01 publication date that USGS back-dated and placed on the report in 2004, long after the fact. The first time Internet Archive shows that the USGS report actually appeared on the internet is 2/5/02. This establishes a severe credibility problem with any USGS claim that their pH data was released on any date in November 2001.

The Internet Archive date of 2/5/02 should be accepted as the credible date when the USGS actually made their report available to the public by publication on the internet. This 2/5/02 date dovetails with the press articles on 1/13/02 and 2/9/02 in the St. Louis Post-Dispatch. If the USGS had actually posted the report on the internet before 2/5/02, then the USGS scientists quoted in the press articles would have stated it. Furthermore, the scientists provided higher pH levels to the journalist than were later included in the 2/5/02 report. Neither the scientists nor the journalists would have made this "mistake" if a hard-copy (or internet version) of the USGS report had been released by this time.

The USGS report apparently is only available in extensively linked HTML format to the public. Typically USGS also releases their reports in the alternative PDF format, which provides a static version that can be downloaded as a unit where any changes can easily be determined. Because the USGS report remains only in HTML format, it is difficult to determine what other "after the fact" surreptitious changes have been made to the USGS report over the years.

See the following www.archive.org analysis and links:

> The last time the USGS report was undated, still labeled "Version 1.1" was April 5, 2004, according to web.archive.org:
> http://web.archive.org/web/20040405112148/http://pubs.usgs.gov/of/2001/ofr-01-0429/
>
> The first time the USGS report was given a date, back-dated to 11/27/01, was on July 4, 2004:
> http://web.archive.org/web/20040604013002/pubs.usgs.gov/of/2001/ofr-01-0429/
>
> The USGS Spectroscopy Lab web page for 11/28/01 allegedly links to the WTC report, dated 11/25/01, but the link does not go to any report of any date, but instead to a 9/11/02 referral page to the more recent report. There is no proof that the link actually went to any WTC report.
> http://web.archive.org/web/20021128172852/http://speclab.cr.usgs.gov/
>
> The USGS Spectroscopy Lab web page for 12/17/01 allegedly links to the WTC report, dated 11/29/01, a different date. But again, the link does not go to any report of any date, but instead to a 9/11/02 referral page to the more recent report. There is no proof that the link actually went to any WTC report.
> http://web.archive.org/web/20011217013302/http://speclab.cr.usgs.gov/
>
> WebArchive gives fairly definitive proof that USGS did not post its WTC report with pH data on the internet until February 5, 2002. The following is the address for the original location of the WTC report on the USGS site:
> speclab.cr.usgs.gov/wtc/
>
> WebArchive gives the first register for this USGS WTC report on the internet as February 5, 2002. at:
> http://web.archive.org/web/*/http://speclab.cr.usgs.gov/wtc/
>
> See the web.archive.org web address below for all USGS press releases in 2001, none of which mention the WTC report:
> http://web.archive.org/web/20020301015945/www.usgs.gov/public/press/public_affairs/press_releases/01news.html
>
> None of the 2002 press releases announce the WTC report as well:
> http://web.archive.org/web/20030605121239/www.usgs.gov/public/press/public_affairs/press_releases/02news.html

[50] My 10/15/06 complaint to the EPA Inspector General erroneously stated that the USGS report was back-dated to 11/15/01, which was a typographical error.

[51] USGS (February 5, 2002 is actual date, 11/27/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

Images of the World Trade Center Site Show Thermal Hot Spots on September 16 and 23, 2001.
Results of Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) remote sensing data and interpretations show the distribution and intensity of thermal hot spots in the area in and around the World Trade Center on September 16 and 23, 2001. Data collected on the 16th were processed, interpreted and released to emergency response teams on the 18th of September, 2001.

[52] Paul J. Lioy, Clifford P. Weisel, James R. Millette, Steven Eisenreich, Daniel Vallero, John Offenberg, Brian Buckley, Barbara Turpin, Mianhua Zhong, Mitchell D. Cohen, Colette Prophete, Ill Yang, Robert Stiles, Glen Chee, Willie Johnson, Robert Porcja, Shahnaz Alimokhtari, Robert C. Hale, Charles Weschler, and Lung Chi Chen (July 2002) Characterization of the Dust/Smoke Aerosol that Settled East of the World Trade Center (WTC) in Lower Manhattan after the Collapse of the WTC 11 September 2001. Environmental Health Perspectives • VOLUME 110, NUMBER 7, 703. http://ehpnet1.niehs.nih.gov/members/2002/110p703-714lioy/EHP110p703PDF.PDF

> pH analyses ... placed them in test tubes; aliquots of distilled, deionized water were added to make a concentration of approximately 30 mg/mL. The tubes were inverted several times and were then sonicated. The samples were left at room temperature for several days before centrifugation. The extract from each filter sample was removed to a new test tube before centrifugation. All samples were centrifuged and the supernatant was removed to new tubes and stored in the refrigerator. A 1-mL aliquot of extract was used for pH measurement.
> ...
> The pH of an aqueous suspension of each sample was > 7; the Cortlandt Street sample had a pH of 11.5. Both the Cherry and Market Street samples had a pH of ≈9 (Table 1). ...

Table 1. General characteristics of settled dust and smoke samples (percent by mass) from the first days after the collapse and fires of the WTC.

	Street		
Sample	Cortlandt	Cherry	Market
Color	Pinkish gray	Pinkish gray	Pinkish gray
pH	11.5	9.2	9.3
...	...	...	...

[53] This description is remarkably vague and inexact as well, using phraseology such as "several days" and not even stating how long samples were stored in the refrigerator, or whether they were covered with septums, etc. In February 2001 I requested laboratory data sheets from Dr. George Thurston at NYU, another EPA-funded scientist, on the grounds that it was public money being paid and the information should be provided. He refused.,

[54] Holt, Rhinehart, and Winston (2002) Modern Chemistry, Teachers Edition, pp. 776-777. http://www.hrw.com/science/mc/index.htm

> Oxides ... The reactive metal oxides of Groups 1 and 2 react vigorously with water and release a large amount of heat. The product of the reaction is a metal hydroxide. The following equation is an example of this reaction. $Na_2O\ (s)\ +\ H_2O\ (l) \rightarrow 2\ NaOH\ (aq)$
> ...
> Reactions of Hydroxides with Nonmetal Oxides ... The reaction of a hydroxide base with a nonmetal oxide is an acid-base reaction. The product is either a salt or a salt and water, depending on the identities and the relative quantities of reactants. For example, 2 mol of the hydroxide base sodium hydroxide and 1 mol of the nonmetal oxide carbon dioxide form sodium carbonate, which is a salt, and water.
> $CO_2\ (g)\ +\ 2\ NaOH\ (aq) \rightarrow Na_2CO_3\ (aq)\ +\ H_2O\ (l)$

[55] NIOSH Pocket Guide to Chemical Hazards (September 2005) DHHS (NIOSH) Publication No. 2005-149. http://www.cdc.gov/niosh/npg/pdfs/2005-149.pdf

> Calcium hydroxide ... Readily absorbs CO_2 from the air to form calcium carbonate.
> ...
> Potassium hydroxide ... Heat is generated if KOH comes in contact with H_2O & CO_2 from the air.

[56] Merck Index (1968) Eighth Edition. Merck & Co., Inc., Rahway, NJ.

> Calcium Hydroxide ... Readily absorbs CO_2 from air forming $CaCO_3$.
> ...
> Potassium Hydroxide ... Rapidly absorbs moisture and CO_2 from the air and deliquesces.
> ...
> Sodium Hydroxide ... Rapidly absorbs carbon dioxide and water from the air. ... Volumetric NaOH solns [*solutions*] used in the laboratory must be protected from air to avoid formation of carbonate.

[57] Merck Chemical Index Online (2007) http://www.merckbooks.com/mindex/cdrom.html

> Calcium Hydroxide ... Calcium hydrate slaked lime ... Readily absorbs CO_2 from air forming CaCO3. Loses water when ignited; forms CaO. d: 2.08-2.34. Slightly sol in water ... pH of aq soln satd at 25 degrees: 12.4.
>
> Potassium Hydroxide ... Potassium hydrate caustic potash ... Rapidly absorbs moisture and CO2 from the air and deliquesces. ... Sol in 0.9 part water, about 0.6 part boiling water ... Keep tightly closed and do not handle with bare hands. A 0.1M aq soln has a pH of 13.5.
>
> Sodium Hydroxide ... Caustic soda soda lye sodium hydrate ... Volumetric NaOH solns used in the laboratory must be protected from air to avoid formation of carbonate. ... The pH of a 0.05% w/w soln (approximate)12, of a 0.5% soln (approximate)13, of a 5% soln (approximate)14.

[58] Wikipedia. Sodium hydroxide. http://en.wikipedia.org/wiki/Sodium_hydroxide

> Pure sodium hydroxide is a white solid, available in pellets, flakes, granules, and also 50% saturated solution. It is very deliquescent and also readily absorbs carbon dioxide from the air, so it should be stored in an airtight container. ... The reaction of carbon dioxide has already been mentioned, but other acidic oxides such as sulfur dioxide (SO_2) also react completely. Such reactions are often used to "scrub" harmful acidic gases (like SO_2 and H_2S) and prevent their release into the atmosphere.
> $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

59 CavemanChemistry. Lime and Lye: Two Strong Alkalis. http://cavemanchemistry.com/oldcave/projects/lime/

> When lime is added to water in a process called "slaking," calcium oxide is converted to calcium hydroxide, or "slaked lime."
> $CaO + H_2O$ <-----> $Ca(OH)_2$
> ...
> If lime is left exposed to the atmosphere, it will, over time revert back to calcium carbonate by absorbing carbon dioxide from the air:
> $Ca(OH)_2 + CO_2$ <-----> $CaCO_3 + H_2O$

60 Dr. Chen, a respected atmospheric scientist at New York University and a collaborator on the Rutgers-lead study, told the New York Times that he was unaware why soaking WTC dust samples in saline solution (water plus common table salt, sodium chloride) for several days would change the pH:

Anthony DePalma (August 25, 2006) E.P.A. Whistle-Blower Says U.S. Hid 9/11 Dust Danger. New York Times
www.NYTimes.com
http://www.knowledgedrivenrevolution.com/Articles/200608/20060828_EPA_911_Whistle_Air.htm
http://newsandmore.typepad.com/daily_news_updates_from_a/2006/week34/index.html
http://www.infowars.com/articles/sept11/epa_whistleblower_us_hid_911_dust_danger.htm

> A senior scientist at the Environmental Protection Agency has accused the agency of relying on misleading data about the health hazards of World Trade Center dust.
>
> The scientist, who has been sharply critical of the agency in the past, claimed in a letter to members of the New York Congressional delegation this week that test reports in 2002 and 2003 distorted the alkalinity, or pH level, of the dust released when the twin towers collapsed, downplaying its danger.
>
> Some doctors suspect that the highly alkaline nature of the dust contributed to the variety of ailments that recovery workers and residents have complained of since the attack. ... Dr. Jenkins said the test reports had a costly health effect, contributing “to emergency personnel and citizens not taking adequate precautions to prevent exposures.”
> ...
> Representative Jerrold Nadler, a Democrat whose district includes Lower Manhattan, received a copy of Dr. Jenkins’s letter, and he said that he intended to look into the dispute. “When a scientist who works for the E.P.A. makes serious allegations about the aftermath of 9/11, they must be examined carefully,” he said.
>
> The two scientists named in Dr. Jenkins’s letter are faculty members of the New York University School of Medicine who collected dust samples from ground zero in the days after the attack. One of them, George D. Thurston, is director of N.Y.U.’s Community Outreach and Education Program. He has helped inform Lower Manhattan workers and residents about health hazards related to the terror attack.
>
> Testifying before a Senate committee in 2002, Dr. Thurston said that more than 95 percent of the dust was composed of comparatively large particles that were highly alkaline. He said that although they were irritating, those dust particles did not pose serious health concerns for residents because they were too large to enter the lower airways of the lungs.
>
> Smaller particles, those less than 2.5 microns in size, are far more dangerous because they can be easily breathed deep into the lungs. Dr. Thurston told the Senate committee that tests showed those particles to be pH neutral, and therefore of less concern.
>
> A year later, the same scientists, in conjunction with the E.P.A., among others, published a report in Environmental Health Perspectives, a professional journal, in which they described a new round of tests in which they found the smallest dust particles to have pH values from 8.8 to 10, which made them alkaline. To keep the particles in the samples from congealing, however, they used a standard process that involved freeze drying and soaking the samples in saline. When pH tested, the particles were then found to be “near neutral.”
>
> **Lung-Chi Chen, the second N.Y.U. scientist, an inhalation toxicologist with N.Y.U.’s School of Medicine who was responsible for the testing, said the saline could not have diluted the alkalinity of the samples so greatly that they went from alkaline to neutral.** “We were not trying to mislead anyone,” he said. ...

61 Chi-Sun Poon, X.C. Qiao, Dixon Chan (2006) The cause and influence of self-cementing properties of fine recycled concrete aggregates on the properties of unbound sub-base. Waste Management 26 1166–1172. http://www.elsevier.com/locate/wasman

62 Poon, *et al.* (2006), *op. cit.*

63 Direct inquiries to the author of this study were not answered. Thus it is unknown how freshly milled the concrete had been from the recycling facility, or whether it had already been subjected to wetting or for how long. The many other state studies cited herein showed that crushed recycled concrete that had been stored in large unprotected piles for long periods of time still generated caustic leachates with pH levels over 11 or 12.

[64] EPA SW 846-On Line. Method 9045D SOIL AND WASTE pH (Revision 4, November 2004). http://www.epa.gov/epaoswer/hazwaste/test/main.htm
http://www.epa.gov/epaoswer/hazwaste/test/pdfs/9045d.pdf

[65] L.-M. Yiin, James R. Millette, A. Vette, V. Ilacqua, C. Quan, J. Gorczynski, M. Kendall, L. C. Chen, C. P. Weisel, B. Buckley, I. Yang, and P. J. Lioy (2004) Comparisons of the Dust/Smoke Particulate that Settled Inside the Surrounding Buildings and Outside on the Streets of Southern New York City after the Collapse of the World Trade Center, September 11, 2001. J. Air & Waste Manage. Assoc. 54:515–528
http://www.awma.org/journal/ShowAbstract.asp?Year=&PaperID=1214

Address	Liberty Street										
Floor	8	5			4				2		
Sample ID	124	5	6	7	8	9	10	11	12	13	14
Location	LR & BR	Library	Hall	Baseboard	Floor	Hall & LR	High Chair	BR	Front Room	Front Room	Entryway
Color	gray/tan	N/A	gray/tan	N/A	gray/tan	gray/tan	tan	N/A	tan	N/A	gray/tan
pH	**11**	N/A	**11**	N/A	**11**	**11**	**11**	N/A	**11**	N/A	**11**
...	...	...	...	...	...	...	...	...	...	...	...

[66] Cate Jenkins (August 22, 2006) SUBJECT: EPA-funded fraudulent pH reporting of WTC dust. Sent jointly to two different groups: Senator Hillary Rodham Clinton, Congressman Jerrold Nadler, Congresswoman Carolyn Maloney, as well as addressed to Bill Roderick, Acting EPA Inspector General.

[67] Cate Jenkins (October 25, 2006) Addressed to Bill Roderick, Acting EPA Inspector General,
COMPLAINT: – Cover-up, corrosive alkalinity of WTC dust by EPA, OSHA and NYC
–Falsification of the health implications of the alkaline pH data
–Fraudulent reporting of pH levels for smallest WTC dust particles
Currently posted on the RawStory website at: http://www.rawstory.com/news/2006/epamemocomplaint.pdf

[68] A micron is one ten thousandth of a centimeter (0.0001 cm).

[69] EPA also funneled Superfund money to other NIEHS programs to manage the WTC disaster. These programs included community outreach, basic scientific research, as well as the Worker Education and Training Program (WETP) for rescue and recovery workers at Ground Zero. See the summary at the end of the following brochure for the EPA-funded NIEHS programs:

National Institute of Environmental Health Sciences, NIH, DHHS. WORLD TRADE CENTER RESPONSE. http://www.wetp.org/wetp/front/wtc_report_v3.pdf

[70] NIEHS Community Outreach and Education Program (COEP) Summary. Expired webpage, now only posted at web.archive.org at:
http://web.archive.org/web/20030222053952/http://www.niehs.nih.gov/centers/coep/nyu-coep.htm

> NYU COEP Helps New Yorkers Understand World Trade Center Disaster and Other Environmental Health Threats ... NIEHS-supported centers have played an important role in sorting out the environmental health issues over the past several months. ... By September 12, scientists from the Environmental Health Sciences Centers at NYU and the University of Medicine and Dentistry of New Jersey (UMDNJ) had begun to collect ground dust samples, and by September 14, NYU had begun to monitor air quality from a second-story window in the NYU downtown hospital, a few blocks from Ground Zero. ...
> ...
> **As voices independent from the government officials, NYU COEP Director Dr. George Thurston and his fellow Center members have been active in interacting with and informing the public about our Center's WTC research** findings since September 11. NYU Center members have attended meetings with PTA's and parent groups, advised the school system on environmental issues, and have presented information at numerous public forums held in downtown New York. NYU Center members have also been widely interviewed by the press and have made appearances in the media since September 11th, including on CNN Live, CBS Nightly News, and NPR's Morning Edition. The NPR interview is available on the Web at: http://www.npr.org/ramfiles/me/20011129.me.03.ram
>
> In addition, on October 18, 2001, the NYU-COEP, in association with the other NIEHS Centers in the NY metro area, organized a public forum entitled "Environmental Health Issues Related to the World Trade Center Disaster" to an audience of over 400 downtown residents. At this forum, the research results and plans of the various participating NIEHS Centers were presented. This was followed by a free-flowing question and answer period of over 1 and one-half hours, in which experts from the various NIEHS Centers applied their knowledge and expertise to try to answer the public's many concerns and questions.
>
> The NYU-COEP hopes to host a follow-up forum in 2002 to keep the public informed as to the growing knowledge being gained by NIEHS Center members investigating the environmental health implications of the WTC disaster.
>
> COEP DIRECTOR CONTACT INFORMATION, Name: Dr. George D. Thurston, Address: Nelson Institute of Environmental Medicine, NYU School of Medicine, 57 Old Forge Rd., Tuxedo, NY 10987, Phone: 845-731-3564, Fax: 845-351-5472, E-mail: thurston@env.med.nyu.edu
> Web Page: http://niem.med.nyu.edu/faculty/ThurstonG.html

[71] EPA NIEHS (January 2002) NYU COEP Helps New Yorkers Understand World Trade Center Disaster and Other Environmental Health Threats.
http://www-apps.niehs.nih.gov/coeprc/spotlight/0102.cfm

> The NYU COEP in particular has demonstrated leadership through its recent scientific and outreach activities.

> **By September 12**, scientists from the Environmental Health Sciences Centers at NYU and the University of Medicine and Dentistry of New Jersey (UMDNJ) had begun to collect ground dust samples, and by September 14, NYU had begun to monitor air quality from a second-story window in the NYU downtown hospital, a few blocks from Ground Zero.
>
> While public health officials reported that the air in lower Manhattan was safe to breathe, many residents suffering from symptoms such as raw throats, burning eyes, nose bleeds, and intermittent asthma attacks, were afraid, confused, and suspicious of what the authorities were telling them.
>
> With their own data in hand, Centers quickly developed an understanding of what is in the air, why people are experiencing symptoms, who is most at risk, and what is and is not known about long-term health effects. NYU's air quality data corroborated the official reports that concentrations of lead, asbestos, and fine particles were generally below federal standards. **However, they also showed extremely high concentrations of unregulated large particles, consisting mostly of pulverized concrete, which is irritating to the eyes, nose, and throat.** Soot, also found initially in high concentrations, can exacerbate asthma and result in other serious health effects.
>
> As voices independent from the government officials, NYU COEP Director **Dr. George Thurston** and his fellow Center members, including **Drs. Lung Chi Chen and Morton Lippmann**, have been active in interacting with and informing the public about these and other findings since September 11.

72 New York Times (October 11, 2001) Contaminants Below Levels for Long-Term Concerns, By KIRK JOHNSON with ANDREW C. REVKIN

> Other impressions by residents do have a basis in science, environmental experts said. For example, there appears to be a tendency for the smell and air quality to worsen at night, and this is consistent with the way air circulates in the city, said Dr. George D. Thurston, an associate professor of environmental medicine at the New York University School of Medicine, who is involved in a study analyzing the constituents in dust and soot.
> ...
> **He [*Dr. Thurston*], too, agreed with the authorities that there was no sign of a clear health risk to residents, but he quickly added that "prudent avoidance remains the best approach for any resident or worker downtown.**

Anonymous (October 27, 2001) News extra: **Early research says dust at World Trade Center site not dangerous.** British Medical Journal 323:956.
http://bmj.com/cgi/content/full/323/7319/956/a

> Environment specialists told New York workers and residents last week that early studies of asbestos and lead levels in the dust at the site of the collapsed World Trade Center showed that they were below danger levels.
>
> The experts addressed a community meeting last week of more than 200 people at a New York University auditorium in Greenwich Village, about a mile north of the disaster site, which is still burning. The affected population includes many thousands who work in the financial district, at least 2000 who live nearby, rescue workers, workers who will be cleaning up the site for months, and several hundred pregnant women who work at or live close to the site.
> ...
> Dr George Thurston, professor of environmental medicine at New York University, said that so far levels of asbestos and lead were below the levels of concern set by the US Environmental Protection Agency.
> ...
> Residents and workers in the financial district asked about the stench that they smelt daily and which was worse at night, even invading buildings. People said it smelt like "burnt rubber" or "burnt electrical cables." **Dr Thurston explained that the sun warmed the site during the day, causing pollutants to rise, mix, and diffuse with the air. At night, however, when air was cool, pollutants were unmixed and smelly, although they were still below allowable limits**.

JOE WILLIAMS, Daily News Staff Writer (November 11, 2001) Government agencies monitoring the air quality near Ground Zero have lost much of their credibility with the public, Environmental Protection Agency officials and public health experts said yesterday. NY Daily News. www.nydailynews.com

> **"I think the government has collected a lot of information, but it's clear that some people aren't believing it when they hear it," Dr. George Thurston**, an NYU environmental medicine expert, said during a Pace University panel on the environmental impact of the Trade Center attacks. Whether it's a general post-Watergate mistrust of government agencies or the belief that the city is engaged in spin control to keep businesses alive, the argument that the air is safe is not registering with the public — particularly those who have felt irritation from smoke and dust near Ground Zero, panelists said.
>
> Frosty Parents
> EPA spokeswoman Bonnie Bellow said she learned firsthand what type of credibility problem the government has with the chilly reception she received at her daughter's alma mater, Stuyvesant High School, near the World Trade Center site. Bellow said she expected she would have the inside track toward easing fears about air quality because only last year she was a Stuyvesant parent. "That was completely overridden by the fact that I worked for the government," she said.
> ...
> Panelists said there is a perception in the community that city, state and federal governments are pressuring their agencies to put a good spin on information in the effort to rebuild the area.
>
> "If I saw a health risk, I would tell people," said Thurston, a tenured professor. "I'd yell from the rooftop."
>
> Thurston, who said he has been called upon regularly to dispute or verify government information about the air quality downtown, has compared his tests with the EPA's and found the results to be similar. "I think it is premature to tell people it is safe, but we can tell people we don't see a danger," said Thurston, who noted he has studied only the outskirts of Ground Zero.

Mark Maremont and Jared Sandberg of The Wall Street Journal (January 3, 2002) Rebuilding Wall Street, The Restoration of America's Financial Marketplace. Dow Jones Newsletters, Tests Say Air Is Safe, But Some People Feel Ill Near Ground Zero. Expired webpage is now available on web.archive.org at: http://web.archive.org/web/20030321211224/http://www.djnewswires.com/pdfs/rws_010302.pdf

> In the weeks since Sept. 11, government agencies testing the air near ground zero have reached a nearly unanimous conclusion: **There is no significant long-term health risk for area workers and residents.** Yet hundreds, and possibly thousands, of people who live, work or go to school in lower Manhattan have experienced persistent sore throats and hacking coughs. Area physicians report a surge in new or worsened asthma cases. How to explain the contradiction?
>
> **"The government is right that otherwise healthy people are not going to end up dying or in the hospital" years from now, says George D. Thurston**, associate professor of environmental medicine at New York University's medical school. But some of the dust and chemicals kicked up by the collapse, he says, "turned out to be more irritating than we had thought."

Fred Kaplan (2/12/02) Concerns intensify on ground zero dust. Boston Globe. www.boston.com

> **Dr. George Thurston of New York University Medical School testified yesterday that the fiberglass particles in the dust would have been too large to penetrate anyone's lungs**.
>
> But another doctor on the panel, Stephen Levin, director of the occupational health clinic at Mt. Sinai Medical Center, disagreed. "Some of them were small enough to reach far down into the lungs," he said in an interview after the hearing of the Senate subcommittee on clean air, wetlands, and climate change.

Paul H.B. Shin and Russ Buettner (February 10, 2002) WTC's Air of Uncertainty Experts weigh health risks of twin towers fires & dust. New York Daily News. www.nydailynews.com

> Again, health experts are critical of early assurances by the EPA that dust from concrete and fiberglass insulation was within acceptable safety standards simply because particles were small.
>
> **NYU's Thurston said it was the larger particles that proved most irritating**.

Kimbra Cutlip (October 2002) In the Wake of September 11 ... Weatherwise Magazine.
Expired direct URL to Weatherwise Magazine, but article captured by web.archive.org at:
http://web.archive.org/web/20030811184228/http://www.weatherwise.org/articles/Oct02.htm

> As a regulatory agency, the EPA bases its reports on standards designed by the scientific community to assess the health risks of long-term exposure. "Most of the studies out there were based on 24-hour averaged data," says George Thurston, an associate professor of environmental medicine at the New York University School of Medicine. "There are very few studies looking at health effects for shorter exposures than that, so they haven't been able to set a standard for short-term exposures. You need a whole body of work to create a set of standards, and it's just not there yet."
>
> Additionally, current medical knowledge suggests that most long-term risks, such as the threat of cancer, are due to prolonged exposure to fine particles that find their way deep into the lungs. These kinds of exposure are what the EPA reports are primarily based on, **not short-term exposure to the large particles that led to the burning, watery eyes and painful breathing people experienced in Manhattan. "With those kinds of symptoms you'd be thinking something really bad was happening," Thurston says. But the painful symptoms, while potentially dangerous to asthmatics and other vulnerable people, were primarily just upper respiratory irritation, according to Thurston, and did not pose a long-term threat to public health.**

Louisa Dalton (October 20, 2003) Chemical Analysis of a Disaster, Scientists struggle to understand the complex mixture of aerosols released during and after the destruction of the World Trade Center. Chemical & Engineering News, Volume 81, Number 42 CENEAR 81 42 pp. 26-30 ISSN 0009-2347
http://pubs.acs.org/cen/NCW/8142aerosols.html

> Because the fine fraction can get past the body's defenses into the deep lung, small particles were among the first species that scientists started looking for in the WTC dust.
>
> They didn't find many. According to Lung Chi Chen and George D. Thurston, professors of environmental medicine at New York University School of Medicine, more than 95% of the mass of the dust particles consisted of particles larger than 10 µm and more than 50% consisted of particles larger than 53 µm. Particles that big are often off the radar screen of health scientists, and the government paid little attention to them when studying the WTC dust, they said. The absence of fine particles, and little evidence of widespread asbestos, may have been some of the early evidence that EPA used to justify its statements in early September that the dust was not harmful. However, Chen and
>
> Thurston continued, some of the workers at ground zero have complained of what they call the "World Trade Center cough." **The culprit for the cough, Chen and Thurston discovered, was actually in particles larger than 10 µm. Large dust particles, because they were alkaline and caustic, irritated the upper passages of the nose and throat. And though this shouldn't lead to long-term health effects, large, caustic particles and fiberglass caught in the upper airways cause acute short-term effects.**

Dr. George D. Thurston, Associate professor of environmental medicine, N.Y.U. School of Medicine (October 14 - 20, 2003) LETTERS TO THE EDITOR: Helping out on air. Downtown Express Volume 16 • Issue 2003. http://downtownexpress.com/de_25/lettertotheeditor.html

> To The Editor:
> Re (Talking Point, "Overreacting to Whitman's deceit on air quality," by Charles Komanoff, Oct. 7 – 13, 2003):
>
> Thanks for your laudatory comments. But I think I just did what most every New Yorker tried to do at the time: help us all to cope with a bad situation the best way we knew how. In my case, by providing my air pollution health effects expertise to any who wanted to listen. I am thankful to have had that to offer.

[73] Email interchange between George Thurston, Sc.D. and Cate Jenkins, Ph.D. from 8/26/03 to 8/27/03 regarding change of Dr. Thurston's conclusions on the hazards of WTC dust, as reflected in his statements to the press. See earlier reference citation for excerpts of Dr. Thurston's press statements.

Cate Jenkins
08/26/2003 08:38 AM
To: thurston@env.med.nyu.edu
Subject: Hey, George ---------
- -

George, I saw your quote in Newsday, 8/23 or 8/24 where you claimed that you told people at the time that everything was too preliminary to make conclusions. See attached early statement of yours in the British Medical Journal where you said conclusively that levels were not of concern. Notice that in my 7/4/03 report I quote your Br. Med. J. statement in Section B.
Am debating whether to circulate an email to everyone saying that your recent quote this week in Newsday really is inaccurate and does not reflect what you were telling citizens at the time.

Yours truly,
Cate

"George D. Thurston, Sc.D."
<thurston@env.med.nyu.edu>
08/26/2003 12:19 PM
To: Cate Jenkins/DC/USEPA/US@EPA
Subject: Re: Hey, George ---------
- -

I always said that the declaration that the "Air was safe to breath" was premature. Check my statement at the Senate hearing for one, which is a much more public forum than the journal article, and earlier on.

Cate Jenkins
08/26/2003 12:38 PM
To: "George D. Thurston, Sc.D." <thurston@env.med.nyu.edu>
Subject: Re: Hey, George ---------
- -

Really, George? You are defending yourself by saying the British Medical Journal really wasn't read by many people, but what you said at a Senate hearing was more widely disseminated, and thus we should excuse the British Medical Journal piece? Then what do you say about these other quotations from you, below, which were all much more widely distributed than your testimony at the Senate hearing?

Cate

[*abstracts of the various earlier press quotations of Dr. Thurston were attached to this email*]

"George D. Thurston, Sc.D."
<thurston@env.med.nyu.edu>
08/27/2003 10:49 AM
To: Cate Jenkins/DC/USEPA/US@EPA
Subject: Re: Hey, George ---------
- -

As I said, I never stated that the EPA pronouncement was appropriate, and always said (WELL b4 the Senate hearing) that it was NOT appropriate 4 her 2 do so at that time, when the issue came up. George

---

Cate Jenkins
08/27/2003 10:55 AM
To: "George D. Thurston, Sc.D." <thurston@env.med.nyu.edu>
Subject: Re: Hey, George ---------
- -

George,
It is irrelevant whether you specifically addressed the EPA pronouncement. It is your own statements on the record that said that the air was within EPA benchmarks for health concerns, and your statements that if you yourself felt that there was anything wrong with the air that you would be "shouting it from the rooftops" and that
the only hazard was for irritant effects.

Cate

"George D. Thurston, Sc.D."
<thurston@env.med.nyu.edu>
08/27/2003 11:10 AM
To: Cate Jenkins/DC/USEPA/US@EPA
Subject: Re: Hey, George ---------
- -

No, that IS the issue discussed in the article that you wrote 2 me about, and that I responded to in my quote.

See below.
George

http://www.nynewsday.com/news/local/manhattan/nyc-epa0823.story

---

Cate Jenkins
08/27/2003 12:30 PM
To: "George D. Thurston, Sc.D." <thurston@env.med.nyu.edu>
Subject: Re: Hey, George ---------
- -

George,
Whatever you said in the 8/22/03 quote is entirely irrelevant and revisionist, as you well know. You are on record saying to the public after the 9/11 attacks that the air was below EPA health benchmarks and that if there were anything wrong with the air you would be shouting it on the rooftops.

You are on my list, and always have been.

Cate

"George D. Thurston, Sc.D."
<thurston@env.med.nyu.edu>
08/27/2003 04:28 PM
To: Cate Jenkins/DC/USEPA/US@EPA
Subject: Re: Hey, George ---------
- -

What list is that?

Cate Jenkins
08/27/2003 04:28 PM
To: "George D. Thurston, Sc.D." <thurston@env.med.nyu.edu>
Subject: Re: Hey, George ---------
- -

Guess.

"George D. Thurston, Sc.D."
<thurston@env.med.nyu.edu>
08/27/2003 04:37 PM
To: Cate Jenkins/DC/USEPA/US@EPA
Subject: Re: Hey, George ---------
- -

What do you mean, guess? Why can't you tell me the truth? What are you hiding?

George

Cate Jenkins
08/27/2003 05:46 PM
To: "George D. Thurston, Sc.D." <thurston@env.med.nyu.edu>
Subject: Re: Hey, George ---------
- -

Boy, George, you are starting to sound pretty desperate there. Hiding things and all that.

[*Thereafter Dr. Thurston declined to respond to my emails*]

74 Thurston, G. D. (February 11, 2002) Statement of Dr. George D. Thurston, Sc. D. to the Committee on Environment and Public Works of the United States Senate Re: The Air Pollution Effects of The World Trade Center Disaster, February 11, 2002. http://www.senate.gov/~epw/107th/Thurston_021102.htm

> Only trace amounts of asbestos were found in our samples. [*contrast this claim with NYU's later publication that the range was 0.8 to 3% for their samples.*] **The less than one percent that was as PM2.5, or the particles that would reach deepest in the lung, was found to have a neutral pH, with no detectable asbestos or fiberglass.** Thus, while our analyses are consistent with the government's conclusion that the WTC dust is not likely to have short or long-term serious health impacts on otherwise healthy local residents, we found that it is very irritating and capable of causing the symptoms reported by many residents.

75 Andrew Schneider (02/09/2002)Caustic dust blankets World Trade Center area. St. Louis Post-Dispatch
http://www.stltoday.com/
http://www.nyenvirolaw.org/PDF/StLouisDispatch-2-9-02-CausticDustBlanketsWTCarea.pdf

> Even as the dust from the collapsed World Trade Center was still settling, top government scientists were determining that the **smoky gray mixture was highly corrosive and potentially a serious danger to health**.
>
> The U.S. Geological Survey team found that some of the **dust was as caustic as liquid drain cleaner** and alerted all government agencies involved in the emergency response. But many of those on the front lines of protecting the health of the public and workers cleaning up the site say they never got the information. "I'm supposed to be in the loop, and I've never heard any specific numbers on how caustic the dust actually was," said Dr. Robin Herbert, co-director of the Mount Sinai Center for Occupational and Environmental Medicine. "There is a large segment of the population here whose physicians needed to know that information that USGS submitted. Exposure to dust with a high pH could impact everyone, but especially the very young, the very old and those with existing pulmonary disease."

...
[A]n examination of all the EPA's public and press statements made since Sept. 11 found nothing that warned of the very high pH levels found by the Geological Survey scientists. Nor did the statements disclose the specific levels that the EPA's own testing found.

"We've not heard of EPA or anyone else releasing information on specific pH levels in the dust, and that's information that we all should have had," said Carrie Loewenherz, an industrial hygienist for the New York Committee for Occupational Safety and Health, which provides assistance to more than 250 unions. "It's the specific numbers - those precise pH levels - that we need to make the appropriate safety decisions for the workers, and they were never released," Loewenherz said. "The dust, once it's in contact with moist tissue, the throat, the mouth, nasal passages, the eyes and even sweaty skin, it becomes corrosive and can cause severe burns."

Most of the samples taken by USGS' team had a **pH of 9.5 to 10.5**, about the same alkalinity as ammonia. **Two samples that were taken inside a high-rise apartment and in a gymnasium across from the wreckage of the World Trade Center had a pH of 11.8 to 12.1** - equivalent to what would be found in liquid drain cleaner. The degree of acidity or alkalinity in a material is expressed as a pH measurement. Neutral pH - like water - is 7 on a 15-point scale. Lower than 7, to 0, is an indication of acid. Higher than 7, to 14, the top of the scale, is alkaline. Levels near either end of the pH scale can harm the health of people and animals.

Bruce Lippy, Loewenherz's counterpart with the operating engineers union, is responsible for the 300 workers running heavy equipment at ground zero. "Part of the dilemma we faced was not knowing precisely what was in the dust," Lippy said. "We knew it was caustic but had no information on exactly how caustic it was. I was trying to get people to wear the respirators, but if I knew how high the pH levels were, I could have been more persuasive in convincing the workers of the dangers."
...
The Geological Survey's **test results were posted Sept. 27** on a Web site restricted to government agencies. ... The USGS data on **pH levels were not released by the EPA**, nor apparently were the environmental agency's own test results on the dust. "It is extremely distressing to learn that the EPA knew how caustic samples of the dust were and didn't publicize the information immediately, or make sure that OSHA publicized it," said Joel Shufro, executive director of the New York Committee for Occupational Safety and Health.

"If we had known at the time exactly how caustic the dust could be, we would have been in a better position to make informed decisions about respiratory protection to recommend and about the urgency of ensuring that workers and residents followed those recommendations," Shufro said. "It is inexcusable for EPA to have kept silent for so long about such a potential hazard."
...
"What we're finding is incredible irritation to the lungs, throat and nasal passages," said Herbert, from Mount Sinai. "Some of the tissue is cherry red, vivid, bright, and "There are a large number of clinicians and public health specialists who are struggling to reconcile the health problems they're seeing with the exposure data they're being given," Herbert said. "**The high pH in the dust may be a part of the answer. If the government had these pH readings of 11 and 12, the public and their physicians should have been told.** Any credible information the government had relating to health issues just should have been released," she said. "There is no justification for holding it. You don't conceal the information from those who need it."
...
Even within the EPA, professionals believe the agency did a disservice by not acknowledging and releasing the Geological Survey's data. Cate Jenkins, a senior environmental scientist in the hazardous materials division at the EPA headquarters, said: "The pH levels the USGS documented were far too high for EPA to ignore. They insisted that all the information regarding health and safety was being released to the public. Well, that's not true. There's nothing, internally or in public releases, that shows the agency ever disclosed specific pH levels."

Late Thursday, the EPA's Bellow told the Post-Dispatch: "We have no specific data on pH levels." Bellow added, "This is all the available information on the subject." Late Friday, the EPA responded to the question of why it didn't collect its own pH numbers.

"EPA had enough information about the alkalinity of the material from the World Trade Center without doing further analysis," Bellow said. The question of why EPA didn't release the data it had had remains unanswered.

[76] The pH level of 12.1 was the highest level reported by USGS thus far. Later data releases in October 2002 from USGS showed pH levels as high as 12.4.

[77] February 2002 Email interchange where Dr. Thurston and Dr. Chen, NYU, reaffirm contentions that smallest WTC particles were non-alkaline

Cate Jenkins
02/13/02 12:08 PM
To: thurston@env.med.nyu.edu
Subject: Questions on your pH measurements
\- -

George, I have another question for your that I am sure you can clear up, in the never-ending battle to clarify hearsay: You are quoted as saying at the 2/11 hearing that in your studies you measured the pH of WTC dusts. You fractionated the dust into smaller, respirable-size particulates, and found that the smaller particles did not have a high pH (a high pH meaning alkaline or caustic).

Considering the high surface to mass ratio of the small particulates, wouldn't you be concerned that the high pH would quickly be neutralized by the moisture in the air? The cause of the high pH would be the presence of calcium carbonate without any moisture content (anhydrous calcium carbonate), created by the extremely high temperatures of the fires burning in the collapse of the WTC.

My questions would be as follows:
1. How long was it from the time of generation (time the dust was deposited on the ground directly after being in the dust cloud) to the time of analysis?
2. Under what conditions were the samples maintained to preserve their anhydrous state?
3. Were WTC samples subjected to vacuum extraction and storage with a strong dessicant prior to analysis if in fact they were collected almost instantaneously from the time of deposition from any smoke or dust plume?

4. Were any experiments performed where the smallest particles of WTC dusts were re-subjected to temperatures comparable to the fires at the WTC to return them to their alkaline state, which would be more similar to what their pH was at the time they were in the dust cloud and inhaled by firefighters and police officers?
5. I heard that you said that you aerosolized the finer particulates to study them. What methods did you use? Did you aerosolize them prior to subjecting them to pH measurements? What type of anhydrous conditions were employed during aerosolization to ensure that the moisture present in the air did not neutralize the alkalinity/caustic nature of the small particulates? 6. Were any of the dusts subjected to pH measurement ever in a wet environment outside prior to collection (i.e., rain or fire hoses)?

Thanks again,
Cate

---

thurston@env.med.nyu.edu (George Thurston)
02/13/02 12:37 PM
To: chenl@env.med.nyu.edu
cc: Cate Jenkins/DC/USEPA/US@EPA
Subject: Fwd: Questions on your pH measurements
\- -
Lung Chi,

Can you please answer these questions regarding the pH analyses of size - fractionated WTC dust.
George

Lung Chi Chen <lcc4@nyu.edu>
02/20/02 09:30 AM
To: Cate Jenkins/DC/USEPA/US@EPA
cc: Thurston <thurston@env.med.nyu.edu>,
Mort Lippmann <Lippmann@env.med.nyu.edu>
Subject: Re: Questions on your pH measurements
\- -
Dr. Jenkins:

I am not sure I can answer you questions. We first mechanically separated particles (sieving) with a cut off at 53 µm. We then aerodynamically separated the < 53 µm fraction to between 53 -10 µm, 10-2.5 µm, and < 2.5 µm. **We took a small aliquot from each fraction and suspended in a small volume of distilled, deionized water and used a pH meter to measure their pH. We found that the suspensions of the particles larger than 10 µm had a pH above 11, for 10 -2.5 µm fraction, pH is above 8, and those < 2.5 µm is near neutral.**

I am not sure whether this measurement technique is applicable to what you are envisioned. An airborne particle may absorbed moister if the material made up of the particle is hygroscopic. It will reach an equilibrium quickly with the surrounding air, and at very high relative humidity, may become a droplet. Unless other chemicals present that may neutralize the pH, I can not see water itself would have any effect.

I hope this help.

best. -- Lung Chi Chen, Ph. D.
New York University School of Medicine 57 Old Forge Road Tuxedo, New York 10987,
Voice: (845) 731-3560 Fax: (845) 351-5472 E-Mail: chenL@env.med.nyu.edu

---

Cate Jenkins
02/20/02 06:28 PM
To: gplumlee@usgs.gov
Subject: NYU's pH measurement of fine particulates
\- -
Jeff, attached is info from Kirk Othmer on cement chemistry, and an email exchange I have been having with NYU. Initially, calcium and magnesium hydroxides are formed, with a saturated water solution of pH up to 13. But that then reacts further with all the other mineral forms. NYU (George Thurston) testified on 2/11/02 at Clinton/Lieberman's hearing in NYC that:

"Our analyses of the WTC dust samples revealed that some 99 percent of the dust was as particles too large to be breathed deeply into the lung, being largely caught in the nose, mouth and throat when inhaled. This large dust, however, contained approximately one-third fiberglass, with much of the remainder as alkaline cement dust. This large dust was, therefore, quite caustic and irritating to the eyes, nose and throat, consistent with the now famous "World Trade Center cough"... The less than one percent that was as PM(2.5), or the particles that would reach deepest in the lung, was found to have a neutral pH, with no detectable asbestos or fiberglass."

I have been conversing with NYU on the matter, my theory being that the smaller particles could also have been alkaline, but neutralized with atmospheric moisture, or just common rain, due to their high surface area to mass ratio. What are your thoughts on the subject?

Cate Jenkins 703/308-0453

Geoffrey S Plumlee <gplumlee@usgs.gov>
02/21/02 12:52 PM
To: Cate Jenkins/DC/USEPA/US@EPA cc:

Subject: Re: NYU's pH measurement of fine particulates
- -

Hi Cate-

The NYU results are quite interesting. I am glad that there are others who are working on the alkalinity of the dusts. It is not clear from the procedure described in the NYU email whether the NYU folks added the same mass of dust to the same amount of water for each of the size fractions. If not, then the differences in pH may reflect at least in part a progressive dilution of the dust by water at increasingly finer particle sizes (i.e. there is less of the dust at the finer sizes, that would therefore not have as much portlandite, etc., as the coarser sizes, and that would therefore not shift the pH to as high a value as the coarser particle sizes).

If they did indeed add the same mass of dust to the same amount of water for each of the size fractions, then the variations in pH between different size fractions could potentially reflect variations in the extent of interactions of the dusts with slightly acidic water vapor or rain water (the acidity coming from carbonic acid, ± low concentrations of sulfuric and nitric acids, found in rain). It could be that the smaller particles react more completely and more rapidly with rain or water vapor, and therefore would show a less alkaline pH than the larger particles.

Based on my experiences in sulfide oxidation and acid-mine drainage generation, I have seen cases where reactive sulfide mineral samples stored in sample drawers pull moisture from the air, oxidize, and form sulfuric acid droplets - I suspect that reactive concrete powder could similarly pull moisture from the air and become progressively neutralized.

I think that it would be possible to grind up concrete and separate it into the same sorts of size fractions that NYU used so that this hypothesis could be tested. I would put the different size fractions in humidity cells (which are typically used to test the acid-generating capacity of mine wastes) for a given length of time, then do the pH tests. It would be interesting to measure how rapidly the fine particles react and lose alkalinity as a function of the relative humidity and temperature of the air - this could play in to whether or not people who inhaled the finest dust fractions on or right after September 11th may have inhaled "fresher", more reactive and alkaline particles.

Many Regards, Geoff Plumlee
gplumlee@usgs.gov Geoffrey S. Plumlee, Ph.D. Research Geochemist U.S. Geological Survey Crustal imaging and Characterization Team MS964 Denver Federal Center Denver, CO 80225 303-236-1204, FAX 303-236-1229 gplumlee@usgs.gov

---

Cate Jenkins
02/21/02 03:47 PM
To: lcc4@nyu.edu
cc: Thurston <thurston@env.med.nyu.edu>, Mort Lippmann <Lippmann@env.med.nyu.edu>, gplumlee@usgs.gov Subject: NYU pH studies of WTC dusts
- -
Dr. Chen,

Thank you for your clarification of 2/20/02. Attached are excerpts from the Kirk-Othmer Encyclopedia on the reactions that claimed (heated to high temperatures) uncured cement undergoes with the addition of water. Initially, calcium and magnesium hydroxides are formed. This accounts for the fact that dry, uncured cement, in a saturated solution with water, can have a pH of up to 13, which is quite alkaline.

However, on subsequent reaction of the hydroxides with the other mineral materials present, other reactions take place, resulting in the formation of gels and eventually the cross linked cured cement product itself, which is no longer alkaline. In other words, the alkalinity of new cement powder when water is added is temporary. With the fires and high temperatures present during the collapse of the World Trade Towers, the cement-like materials were essentially re-calcined and converted back to uncured, reactive cement. The resulting dusts, therefore, were found to be highly alkaline by both the US Geological Survey as well as yourself at NYU.

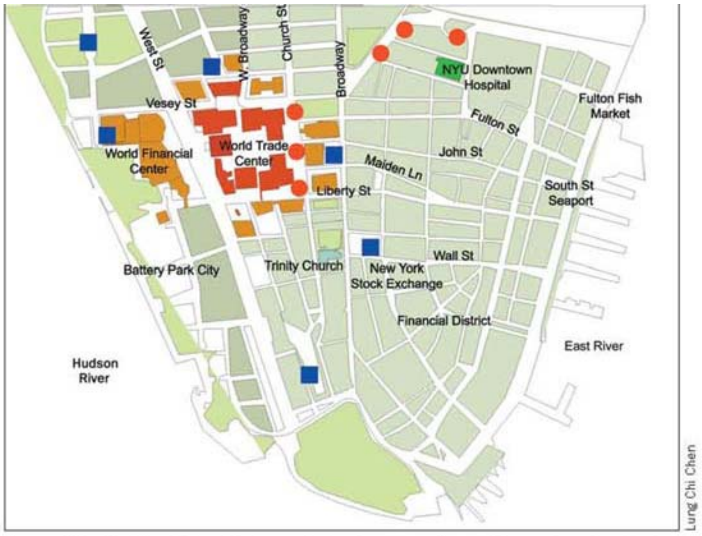
I raised the question of whether or not your group's failure to find alkalinity in the very small particle fraction of WTC dusts could be due to the fact that the very high surface-to-mass ratio of these particles could result in the more rapid neutralization of the particles with either rain or moisture in the air on storage.

As you can see from the below attached correspondence, I also forwarded my hypothesis to Dr. Geoff Plumlee of the US Geological Survey, who has also studied the alkalinity of WTC dusts. He has suggested a confirming experiment of grinding uncured, powdered cement (under anhydrous conditions, of course), then fractionating it into small particles as you did for WTC dusts (under strict anhydrous conditions), and then immediately testing the pH. Alternatively, in my original correspondence to Dr. George Thurston, there might be an easier experiment, namely heating the small, fractionated portions of WTC dusts to temperatures similar to those found in the WTC. Then the pH could be tested immediately. This would be helpful, I believe, in elucidating, diagnosing, and treating the health problems of those who were exposed to the dusts as they existed at the time they were inhaled.

Thank you very much,
Cate Jenkins

[78] Lung Chi Chen, George Thurston (December 2002) World Trade Center cough. THE LANCET Supplement, Vol 360, www.thelancet.com http://niem.med.nyu.edu/WTC/wtccough.pdf

At the immediate urging of the US National Institute of Environmental Health Sciences, we sent a team of technicians and students to collect dust samples at a number of locations in the area immediately adjacent to the World Trade Center site, and at nearby sites in lower Manhattan east, west, north, and south of the epicenter (Ground Zero) on the days after the collapse. All samples were collected from undisturbed surfaces, such as the top of a car, windowsills, or on sidewalks. The locations where we collected these dust "fallout" samples are displayed in the map.



Lower Manhattan, New York: red circles, samples gathered on Sept 12, 2001; purple squares, samples gathered on Sept 13, 2001

> Although most governmental agency and other research efforts centred [*sic, British spellings*] on Ground Zero, **we focused on community exposures to the particle pollution emanating from the site fires; the resuspension of settled dusts during rescue, recovery, excavation, and clean-up activities**; and from the combustion particles produced by the diesel trucks at Ground Zero.
> ...
> Probably the most important variable related to particle exposure is particle size. Particles larger than 10 μm are usually captured in the nose and throat before they get to the lungs. Particles between 2·5 μm and 10 μm will deposit in the lungs' upper airways, whereas **particles smaller than 2·5 μm will be breathed into the deepest (alveolar) regions of the lungs**. Our results showed that more than 95% of the dust particles' mass was larger than 10 μm in diameter, with more than 50% larger than 53 μm. ...
>
> As expected, the fraction of particles larger than 53 μm was much smaller for dust that infiltrated indoors than for outdoor dust samples. Thus, we identified more particles between 10 μm and 53 μm in the indoor samples than in the outdoor samples, but in both cases almost all the dust would be caught in the nose, throat, and upper airways, rather than reaching deep in the lungs. Thus, the natural defenses designed to protect the deep lung worked well against the World Trade Center dust, but resulted in the potential for high dust exposures to residents' noses and throats.
>
> One property of the dust that probably contributes to its irritancy is its caustic nature. The pH of most of the suspensions of the bulk World Trade Center settled dust was greater than 10, which is irritating to mucous membranes. **However, the dust's alkalinity decreased with decreasing particle size, with particles less than 2·5 μm at about neutral pH. The caustic, alkaline large particles and large fibreglass fibres that were caught in the eyes, nose, and throat were probably responsible for the chronic cough of the residents and workers near Ground Zero. Thus, although the caustic large dust particles caused temporary nose, throat, and upper airway symptoms, they were effectively caught by the body's defenses. Conversely, the fine dust that did reach the deep lung was lower in concentration and much less caustic.** Therefore, although the public had severe acute symptoms, the overall dust exposures probably did not have many cumulative health implications for the general population in lower Manhattan, as long as their indoor spaces had been properly cleaned.
> ...
> Our work is supported by NIEHS [*funded by EPA*] Center of Excellence (ES00260) and US EPA PM Health Research Center (R827351).

79 EPA (December 2002) Toxicological Effects of Fine Particulate Matter Derived from the Destruction of the World Trade Center. National Health and Environmental Effects Research Laboratory Office of Research and Development U.S. Environmental Protection Agency Research Triangle Park, North Carolina 27711. http://www.epa.gov/nheerl/wtc/WTC_report_7b3i.pdf

[*Note that the small particulates were tested for pH both before and after a step called "lyophilization." This is a pre-treatment test to keep the particles suspended as separated particles, in this case so as to be administered to the nasal cavities of test animals. The EPA study reported the pH both before and after this procedure, but only for the small particles. The larger particles were never subjected to any lyophilization procedure. Presumably, lyophilization would also neutralize the larger particles as well.*]

> The suspension of PM was thoroughly mixed, the pH was determined, and 10 ml was pipetted from each of the 7 samples into a single sterilized 150 ml Erlenmeyer flask on ice to make a pooled sample (WTCX). The pH of the pooled sample was also determined.
> ...
> The flask containing the pooled sample was covered with parafilm, and the pooled and individual site samples were frozen at -80 °C prior to lyophilization. Holes were poked in the parafilm of the pooled sample, while the caps on the 15 ml individual site sample tubes were loosened. Samples were lyophilized for 2 days at -55 °C and 140 mtorr (Virtis Company, Gardiner, NY). After lyophilization, samples were stored at 4 °C until resuspension in sterile saline on the day of use in oropharyngeal aspiration.
> ...
> E. Chemical analysis of liquid extracts of bulk and filter samples.
> 1. pH. The pH of samples isolated by aqueous extraction was determined immediately after the extraction

procedure with an audited calibrated Corning 440 pH meter (audited by Research Triangle Institute, Research Triangle Park, NC).

...

Table 2. Endotoxin and pH Levels of PM Samples after Water Extraction and Resuspension in Saline.

Sample Code a	pH in water	Endotoxin d EU/ml Inhibition	pH in Saline e
Water b	5.28		
WTC 8-100	10	0.5	none
WTC 11-100	9.16	0.25	none
WTC 13-100	9.47	0.5	none
WTC B-100	9.54	0.25	none
WTC C-100	9.32	0.5	none
WTC E-100	8.88	0.25	none
WTC F-100	9.55	0.5	none
NIST-100 c	4.2	25	none
Saline			6.67
WTCX-10			7.38
WTCX-31.6			7.38
WTCX-100	9.35		7.36
MSH-100			6.61
ROFA-100			3.74

…

A. Chemical analysis of solid samples and liquid extracts.

1. Endotoxin and pH levels. **The pH of water extracted WTC PM2.5 ranged from 8.88 in WTCE to 10.00 in WTC8 (Table 2). The alkaline pH is consistent with previous reports of WTC PM (USGS, 2002) and probably results from the building materials comprising much of the dust** (see below). **The pH of lyophilized WTC PM2.5 reconstituted in unbuffered saline was very close to neutral,** while MSH was very slightly acidic and ROFA was moderately acidic (average 3.74 at 2 mg/ml). It is not known why the pH of WTC PM2.5 should be close to neutral after reconstitution in saline; perhaps the salt neutralizes a basic component of the extract.

...

Very few studies have been published regarding the effects of alkaline aerosols on pulmonary function in asthma. One study reported that inhalation of high concentrations of an alkaline aerosol (pH 9.8 to 10.3) had no significant effect on irritant symptoms or specific airways resistance in mild asthmatic patients (Eschenbacher, 1991). However, this aerosol was composed of a simple mixture of sodium carbonate, sodium bicarbonate, and sodium hydroxide. The chemical composition of the alkaline (pH 8.88 to 10.00) WTC PM2.5 is much more complex and interactions of numerous chemical species may be associated with development of airway hyperresponsiveness to methacholine or other bronchoconstrictors.

80 Lung Chi Chen to Cate Jenkins (February 20, 2002) Email:

Lung Chi Chen <lcc4@nyu.edu>
02/20/02 09:30 AM
To: Cate Jenkins/DC/USEPA/US@EPA
cc: Thurston <thurston@env.med.nyu.edu>,
Mort Lippmann <Lippmann@env.med.nyu.edu>
Subject: Re: Questions on your pH measurements
- -

Dr. Jenkins:

I am not sure I can answer you questions. We first mechanically separated particles (sieving) with a cut off at 53 μm. We then aerodynamically separated the < 53 μm fraction to between 53 -10 μm, 10-2.5 μm, and < 2.5 μm. We took a small aliquot from each fraction and suspended in a small volume of distilled, deionized water and used a pH meter to measure their pH. **We found that the suspensions of the particles larger than 10 μm had a pH above 11 ...**

...

I hope this helps.

best. -- Lung Chi Chen, Ph. D.

New York University School of Medicine
57 Old Forge Road Tuxedo, New York 10987,
Voice: (845) 731-3560 Fax: (845) 351-5472 E-Mail:
chenL@env.med.nyu.edu

81 J. K. McGee, L. C. Chen, M. D. Cohen, G. R. Chee, C. M. Prophete, N. Haykal-Coates, S. J. Wasson, T. L. Conner, D. L. Costa, and S. H. Gavett (2003) Chemical Analysis of World Trade Center Fine Particulate Matter for Use in Toxicological Assessment. Environmental Health Perspectives, 11(7): 972
http://www.ehponline.org/members/2003/5930/5930.pdf

Fires at the WTC site continued for several months before finally being extinguished, and recovery and reconstruction efforts contributed to emissions of fine [particulate matter with a mass median aerodynamic diameter (MMAD) < 2.5 μm; PM2.5], coarse (> 2.5 and < 10 μm; PM2.5–10), and larger (> 10 μm) PM fractions.

...

In this study we collected samples of settled dust from several sites in the immediate vicinity (< 0.5 miles) of Ground Zero on 12 and 13 September 2001. ... Using a paper scoop, we sampled several outdoor locations as well as one indoor location, all of which appeared undisturbed since the collapse of the towers, as judged by the presence of a smooth uniform layer of dust and the absence of indicators of recent human activity. All samples were collected within a half-mile of Ground Zero and labeled with numbers (1–13) on 12 September 2001, and letters (A–F) on 13 September 2001. After examination of the available inventory of samples, we selected seven locations (8, 11, 13, B, C, E, and F) to assess toxicity of samples from different geographical locations as well as overall toxicity of a pooled sample from these locations (Figure 1). The locations were selected to represent a distribution surrounding Ground Zero, with more collection sites in the east reflecting the direction of the predominant winds during the collapse of the WTC towers and surrounding building

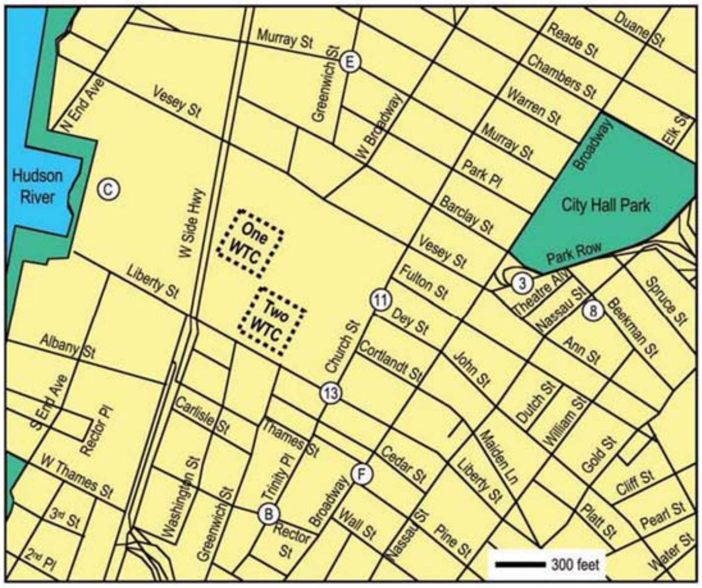


Figure 1. WTC dust samples were collected by New York University scientists from 13 sites on 12 September 2001 (numbers) and from 6 sites on 13 September 2001 (letters). Collection sites are shown only for samples reported in this article. Map reference: U.S. Census Bureau (2002).

...

The dust particles from the WTC site appear to be quite alkaline in nature ...

...

Analytical chemistry of aqueous extracts of samples. pH and endotoxin levels. **pH levels of water-extracted WTC PM2.5 and control samples are shown in Table 5. The pH of water-extracted WTC PM2.5 samples before lyophilization ranged from 8.88 in WTCE to 10.00 in WTC8. The alkaline pH results from the building materials comprising much of the dust**, most likely the alkaline earth (Ca, Mg) compounds. Calcium carbonate, identified by XRD, is a major component of cement (McKetta 1978) and other building materials. It is almost insoluble in water (14 µg/mL), yet a saturated solution produces a pH of 9.4 (Weast 1985). For a 2 mg PM/mL ratio, this requires < 7 µg soluble calcium carbonate/mg PM. Such a level is easily attainable in the WTC samples, given the percent ranges of Ca and carbonate carbon measured by elemental and OC/EC/CC analysis. The pH of lyophilized WTC PM2.5 reconstituted in unbuffered saline was very close to neutral (pH 7.36), whereas MSH was only slightly acidic (pH 6.61) and ROFA was moderately acidic (pH 3.74). **It is not known why the pH of WTC PM2.5 should be close to neutral after reconstitution in saline.**

...

Table 5. PM 2.5 [*endotoxin levels in table not shown*]

Sample code	pH in water	pH in saline [*after pre-neutralization by "lyophilizing"*]
Extraction water	5.28	
WTC8	10.00	
WTC11	9.16	
WTC13	9.47	
WTCB	9.54	
WTCC	9.32	
WTCE	8.88	
WTCF	9.55	
SRM 1649a	4.20	
Sterile saline		6.67
WTCX	9.35	7.36
MSH		6.61
ROFA		3.74

We conclude that water-soluble Ca containing compounds were enriched in the WTC PM2.5 fraction compared with those in the whole settled dust. Additionally, the WTC PM2.5 samples were remarkably homogeneous in their overall elemental content, considering the wide geographic range of sample collection. These results were unexpected, given the complexity of the building material composition and scale of the

> disaster. However, they are reasonable, considering the prevalent use of gypsum in building materials such as ceiling tiles, wallboard, and cement, and the ease with which these materials can be crumbled into a fine powder, mix, and homogenize.
>
> **The likely major acute inhalation hazards of WTC PM2.5 based on the results from this study are due to the presence of gypsum, calcite, and cement or concrete dust components.** Both gypsum and calcite irritate the mucus membranes of the eyes, nose, throat, and upper airways (Stellman 1998). Calcium carbonate dust causes coughing, sneezing, and nasal irritation (NLM 2002). These symptoms of inhalation exposure are similar to those reported by rescue and cleanup workers in the immediate aftermath of the WTC attack (Kelley 2001). **The high content of gypsum and calcite in the WTC PM2.5 fraction suggests that potentially toxic effects may also extend into the smaller airways and lung parenchyma.**
>
> ...
>
> WTC PM that infiltrated into buildings is most likely of smaller particle sizes and more of an inhalation hazard than that found outdoors.

[82] Stephen H. Gavett, Najwa Haykal-Coates, John K. McGee, Jerry W. Highfill, Allen D. Ledbetter, Lung Chi Chen*, Mitchell D. Cohen*, and Daniel L. Costa. (May 1 and 2, 2002) Toxicological Effects of Particulate Matter Derived from the Destruction of the World Trade Center on the Respiratory Tract of Mice. PROCEEDINGS EPA SCIENCE FORUM 2002: MEETING THE CHALLENGES. Authors from EPA/ORD/National Health and Environmental Effects Research Laboratory unless noted with asterisk. *New York University School of Medicine Department of Environmental Medicine
[*directory to all abstracts*]: http://epa.gov/scienceforum/2002/
[*direct URL to Gavett, et al. abstract*]: http://epa.gov/scienceforum/2002/air_abstracts/gavett.pdf

> New York University scientists collected several bulk dust samples around Ground Zero on September 12 and 13 and isolated the fine particulate matter fraction (<2.5 microns in diameter) on filters. Filters from seven of the collection sites were sent to EPA NHEERL. In the first health effects study, these filters were extracted and extensively analyzed by several analytical techniques.

[83] J. K. McGee, L. C. Chen, M. D. Cohen, G. R. Chee, *et al.* (2003) *op. cit.*

[84] Philip J. Landrigan, Paul J. Lioy, George Thurston, Gertrud Berkowitz, L.C. Chen, Steven N. Chillrud, Stephen H. Gavett, Panos G. Georgopoulos, Alison S. Geyh, Stephen Levin, Frederica Perera, Stephen M. Rappaport, Christopher Small, and the NIEHS World Trade Center Working Group (2004) Health and Environmental Consequences of the World Trade Center Disaster. Environ Health Perspect. 112:731–739.
http://ehp.niehs.nih.gov/members/2004/6702/6702.pdf

> Dust pH was highly alkaline (9.0-11.0). ...
>
> ...
>
> Settled dust. To evaluate the composition of material deposited in lower Manhattan immediately after destruction of the WTC, samples of settled dust were collected at sites in lower Manhattan (Lioy et al. 2002; McGee et al. 2003). ... Each sample of settled dust had a highly alkaline **pH (9.0–11.0)**.
>
> ...
>
> To assess the composition of settled dust by size, samples were mechanically sieved and then separated aerodynamically into three fractions (Lioy et al. 2002; McGee et al. 2003). More than 95% of the mass consisted of particles larger than 10 µm in diameter. The largest mass concentration consisted of particles of > 53 µm in diameter, and there were proportionately more particles in this large size range in outdoor than in indoor samples. Materials < 2.5 µm in aerodynamic diameter comprised 0.88-1.98% of total mass. **Alkalinity decreased with decreasing particle size, and particles <2.5µm had a more nearly neutral pH (Lioy *et al.* 2002; McGee *et al.* 2003). This finding is consistent with the dominant presence of highly alkaline, coarse cement particles in the large size fraction.**
>
> ...
>
> A property of the dust that appears to have contributed to its intense respiratory irritability was its high alkalinity (Lioy et al. 2002; McGee et al. 2003). **Larger particles composed principally of cement dust were especially alkaline (pH 9.0–11.0)**. These particles were of a size likely to be caught in the upper airways.
>
> [*Basis for claiming that small particles were non-alkaline came from the McGee 2003 which states the exact opposite.*]
>
> [*Extended information on funding, reviewers given below:*]
>
> This research was supported by grants from the National Institute of Environmental Health Sciences (NIEHS) through the Superfund Basic Research Program (P42 ES07384 to Mount Sinai School of Medicine and P42 ES05948 to UNC-Chapel Hill); through grants from the Centers for Environmental Health Science (P30 ES09089-04S at Columbia University; P30 ES00260 at New York University (NYU); P30 ES03819 at Johns Hopkins University; P30 ES05022 at The University of Medicine and Dentistry of New Jersey (UMDNJ); by the U.S. EPA through the Particulate Matter Health Research Center Program (R827351 at NYU) and a university partnership between the National Exposure Research Laboratory and the Environmental and Occupational Health Sciences Institute (CR-827033 at UMDNJ); and by grants from the September 11th Fund created by the New York Community Trust and United Way of New York City (NYTF CU517002 and SEPELES CU 517438 to Columbia University and MSSM 0266-0507 to Mount Sinai School of Medicine. **This manuscript was reviewed and approved for release by the National Health and Environmental Effects Research Laboratory, U.S. EPA.** Approval does not signify that the contents necessarily reflect the views and policies of the U.S. EPA, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. The authors declare they have no competing financial interests.

[85] J. K. McGee, L. C. Chen, M. D. Cohen, *et al.* (2003), *op. cit.*

[86] Landrigan *et al.* also cited Lioy *et al* 2002 study as the basis for their claim that the smallest particles were non-alkaline, but the Lioy *et al* 2002 study had no data on the smallest particles, only pH data for the whole aggregate sample, large and small particles combined.

[87] J. K. McGee, L. C. Chen, M. D. Cohen, *et al.* (2003), *op. cit.*

> **We conclude that water-soluble Ca containing compounds were enriched in the WTC PM2.5 fraction compared with those in the whole settled dust.** Additionally, the WTC PM2.5 samples were remarkably homogeneous in their overall elemental content, considering the wide geographic range of sample collection. These results were unexpected, given the complexity of the building material composition and scale of the disaster. However, they are reasonable, considering the prevalent use of gypsum in building materials such as ceiling tiles, wallboard, and cement, and the ease with which these materials can be crumbled into a fine powder, mix, and homogenize.
>
> **The likely major acute inhalation hazards of WTC PM2.5 based on the results from this study are due to the presence of gypsum, calcite, and cement or concrete dust components.** ...

[88] New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan
http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

> The XRD [*X-ray diffraction*] analysis for crystalline minerals in settled surface dust is semiquantitative (estimated values, indicated by “J”). However, **quartz [SiO_2], calcite [$CaCO_3$], portlandite [$Ca(OH)_2$] and gypsum [$CaSO_4$] appear to make up a higher percentage of dust in some buildings in lower Manhattan when compared to settled surface dust samples from buildings above 59th Street**. Quartz was detected up to an estimated 31%J versus up to 2%J found in the comparison areas above 59th Street.
>
> ...
>
> The comparison air samples, taken in areas above 59th Street, contained no quartz, cristobalite, tridymite, calcite, portlandite, mica, or halite above method detection limits ... All of the minerals found in the settled surface dust were seen in at least one air sample from lower Manhattan ... Similar observations [*in air samples in lower Manhattan*] can be seen in the results for **calcite [$CaCO_3$] and portlandite [$Ca(OH)_2$]**. Calcite and portlandite occur at a similar frequency to quartz (Table 11) and tend to be present in the same air samples (Appendix C.) **Both minerals are present in PM4, PM10, and PM100 size fractions. Calcite was estimated at 3 μg/m^{3}J–14 μg/m^{3}J and portlandite at 14 μg/m^{3}J–95 μg/m^{3}J in inhalable dust**.
>
> ...

[89] Paul J. Lioy, Clifford P. Weisel, James R. Millette, Steven Eisenreich, Daniel Vallero, John Offenberg, Brian Buckley, Barbara Turpin, Mianhua Zhong, Mitchell D. Cohen, Colette Prophete, Il Yang, Robert Stiles, Glen Chee, Willie Johnson, Robert Porcja, Shahnaz Alimokhtari, Robert C. Hale, Charles Weschler, and Lung Chi Chen (July 2002) [*received for publication January 15, 2002*] Characterization of the Dust/Smoke Aerosol that Settled East of the World Trade Center (WTC) in Lower Manhattan after the Collapse of the WTC 11 September 2001. Environmental Health Perspectives • VOLUME 110, NUMBER 7, 703.
http://ehpnet1.niehs.nih.gov/members/2002/110p703-714lioy/EHP110p703PDF.PDF

> pH analyses ... placed them in test tubes; aliquots of distilled, deionized water were added to make a concentration of approximately 30 mg/mL. The tubes were inverted several times and were then sonicated. The samples were left at room temperature for several days before centrifugation. The extract from each filter sample was removed to a new test tube before centrifugation. All samples were centrifuged and the supernatant was removed to new tubes and stored in the refrigerator. A 1-mL aliquot of extract was used for pH measurement.
>
> ...
>
> The pH of an aqueous suspension of each sample was > 7; **the Cortlandt Street sample had a pH of 11.5**. Both the Cherry and Market Street samples had a pH of ≈9 (Table 1). ...

Table 1. General characteristics of settled dust and smoke samples (percent by mass) from the first days after the collapse and fires of the WTC.

	Street		
Sample	Cortlandt	Cherry	Market
Color	Pinkish gray	Pinkish gray	Pinkish gray
pH	11.5	9.2	9.3

[90] New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan. http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

> [*p. 5*] Several of the minerals detected in the settled surface dust samples, such as **Portlandite**, can make the dust more alkaline, or raise the pH. Originally, the pH of all of the settled surface dust samples was to be determined. However, enough dust for this analysis was only available at two locations. **Both dust samples were alkaline (pH of 8.6 and 9.8)**. On the pH scale of 0 (acidic) to 14 (alkaline or basic), these values are **slightly alkaline**. Mineral analysis of these two settled surface dust samples estimate levels of **calcite (15%J, 19%J) and Portlandite (6%J, 3%J)** were present, respectively. These crystalline minerals along with other components of concrete would have contributed to the measured alkalinity. [*The "J" after the % indicates uncertainties in the laboratory data.*]
>
> ...
>
> [*p. 21*] **Calcite (calcium carbonate) and portlandite (calcium hydroxide) are also components of concrete.** They occurred with similar frequency in the dust samples and were often colocated with the quartz. **Calcite ranged from an estimated 0.8%J to 19%J in outdoor areas, and from 0.02%J to 21%J in indoor areas. Portlandite ranged from an estimated 0.07%J to 6%J in outdoor areas and from 0.04%J to 8%J in indoor areas.**
>
> ...
>
> [*p. 32*] **The potential health effects** of gypsum (hydrated calcium sulfate), **portlandite (calcium hydroxide), and calcite (calcium carbonate)** are similar as these minerals are similar chemically and physically. All three minerals are crystalline in form and soluble (11,12). Because these minerals are soluble in body fluid, they are easily cleared from the respiratory tract and lungs when inhaled (13,14,15). Therefore, **no long-term respiratory effects have been observed, even at the very high exposures** that occur during the mining and processing of these minerals (16,17).
>
> ...
>
> [*References cited by ATSDR/NYC*]
>
> 11. Merck Chemical Index. Merck Research Laboratories, Rahway, N.J., 1998

12. National Institute of Safety and Health. Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Washington, D.C., 2001
13. American Conference of Governmental Industrial Hygienists (ACGIH). TLV Documentation: Calcium Sulfate, 2001.
14. American Conference of Governmental Industrial Hygienists (ACGIH). TLV Documentation: Calcium Hydroxide, 2001.
15. American Conference of Governmental Industrial Hygienists (ACGIH). TLV Documentation: Calcium Carbonate, 2001.
16. Hunter D. The Disease of Occupations, 5th Ed. The English Universities Press, Ltd., London, 1975.
17. Beal AJ, Griffin OG, Nagelschmidt G. Safety in Mines Research Establishment (SMRT) Research Report No. 72, 1956.

New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan. http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

[91] It is of interest that USGS scientists failed to acknowledge this superior data set when they were proposing to "fingerprint" WTC dust distribution for the purposes of defining the EPA residential cleanup program boundaries. USGS insisted on using its own, statistically insignificant data set which would have prevented an expanded cleanup program.

[92] A saturated water solution of calcium hydroxide has a concentration of 0.185%. Solubilization at this saturation point of calcium hydroxide from WTC dust might be prevented by competing solubilities, matrix effects, etc.

0.185% solubility references: Wikipedia. Calcium Hydroxide. http://en.wikipedia.org/wiki/Calcium_hydroxide
Caveman Chemistry. Lime and Lye: Two Strong Alkalis. Lime and Lye: Two Strong Alkalis. http://cavemanchemistry.com/oldcave/projects/lime/
ACGIH (2001) Documentation for the TLVs®. Calcium hydroxide. www.acgih.org/store

[93] New York City Department of Health Office of Public Affairs (February 8, 2002) Press Release: NYC Department of Health Presents Findings from Indoor Air Sampling in Lower Manhattan. http://www.nyc.gov/html/doh/html/press_archive02/pr08-208.shtml

> As part of an ongoing effort to assess the environmental impact of the World Trade Center (WTC) disaster and to respond to public health concerns, the New York City Department of Health (DOH) in collaboration with the federal Agency for Toxic Substances and Disease Registry (ATSDR) conducted indoor and outdoor tests of thirty residential buildings in lower Manhattan.

[94] The Merck Index Online (2007) 14th Edition. http://www.merckbooks.com/mindex/cdrom.html

[95] NIOSH (2005) NIOSH Pocket Guide to Chemical Hazards. Department of Health and Human Services, CDC. DHHS (NIOSH) Publication No. 2005-149. http://www.cdc.gov/niosh/npg/pdfs/2005-149.pdf

[96] ACGIH (2001) Documentation for the TLVs®. www.acgih.org/store
Index all ACGIH Documentations for TLVs® and BEIs® with their associated Document Numbers: http://www.acgih.org/products/catalog/OnlineDocs.pdf

[97] ACGIH (2001) Calcium Hydroxide, Documentation for the TLV. www.acgih.org/store
Index for all ACGIH Documentations for TLVs® and BEIs® with their associated Document Numbers: http://www.acgih.org/products/catalog/OnlineDocs.pdf

> A TLV-TWA of 5 mg/m^3 is recommended for occupational exposure to calcium hydroxide this value is intended to minimize the potential for ocular, dermal, and respiratory tract irritation. ... soluble in cold water at 0°C to the extent of 185 mg/100 cc [*0.185%*]; in water at 100°C, 77 mg/100 cc [*0.077%*] ... **The pH of its aqueous solution is 12.4**. ... Calcium hydroxide is a relatively strong base and hence a moderately caustic irritant to all exposed surfaces of the body, including the eyes and respiratory tract. ... [A] **TLV – TWA of 5 mg/m^3** is recommended for calcium hydroxide. This value corresponds in total alkalinity to 5 mg/m^3 of **sodium hydroxide (NaOH), or 2.5 times the TLV** – TWA of the latter. It should be sufficiently low to protect against undue irritation (see the current TLV Doc for sodium hydroxide).

[98] NIOSH (August 16, 1996) Calcium oxide, IDLH Documentation. http://www.cdc.gov/NIOSH/IDLH/1305788.html

> Calcium Oxide ... NIOSH REL [Recommended Exposure Limit]: 2 mg/m^3 TWA
> Current OSHA PEL [Permissible Exposure Limit]: 5 mg/m^3 TWA
> 1989 OSHA PEL: Same as current PEL
> 1993-1994 ACGIH TLV [Threshold Limit Value]: 2 mg/m^3 TWA
>
> Because Patty [1963] reported that inhalation of the dust can cause chemical pneumonia and severe respiratory tract irritation, respirators have been selected on the basis of the assigned protection factor afforded by each device up to 50 × the OSHA PEL of 5 mg/m^3 ... **The revised IDLH for calcium oxide is 25 mg/m^3 based on acute inhalation toxicity data in humans (ACGIH 1991)**.

[99] The participation of Dr. Jessica Leighton, Ph.D., MPH, Associate Commissioner, Division of Environmental Health, NYC DOHMH as the lead author of the ATSDR/NYC study may explain many of these problems with the use of antiquated references to support a claim of no hazard. On November 1, 2001, she testified that health standards for WTC dust exposures were overly protective. She also had responsibility for the NYC fact sheet that advised residents and occupants of commercial buildings to perform do-it-yourself cleanups, explicitly stating that even ordinary dust masks were unnecessary, much less HEPA respirators. On February 8, 2002, she is quoted in the New York Times as doing one of these paper-towel do-it-yourself cleanups of her own apartment. Then, at a February 27, 2006 City Council hearing, she appears to have changed, saying that she no longer knows whether there is a continuing health hazard (the fact

that there was being implicit). It would be important to ascertain whether she had a subsequent professional cleaning of her apartment after advising New Yorkers that do-it-yourself jobs were safe and effective, and after doing one herself.

Jessica Leighton, Ph.D. (November 1, 2001) Before the NYC Committee on Environmental Protection, 11/1/01
[*Direct link to 11/1/01 testimony not available. The link below is to the web.archive.org version.*]
http://web.archive.org/web/20020210002057/http://nyc.gov/html/doh/html/public/testi/era1101.html

> The standards or tolerance levels that are being used are very conservative. For example, for asbestos, we are using the standard that is used for indoor air quality for reentry into a school after asbestos removal, which is the most stringent standard, as the tolerance level or standard for outdoor air quality in the residential areas. This is also true for other substances, such as dioxins, identified at the perimeter of the site. . . . Moreover, **these standards have been designed to include many safety factors so that acceptable levels of exposure are far below the levels at which health effects are expected to occur.**

NYC DOH (September 2001) Recommendations for People Re-Occupying Commercial Buildings and Residents Re-Entering Their Homes
[*Direct link to 11/1/01 testimony not available. The link below is to the web.archive.org version.*]
http://web.archive.org/web/20011111024046/http://www.ci.nyc.ny.us/html/doh/html/alerts/wtc3.html

Kirk Johnson (February 8, 2002) With Uncertainty Filling the Air, 9/11 Health Risks Are Debated. NY Times. www.nytimes.com
http://www.911ea.org/News_Stories_From_February_2002.htm

> Beth Kaltman, 22, a model, **cleaned her own apartment using paper towels. So did Dr. Jessica Leighton, an assistant commissioner of risk and environmental communication at the New York City Department of Health**. ...

David Seifm (February 28, 2006) WTC Dust May Still Be a Risk. NY Post. www.nypost.com
http://www.911ea.org/News_Stories_From_February_2006.htm

> A top city health official couldn't offer assurances yesterday that dust remaining from the World Trade Center attack isn't a threat to residents of lower Manhattan. Asked at a City Council hearing, "Is the threat over?" Dr. Jessica Leighton, a deputy commissioner for environmental health at the city's Health Department, responded, "The issue with exposures — the more you have, the more you're affected. "Is there still dust around? I can't say for sure. Is that dust going to be breathed by people? I can't say for sure."

[100] [*Reference number 16 in the ATSDR/NYC report*] Hunter D. The Diseases of Occupations, 5th Ed. The English Universities Press, Ltd., London, 1975.

[101] A Chronology of State Medicine, Public Health, Welfare and Related Services in Britain 1066-1999
http://www.fph.org.uk/policy_communication/downloads/publications/A_Chronology_of_State_Medicine.pdf

[102] Hunter's 9th Edition was greeted by the Journal of the American Medical Association (JAMA) in glowing terms (*JAMA* 2000; 2 84:1985-1986). The CDC has one of the largest health libraries in the world. Furthermore, the ATSDR/NYC study lists 63 authors and contributors (see page 51), proving ample staffing for a competent review of the relevant scientific literature. They would have had ready access to the latest edition of Hunter's.

Hunter's Diseases of Occupations, Ninth Edition (2000) Edited by Peter J. Baxter, *et al.* Oxford University Press
http://www.oup.com/us/
http://www.oup.com/us/catalog/general/subject/Medicine/OccupationalHealth/?view=usa&ci=9780340677506

[103] Naturally occurring portlandite is only associated with high temperature conditions, such as associated with volcanic activity, and has only been found in a few isolated locations in the world, since exposure to carbon dioxide in the atmosphere under normal conditions would convert it to $CaCO_3$.

Hendrik G. van Oss (2005) USGS. Background Facts and Issues Concerning Cement and Cement Data. USGS Open-File Report 2005-1152.
http://pubs.usgs.gov/of/2005/1152/2005-1152.pdf

> In lime mortars, the actual lime species present is **hydrated or slaked lime (or portlandite) and is formed simply by the hydration reaction $CaO + H_2O \rightarrow Ca(OH)_2$.** ... Hydrated lime - The compound $Ca(OH)_2$; also called slaked lime. In solid form, sometimes called portlandite. ... **Portlandite** - A mineral composed of hydrated lime **Ca(OH)2**

Web Mineral. Portlandite. http://rruff.geo.arizona.edu/doclib/hom/portlandite.pdf

Mineralogy Database. Portlandite. http://webmineral.com/data/Portlandite.shtml

[104] Hunter D. (1975) The Diseases of Occupations, 5th Ed. The English Universities Press, Ltd., London, 1975. p. 270.

[105] Andy Menke, Paul Muntner, Vecihi Batuman, *et al.* (2006) Blood Lead Below 0.48 µmol/L (10 µg/dL) and Mortality Among US Adults. Circulation, 114;1388-1394. http://circ.ahajournals.org/
http://circ.ahajournals.org/cgi/content/full/114/13/1388

[106] Hunter D. (1975) The Diseases of Occupations, 5th Ed., *op. cit.*, p. 487

[107] Hunter D. (1975) The Diseases of Occupations, 5th Ed., *op. cit.*, p. 483

[108] 17. Beal AJ, Griffin OG, Nagelschmidt G. Safety in Mines Research Establishment (SMRE) Research Report No. 72, 1956.

[109] EPA SW 846-On Line. Method 9045D SOIL AND WASTE pH (Revision 4, November 2004). http://www.epa.gov/epaoswer/hazwaste/test/main.htm http://www.epa.gov/epaoswer/hazwaste/test/pdfs/9045d.pdf

> 3.0 INTERFERENCES
> 3.1 Samples with very low or very high pH may give incorrect readings on the meter. **For samples with a true pH of >10, the measured pH may be incorrectly low.**
> ...
> 7.2 Sample preparation and pH measurement of soils:
> 7.2.1 To 20 g of soil in a 50-mL beaker, add 20 mL of reagent water, cover, and continuously stir the suspension for 5 min. Additional dilutions are allowed if working with hygroscopic soils and salts or other problematic matrices.
> 7.2.2 Let the soil suspension stand for about 1 hr to allow most of the suspended clay to settle out from the suspension or filter or centrifuge off the aqueous phase for pH measurement.

[110] New York City Department of Health (February 26, 2002) Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near World Trade Center - Sampling Protocol. http://www.epa.gov/wtc/panel/ATSDRIndoorProtocol.pdf

> [*ATSDR/NYC protocol for pH testing*}
> This protocol was used by the New York City Department of Health in collaboration with the U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service Commissioned Corps, and the federal World Trade Center Environmental Assessment Working Group to conduct a limited investigation (November 4 - December 11, 2001) of residential areas near and around the World Trade Center.
> ...
> The pH of the dust will be tested using EPA SW846 Method 9045C. ...
> pH I/O [*inside/outside*] dust EPA SW 846 [*Method*] 9045C (soils) 10-25 g [*grams*]

[111] New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan. http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

> [*p. 22*] Alkalinity of Settled Surface Dust
> Several of the minerals detected in the settled surface dust samples, such as Portlandite, can make the dust more alkaline, or raise the pH. **Originally, the pH of all of the settled surface dust samples was to be determined. However, enough dust for this analysis was only available at two locations.** Both dust samples were alkaline (**pH of 8.6 and 9.8**). On the pH scale of 0 (acidic) to 14 (alkaline or basic), these values are slightly alkaline. Mineral analysis of these two settled surface dust samples estimate levels of calcite (15%J, 19%J) and **Portlandite (6%J, 3%J)** were present, respectively. These crystalline minerals along with other components of concrete would have contributed to the measured alkalinity. [*The "J" after the % means that although the concentration was based on laboratory data, there were uncertainties.*]

[112] The McGee *et al.* 2003 study (op. cit.) required much less than 50 milligrams for a single pH test. This can be deduced from the fact that only 50 mg total sample in the PM2.5 size range was available not only for conducting pH tests, but also for a range of other tests and procedures, including an inhalation study in mice:

J. K. McGee, L. C. Chen, M. D. Cohen, G. R. Chee, C. M. Prophete, N. Haykal-Coates, S. J. Wasson, T. L. Conner, D. L. Costa, and S. H. Gavett (2003) Chemical Analysis of World Trade Center Fine Particulate Matter for Use in Toxicological Assessment. Environmental Health Perspectives, 11(7): 972 http://www.ehponline.org/members/2003/5930/5930.pdf

> The PM2.5 fraction, however, was present in sufficient amounts (2.29–4.06% of PM53 fraction) to study for potential respiratory health effects. ... A total quantity of about 50 mg from each site, collected on 1–3 filters per site, was used in the study (Table 1).

The USGS study a maximum of 2.5 grams WTC dust.

USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

> For this leach test, deionized (DI) water (pH ~5.5) is used as the extractant. Dust samples were leached at a 1:20 ratio (2.5 grams dust / 50 milliliters DI water).

[113] The ATSDR/NYC reported pH test results of 8.6 for a sample containing an estimated 6% $Ca(OH)_2$, and a pH of 9.8 for a sample containing an estimated 3% $Ca(OH)_2$. The table below gives the pH levels reported by ATSDR/NYC and the concentrations determined by X-ray diffraction of several substances.

Building Number	pH	Settled Surface Dust, Outdoors	Quartz SiO_2	Cristobalite	Tridymite	Calcite ($CaCO_3$)	Portlandite $Ca(OH)_2$	Gypsum $CaSO_4$	Mica	Halite NaCl
1	8.6	(%)	27 J	ND	ND	15 J	6 J	14 J	ND	ND
2	9.8	(%)	21 J	ND	ND	19 J	3 J	27 J	ND	<0.03 J

This is not credible for two reasons. First, it is unlikely that a sample containing 2 times the concentration of $Ca(OH)_2$ would have a lower pH, unless there were other substances contributing to the alkalinity that were not measured, such as sodium or potassium hydroxide (Na_2OH, K_2OH), or sodium or potassium carbonate (Na_2CO_3, K_2CO_3).

Second, it is unlikely that any sample containing more than 0.185% (the solubility of $Ca(OH)_2$ in water) would give such low pH levels. A saturated solution of 0.185% $Ca(OH)_2$ results in a pH of around 12.5. It is probable that ATSDR/NYC allowed atmospheric carbonization reactions to convert $Ca(OH)_2$ to $CaCO_3$ before pH testing, by soaking samples in water for extended periods of time. This clever "trick" was known for a fact to have been used by the research team headed by Rutgers University described earlier in this complaint, and probably was used by other EPA funded WTC researchers. There is nothing in the testing protocols for the ATSDR/NYC study protocols to rule out this deliberate pre-neutralization prior to pH testing.

[114] The DELTA Group, for the Detection and Evaluation of the Long-Range Transport of Aerosols. University of California at Davis.
http://delta.ucdavis.edu/index.htm

[115] Esquire Magazine (March 20, 2007)
[*Article in 3 separate parts at the following web addresses*]
http://www.esquire.com/features/Know9_11
http://www.esquire.com/print-this/9_11bag
http://www.esquire.com/features/breakdown0407

Tyler Cabot (March 20, 2007) Now We Know. No one stood in the middle of that violent plume capturing dust in a test tube. But one man saved his messenger bag. Esquire Magazine. http://www.esquire.com/features/Know9_11

> Cahill believes the new sample is unique because it offers the first and, so far, only picture of the finest dust particles in the air at the time of the towers' collapse. Dust that size--about one one-hundredth the diameter of pollen--is the most likely to get lodged in the lungs and cause long-term health problems. It's also the hardest dust to catch and properly analyze. Unless those particles are captured while airborne--as they were by the bag worn by Eric Gillin, now editor of Esquire.com--they tend to fly away or get scattered on the ground.
> ...
> Cahill found that the dust preserved on the shirt and bag was significantly less toxic than samples he had previously tested, which were collected in the weeks following 9/11. Both sets of samples contained large amounts of gypsum and cement. (Gypsum is an innocuous mineral that dissolves in lung fluid and is often used as a food additive because of its high calcium content.) After testing both the particle size and properties of the Esquire dust using a Slotted 8 DRUM Impactor and UC Berkeley's synchrotron, Cahill concluded that in addition to the gypsum from drywall in the collapsed buildings, about one third of the sample consisted of alumino-silicates, natural minerals found in the earth's crust, and finely ground cement, which, while caustic--and the cause for the so-called World Trade Center cough--usually doesn't cause long-term health problems.

The Bag. The messenger bag contains previously unknown information about the dust cloud that enveloped lower Manhattan on September 11, 2001. The information will affect the lives of thousands of people, starting with the life of the man who was wearing it. Esquire Magazine.
http://www.esquire.com/print-this/9_11bag

> So what did I breathe? Construction materials, for the most part: cement dust from the square-acre floors of the tower; aggregate materials, which basically means particulates of rock and gravel; and drywall, which is made of a calcium-based substance called gypsum. The coarsest particles, the ones I presumably spit up in the bank lobby, consisted of all three materials, but the finest particles--the ones that invade your deep lung, never to leave--were also mostly gypsum. And gypsum is safe for human consumption. Matter of fact, it's used to enrich bread with calcium, can be found in toothpaste and blackboard chalk, and helps coagulate tofu. Tofu, for chrissakes.
>
> "That doesn't mean there's not some harm there, but it's a different kind of harm," Cahill says. "Your lung got loaded up with stuff and your mouth and throat got irritated for a short period of time. But that's better than bearing the enormous body burden of very fine metals working from your bloodstream to your heart."
>
> Evidently, these very fine metals didn't enter the air above lower Manhattan en masse until weeks later, when all those smashed computer parts, electrical cords, ceiling tiles, and ballpoint pens began to smolder at extremely high temperatures deep below the street. When the South Tower came down, the massive concrete floors fell like a giant stack of pancakes, slamming into one another and driving the contents of the building straight down, but the air in the building blew out the sides, like a balloon popping when a fat man sits on it. The wind that the building exhaled was hurricane force, instantly aerating the drywall and the glass and some of the concrete, which coated me a few seconds later. "It's no different from when you blow up an old thirty story hotel," says Cahill. "That's the same kind of dust cloud. Heck, the older buildings are probably worse because they have more asbestos."

The Bag. A Breakdown. [*Graphics and dust analysis*] Esquire Magazine. http://www.esquire.com/features/breakdown0407

> Initial Dust Cloud, 9/11/01
>
> Coarse particles (12 to 2.5 microns), 85 percent of sample – Cahill hypothesizes that the large proportion of gypsum here (and in the smaller particles below) is due to the way the towers collapsed: As the concrete floors fell, the five million square feet of gypsum drywall were pulverized and pushed outward.
>
> > 65% gypsum

22% cement

12.5% aggregate (sand and gravel particles)

0.5% other

Very fine aerosols (0.26 to 0.09 microns), 0.02% – Particles this size are the most dangerous because they can get trapped deep in the lungs and enter the bloodstream. These dangerous particles made up only a tiny percentage of the total sample, reducing their health threat.

63% Gypsum Drywall is made almost entirely of gypsum, a fire retardant with no know health threats. Because it is high in calcium, it is a common food additive.

21% Cement Because of its high pH, cement causes skin and nasal irritation. But most cases of WTC cough were reportedly caused by larger particles -- 10 microns or higher.

15% Aggregate Sand and gravel that were mixed to form the World Trade Center's concrete.

2% Other Slight traces of magnesium, phosphorus, chlorine, bromine, zinc, and lead were found, but probably not enough to cause lasting health problems.

[116] The Esquire article only provided portland cement data for the coarse (12 – 2.5 µm) and very fine (0.26 – 0.09 µm) particle size ranges. Further information has been requested of Dr. Cahill regarding the intermediate fine particle (2.5 to 0.26 µm) size range. At this time, it is assumed that the portland cement concentration for the intermediate fine particle size range is similar to the extremes of the size ranges, which are 22 and 21 %, respectively. Even a concentration of 1% portland cement in the fine particle range would be highly significant in terms of human health impacts.

[117] Email interchange, Tom Cahill and Cate Jenkins regarding Esquire article accuracy quoting Dr. Cahill

Cate Jenkins/DC/USEPA/US
03/23/2007 07:29 AM
To: Tom Cahill
Subject: Tom, am giving you an opportunity to disown statements attributed to you in Esquire
\- -
Tom,

I would like to give you the opportunity to specifically confirm or deny numerous statements attributed to you in the March 20, 2007 Esquire article (attached) which may be found at: http://www.esquire.com/print-this/Know9_11

In particular the following is troubling:

> "Cahill found that the dust preserved on the shirt and bag was significantly less toxic than samples he had previously tested, which were collected in the weeks following 9/11. Both sets of samples contained large amounts of gypsum and cement. (Gypsum is an innocuous mineral that dissolves in lung fluid and is often used as a food additive because of its high calcium content.) After testing both the particle size and properties of the Esquire dust using a Slotted 8 DRUM Impactor and UC Berkeley's synchrotron, Cahill concluded that in addition to the gypsum from drywall in the collapsed buildings, about one third of the sample consisted of alumino-silicates, natural minerals found in the earth's crust, and finely ground cement, which, while caustic--and the cause for the so-called World Trade Center cough--usually doesn't cause long-term health problems."

As you recall, I also gave you the opportunity to retract statements in quotation marks from you in an American Lung Association press release claiming that ordinary do-it-yourself cleanups by citizens were adequate, based solely on your measurements of vanadium and other fingerprint metals before and after. You did not.

Thank you for your attention in this matter. Without a response to the contrary, I will quote your statements.

Cate Jenkins, Ph.D.

Thomas A Cahill <tacahill@ucdavis.edu>
03/23/2007 03:44 PM
To Cate Jenkins/DC/USEPA/US@EPA
cc Sylvia Wright <swright@ucdavis.edu>
Subject Re: Tom, am giving you an opportunity to disown statements attributed to you in Esquire
\- -
Cate –

Sorry that the article bothered you, but I made every effort to make the relatively harmless initial collapse dust contrast the miserable "brutal" materials of the smolder phase, with its disastrous and continuing health impacts. These will inevitably include ischemic heart disease deaths in a few years.

First, the dust was only from the first 5 minutes of the South Tower collapse, as the dust front was present on Liberty Street. Not all the dust present, especially the very finest particles, would have been collected on the shirt.

Second, the analyses of those samples were in fact very comforting to me. If you put a drop of water on the material from the shirt (the least modified material) much of the dust promptly dissolved, a characteristic of gypsum. When decanted and allowed to dry, the clear liquid returned to a white solid. It was mostly gypsum, and only very small amounts of the other materials were very fine and capable of deep lung deposition, although of course there were very fine particles that would not have been collected by the shirt. There were also microscraps of what appeared to be paper.

Third, I insisted, and in fact prepared the graphics, that compared the relatively innocuous initial 5 minutes to the now accepted lethality of the fuming smolder phase.

I made every effort to make that very clear in the article, over which I had only limited control. I did not see the article before it was published, but thought they had done a good job. I believe that the benefit of reminding people how bad was the WTC health impacts, and how badly were they handled by out institutions, was worth any uncertainties incurred in a nonscientific publication.

I am preparing a new publication on the analyses we have just finished, Oct. 30 - Dec. 1, and new analyses of the organic species in the ultra fine organics.

Tom

Cate Jenkins/DC/USEPA/US
03/23/2007 04:22 PM
To Thomas A Cahill <tacahill@ucdavis.edu>
cc Sylvia Wright <swright@ucdavis.edu>
Subject Re: Tom, am giving you an opportunity to disown statements attributed to you in Esquire
\- -

Tom, thank you for your prompt response. I am not going to prompt you with any additional specifics about the troubling statements in the Esquire article any more than I have, drawing your attention to the particular paragraph for which I had concerns. However, there are additional questions raised by your email. You said that the smallest particles would not have collected on the shirt.

Did you test the size range at this late date, and how would the size range have changed over the extended time period from the original generation of the dust?

In addition, was solution in water your only test to determine the identity of gypsum, by which I assume you mean calcium sulfate? Did you only test the solubility range by looking at an inexact "drop" of water on a shirt? Did you attempt to test the actual solubility range by weighing the dust and adding a known amount of water? If you only tested what you thought was solubility by wetting the shirt with water, then not observing a white powder while in contact with water, how can you say that you were observing genuine dissolution and not just a result of decreasing the relative optical refraction?

Thank you,

Cate

Cate Jenkins/DC/USEPA/US
03/27/2007 08:00 AM
To Thomas A Cahill <tacahill@ucdavis.edu>
cc Sylvia Wright <swright@ucdavis.edu>
Subject Tom, am asking you again for documentation for your reassurances regarding gypsum.
\- -

Tom,

You have not responded to my earlier email of 3/27/07 where I asked you for additional information on the testing of the solubility of gypsum (calcium sulfate) from the shirt in the Esquire editors bag, contaminated by WTC dust on 9/11/01.

You very publicly told the world that you identified gypsum, a harmless substance used in food products, soluble in the lungs. You described at least some of your solubility determination in your email to me. I asked you further information on your solubility determination, and you have yet to respond. Since you were giving the public assurances about the safety of exposures, I will need to quote you on the information that you have already supplied by way of the Esquire article and your earlier email to me, unless you would also respond to my earlier questions asking additional information on your solubility tests.

Thank you very much if you could respond to my earlier questions.

Cate

Thomas A Cahill <tacahill@ucdavis.edu>
04/01/2007 06:06 PM
To Cate Jenkins/DC/USEPA/US@EPA
Subject Re: Tom, am asking you again for documentation for your reassurances regarding gypsum.
\- -

Cate

I just got back from a week in Australia.

Soon.

Tom

From: jenkins.cate@epamail.epa.gov [mailto:jenkins.cate@epamail.epa.gov]
Sent: Thursday, April 05, 2007 3:45 AM
To: Thomas A Cahill
Subject: Tom, your delay looks like you had to go back to lab for more work

> \- -
> Tom,
>
> Unfortunately, your delaying getting back to me is looking like you had to go back to the laboratory to do more work to substantiate your earlier statements to Esquire and me. I really did not ask for any detailed information or actual lab sheets or anything.
>
> I also need the information in the next few days from you in order to include it. Otherwise I will have to go on what I already have from you.
>
> Thanks,
> Cate
>
> ---
>
> TACahill <tacahill@ucdavis.edu>
> 04/05/2007 01:54 PM
> To Cate Jenkins/DC/USEPA/US@EPA
> Subject RE: Tom, your delay looks like you had to go back to lab for more work
> \- -
> No, the delay is that I was in Australia and have a bad cold.
>
> Soon
>
> Tom
>
> ---
>
> Thomas A Cahill <tacahill@ucdavis.edu>
> 04/07/2007 10:33 AM
> To Cate Jenkins/DC/USEPA/US@EPA
> cc Sylvia Wright <swright@ucdavis.edu>
> Subject Esquire article
> \- -
> Cate -
> Here is a short summary. More will follow as we prepare this for a journal article.
>
> I have to be very careful to put everything I can in the refereed literature, as I am the sole source of a lot of important data. If I were to become an all-out advocate, my science would get dismissed as biased. Thus, I think the article helps because –
>
> 1. It shows I can deliver good news when such is available, arguing against a personal bias,
>
> 2. A lot of people will read the article, and its posting on Google and elsewhere, keeping the sad plight of WTC workers in their minds,
>
> 3. It allowed me again to say how bad the smolder phase was.
>
> As for the accuracy of my analyses, relax. I was responsible for more trace and gross elemental data than all other scientists in the world, combined, until I retired as had of IMPROVE aerosols in 1997. Our quality assurance protocols were the best in the world, and today my capabilities are even better.
>
> Tom

[118] The United Nations Environmental Programme, the Organization for Economic Cooperation and Development, as well EPA's OPPTS have long established a pH of 11.5 as the presumptive trigger level for alkaline tissue corrosivity (skin and eye), as discussed earlier in the section on USGS's failure to acknowledge this standard, as well as more extensive discussions on the history of the development of this standard.

[119] NIOSH (2005) NIOSH Pocket Guide to Chemical Hazards. Department of Health and Human Services, CDC. DHHS (NIOSH) Publication No. 2005-149. http://www.cdc.gov/niosh/npg/pdfs/2005-149.pdf

ACGIH (2001) Documentation for the TLVs®. www.acgih.org/store
Index all ACGIH Documentations for TLVs® and BEIs® with their associated Document Numbers: http://www.acgih.org/products/catalog/OnlineDocs.pdf

[120] Just looking at water and seeing that it appears somewhat clear when you add a solid does not necessarily mean that the solid material actually dissolved in the water. A mixture of a solid and water, where the solid is still solid, can appear to be very clear. There needs to be a significant difference in the refractive index of the solid and the refractive index of the water in order to see a cloudy suspension instead of a clear or translucent suspension.

This is a well studied phenomena in paint chemistry. To make a white paint, there needs to be a white pigment with a much higher refractive index than the binder (whether the binder is traditional linseed oil, acrylic latex resin, polyurethane, etc.) The particle size of the pigment also adds to whether or not it will make the paint binder-pigment system more opaque. From one of my old paint technology texts, the following explanation is given:

Preuss, H. P. (1974) Pigments in Paint. Noyes Data Corporation, Park Ridge, NJ.

> The hiding power of a pigment is a function of the difference in refractive index of the pigment and the binder as well as the particle size of the pigment. since oils and resins have refractive indexes between 1.48 and 1.55 it follows that rutile titanium dioxide with refractive index of 2.76 has higher hiding power than any of the others in Table 1.
> ...

Table 1. Average Refractive Indices of Some Common Materials

Air	1.00
Water	1.33
Linseed oil	1.48
Silica [*as in silicon dioxide, which is sand, used as a "filler pigment" because it does not have good hiding power, or opacity in paint systems. It just adds bulk without whitening power.*]	1.55
Calcium carbonate [*calcite, or limestone. Found in WTC dust. Also considered as a "filler pigment" because it does not have good hiding power.*]	1.57
Calcium sulfate [*gypsum. Also considered as a "filler pigment" because it does not have good hiding power.*]	1.59
...	
Zinc oxide [*considered a good white pigment*]	2.02
...	
Titanium dioxide (rutile) [*very good opaque white pigment, because of the higher refractive index compared to paint binders or water*]	2.76

...

Imagine very small particles of silica (silicon dioxide, common sand) ground extremely fine to the same size as the WTC particles studies by Dr. Cahill. If water was added to them, the resulting suspension would also appear to be clear. Silica has essentially the same refractive index as glass, and very finely ground glass also would not dissolve in water, but would result in a suspension that appeared clear. Note that the refractive index of calcium sulfate (gypsum) is approximately the same as silica. Calcium sulfate (gypsum) is not useful in paints as a white pigment for any hiding power. It is considered to be a "filler pigment" (Colour Index Name: Pigment White 25). Note that calcium carbonate, also found in WTC dust, has a similar refractive index and also would result in a visually transparent/translucent solution in water if the particle size range was small enough.

Determining whether a solid has in fact dissolved is not a simple matter of holding up a test tube to the light and looking at it, as Dr. Cahill apparently did. Sophisticated instruments are required, such as laser diffraction. As stated in the text, Dr. Cahill has yet to provide any scientific basis for his claim that the WTC dust he examined actually dissolved.

See similar discussions of the properties of particles that make a liquid appear opaque (in the context of a pigment making a paint system have hiding power) at:
http://www.specialchem4coatings.com/tc/color-handbook/index.aspx?id=opacity

http://www.handprint.com/HP/WCL/pigmt3.html

http://www.millenniumchem.com/Products+and+Services/Products+by+Type/Titanium+Dioxide+-+Paint+and+Coatings/r_TiO2+Fundamentals/Opacity+and+Tinting+Strength_EN.htm

121 Lerman Y, Schwarz Y, Kaufman G, Ganor E, Fireman E. (2003) Case series: use of induced sputum in the evaluation of occupational lung diseases. Arch Environ Health. 58(5):284-9.

> The authors recently reported that analysis of induced sputum may reveal the status of hazardous dust exposure (e.g., silica, hard metals) as effectively as does bronchoalveolar lavage. In the current study, the authors describe how induced sputum can assist in the evaluation and diagnosis of suspected occupational lung diseases. The 3 patients who underwent induced sputum testing included ... a teacher who suffered from undefined interstitial fibrosis and in whom induced sputum analysis revealed the presence of a high burden of calcium sulfate and silica.
> ...
> A 46-yr-old female nonsmoker was referred to our clinic. She had progressive cough and dyspnea on exertion. Five years earlier, she had undergone a clinical evaluation that included computerized tomography (CT) of the chest and a lung biopsy. The chest CT had shown diffuse interstitial fibrosis, peripheral emphysematous bullae, and signs of pulmonary hypertension (i.e., dilation of the pulmonary arteries). The lung biopsy had shown nonspecific interstitial pneumonia, with some areas of unusual interstitial pneumonia in the 1st stages.. The patient was treated with corticosteroids, which provided brief relief from her symptoms. The exacerbation of dyspnea lead her to again seek medical care. On this occasion, she also exhibited hypoxemia with minimal exertion, and she was referred to our clinic. Her medical history was unremarkable for serious illness or lung disease.
>
> The patient's occupational history revealed that she had been employed full time as a teacher for 24 yr, and she had used various blackboard chalks daily. There were no other exposures to potentially hazardous materials.
>
> Pulmonary function tests revealed combined restrictive and obstructive patterns. Saturation at rest was 87%, and it decreased to 80% after 10 steps were climbed. This patient has since undergone lung transplantation; the histology of the resected tissue was compatible with unusual interstitial pneumonia.
>
> A polarizing light microscopic study of induced sputum cells showed the presence of polarizing particles. Chemical analysis by SEM-EDS and petrographic microscopy was performed, and the most abundant particles present (1 – 8 μm) were calcium sulfate ($CaSO_4$), silica (SiO_2), and silicates (SiCaFe and AlSi) (Fig. 1). A similar analysis, performed on the lung tissue resected during her transplantation, revealed a similar composition.

122 Although the following study dates from 1955, it was found to have current validity and utilized as a basis for the stringent 2006 updated ACGIH workplace standard for gypsum:

Schepers G.W., Durkan T.M., Delahant A.B. (1955) The biological effects of calcined gypsum dust; an experimental study on animal lungs. AMA Arch Ind Health. 1955 Sep;12(3):329-47.

> The calcined gypsum used in the experiments was the standard product of plaster mills ... guinea pigs were exposed to dust under various environmental conditions, as follows:
> Calcined gypsum dust for 21 months.
> Calcined gypsum dust for 24 months and then normal air for 22 months.

...
Calcined gypsum dust for 6 months, then infection with R_1 tubercle bacilli, and then calcined gypsum dust for 18 months more.
Calcined gypsum dust for 25 months, then infection with R_1 tubercle bacilli, and then normal air for 12 months.

For the entire exposure period the average dust concentration was 448,000,000 particles per cubic foot of air. The guinea pigs were exposed to the dust for periods up to 24 months, animals being sampled at various intervals, At the end of 24 months the surviving animals were removed from dust and transferred to a normal atmosphere to constitute the second part of this experiment. Some of this group lived as long as 22 months after the termination of the dust exposure, and samples were taken at 3-month intervals during this period.

Twelve of the twenty-one guinea pigs died of pneumonia or other pulmonary lesions. This mortality trend was widely dispersed over the whole experimental period. Deaths were slightly commoner in the earlier months but perhaps not significantly so. It would see111 that the death rate of 28.5% per annum was slightly high. ... The fact, however, that all deaths in the experiment with calcined gypsum were from respiratory causes may be meaningful. ... In isolated animals pigmentation commenced to appear toward the end of 10 months, and minute foci of atelectasis was more frequently observed. ... although a diffuse cellular reaction ultimately ensued no fibrosis attended this process. The lymph nodes showed irregular enlargement of a moderate degree, characterized by growth of the follicles more particularly.
...
Ten guinea pigs were left in normal air for periods up to 22 months after they had been exposed for 24 months in the calcined gypsum dust chamber. Only four of the animals died naturally, and in only two of them was pneumonia the cause (Table 2). Pigmentation persisted in the majority, but atelectasis soon disappeared though diffuse cellular proliferation could still be seen. In the lymph nodes a low-grade chronic inflammatory reaction developed during the first two months the animals were in normal air ... Until the precise and specific underlying histopathologic mechanism is appreciated in the case of the gypsum-exposed guinea pigs, the significance of the occurrence of these lymph node changes may be missed.
...
[T]he effect of inhaled calcined gypsum dust on a tuberculous infection was studied. ... When the guinea pigs in one of the dusted groups (Table 13) had been exposed to calcined gypsum dust for 6 months, infected, and then further exposed to the gypsum dust for an additional 18 months, only 9 of the 20 animals died spontaneously. Of these deaths, only six were ascribed to pulmonary causes. While signs of healing were in evidence in most instances, in a few cases with associated calcification, spreads occurred in six instances; two cases developed cavitary tuberculosis and one died from this disease. Fibrosis was a prominent feature in a majority of instances, but caseation persisted in eight cases. The tuberculous process had, however, spread to the pulmonary lymph nodded, liver, and spleen but in most instances was partly healed. Caseatioin occurred in isolated instances, and fibrocaseous tuberculosis in one case. There was a higher proportion of nodules in the animals surviving longer, and in these there was also associated hyaline fibrosis.

The occurrence of 34% spreads in the gypsum-dusted guinea pigs indicates a distinct excess over that which occurred in the control series (8.3%). ... All these changes indicate some stimulatory effect of the calcined gypsum dust on the tuberculous process. ... But 3 of the 15 animals died of pneumonia within the first month after infection and none thereafter. ... This study therefore indicates that the prior two-year period of inhalation of calcined gypsum dust modified the native susceptibility of the guinea pigs to the R_1 tubercle bacillus adversely, though not materially so. The localization of the lesions was affected, and for their normal tendency to heal by resolution there was substituted a process of healing by fibrosis, with calcification in a few instances.

123 Anna Clouter Catherine E. Houghton Leon; R. Hibbs John; A. Hoskins (1998) Effect of Inhalation of Low Doses of Crocidolite and Fibrous Gypsum on The Glutathione Concentration and-Glutamyl Transpeptidase Activity in Macrophages and Bronchoalveolar Lavage Fluid. Inhalation Toxicology, 10:1, 3 – 14.
http://dx.doi.org/10.1080/089583798197835

Inhalation of asbestos can result in pulmonary fibrosis and in some cases the development of tumors, often many years after exposure. There is, however, an acute response by the lung, particularly the lower respiratory tract, which is part of the defensive mechanism for clearing the fibers. This is a process dominated by alveolar macrophages, which phagocytose the shorter fibers and release inflammatory products in attempting to deal with the longer ones. The result of this can be the production of active oxygen species that may lead to oxidative damage. To defend against such injury, the lung airways and parenchyma contain a number of antioxidants for their protection, of which the dominant one is glutathione (GSH) ... An alteration in levels of GSH as a result of toxic action could leave the lung vulnerable to damage. ... This study investigated the effect of inhaled crocidolite asbestos on GSH concentration (in the form of nonprotein sulfydryl, NPSH) and g-GT activity in macrophages and bronchoalveolar lavage (thought to represent the extracellular milieu) ... Calcined anhydrous gypsum was used as a putative control.
..
One theory is that the fibers exert an acute toxic response through the generation of active oxygen species, possibly due to frustrated phagocytosis by pulmonary macrophages (Mossman & Marsh, 1989). It is certainly possible that oxidative damage to the lung is one of the first steps leading to toxicity (Hobson et al., 1990). ... Of the several antioxidant species known, glutathione (GSH) is the major antioxidant in the lower respiratory tract
...
Fibers may induce oxidative damage in the lung by altering GSH concentrations in the ELF and parenchyma. However, since fibers have differing toxicities with respect to their long-term effects, it is important to establish whether this effect would be dependent on fiber type.
...
Calcium levels in lung tissue from gypsum-treated animals were measured in the ashed postcaval lobe by inductively coupled plasma spectroscopy (ICP) ... No gypsum fibers were found in any of the samples analyzed, despite measuring airborne levels of, on average, 15 mg•m–3. Analysis of calcium levels in ashed lung, in an attempt to estimate lung burden, was made, but calcium levels in animals from all groups, including controls, were not significantly different from each other. Even animals that were killed immediately postexposure did not have raised calcium levels. **However, histological sections showed the presence of fibers in the lungs, proving that there were enough respirable fibers in the aerosol to reach the alveoli (data not shown). It is possible that the method of solubilizing the lung may have interfered with the calcium assay.**
...
g-Glutamyl transpeptidase activity (g-GT) was significantly increased in the lavage of animals exposed to crocidolite and allowed the 4-wk recovery period. There was a significant decrease in extracellular GGT after recovery following calcium sulfate exposure. ... The effect on NPSH levels and the activity of g-GT following inhalation of low-durability fibrous gypsum and high-durability crocidolite was studied. We have previously ... found that g-GT activity in the macrophages increased fourfold with gypsum and sixfold with crocidolite. ... GSH is a key part of the lung's antioxidant protection system. It is found in high extracellular concentrations in both human (~0.4 mM) and rodent (~0.1 mM) lungs. If the role of GSH in the lung is correctly understood, then a decrease in GSH levels as a response to inhaling a toxin could leave the lung vulnerable to oxidative damage. It was

expected that crocidolite would alter GSH concentrations in the lungs of treated animals to a greater extent than fibrous calcium sulfate, in some degree
proportional to the relative toxicity of the fibers.
...
The most notable effect observed in this study was an increase ($p < .01$) in NPSH in the macrophages in both nonrecovery and recovery animals (15- and 23-fold, respectively). This can be contrasted with the response to the gypsum, where NPSH in macrophages decreased to one-fifth that of controls. It is possible that this significant increase in both intra- and extracellular NPSH may be due to an overcompensation type response that seems, to some degree, to be fiber dependent. This is a typical response to damage where the initial effect is a decline in levels of an endpoint followed by overproduction. ... It was possible that this response by the lung would occur regardless of the fiber type and only the extent of the response would be different, and NPSH in gypsum-exposed animals did increase, although it was to a lesser degree than those animals exposed to crocidolite. Furthermore, in previous studies we have shown that calcium sulfate in its milled form can also cause changes in NPSH, and although this experiment was run at lower concentrations it is likely that the presence of calcium as opposed to fibers is responsible for this result. The significant decrease in macrophage NPSH following calcium sulfate is interesting. This is beginning to recover after 4 wk postexposure. It is not clear whether exposure to another fibrous nontoxic compound would induce a similar response.

[124] Andrew Schneider (02/09/2002)Caustic dust blankets World Trade Center area. St. Louis Post-Dispatch
http://www.stltoday.com/
http://www.nyenvirolaw.org/PDF/StLouisDispatch-2-9-02-CausticDustBlanketsWTCarea.pdf

Late Thursday, the EPA's Bellow told the Post-Dispatch: "**We have no specific data on pH levels**." Bellow added, "This is all the available information on the subject." Late Friday, the EPA responded to the question of why it didn't collect its own pH numbers.

"**EPA had enough information about the alkalinity of the material from the World Trade Center without doing further analysis**," Bellow said.

[125] OSHA Regulations (Standards - 29 CFR) Hazardous waste operations and emergency response. - 1910.120
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765

Scope, application, and definitions. -- 1910.120(a)(1)
Scope. This section covers the following operations ...
1910.120(a)(1)(i)
Clean-up operations required by a governmental body, **whether Federal, state local or other** involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);
...
1910.120(a)(1)(v)
Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

1910.120(a)(2) ...
Emergency response or responding to emergencies means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance.
...
IDLH or Immediately dangerous to life or health means an atmospheric concentration of any toxic, **corrosive** or asphyxiant substance that poses an immediate threat to life or would interfere with an individual's ability to escape from a dangerous atmosphere.
...
Uncontrolled hazardous waste site means an area identified as an uncontrolled hazardous waste site by a **governmental body, whether Federal, state, local or other** where an accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both.
...
1910.120(b) Safety and health program. ... Safety and health programs developed and implemented to meet other federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph.

[126] OSHA. Appendix D HAZWOPER INTERPRETIVE GUIDANCE.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1572

This instruction establishes policies and provides clarification to ensure uniform enforcement of paragraph (q) of the Hazardous Waste Operations and Emergency Response Standard (HAZWOPER), 29 CFR 1910.120 and 1926.65, **which covers emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.**

Appendix D HAZWOPER INTERPRETIVE GUIDANCE
This appendix includes clarifications and interpretations that respond to the most frequently asked questions regarding 29 CFR 1910.120(q), **Emergency response to hazardous substance releases.**
...
Employee exposure or the reasonable possibility of employee exposure to safety or health hazards must consider all routes of entry (inhalation, ingestion, and skin absorption) without regard to the use of PPE. The exposure or potential exposure must be associated with a hazardous substance from operations addressed in (a)(1)(i-iv) or with the release of a hazardous substance during operations addressed in paragraph (a)(1)(v) of the standard. **Safety hazards from a hazardous substance could include fire, explosion, corrosive action, etc., from flammables,**

corrosive materials, etc. associated with the work site or emergency site. Health hazards from a hazardous substance could include cancer or organ function impairment from toxic,
carcinogenic, or infectious material associated with the work site or emergency site. ... Employees are considered "exposed" when they encounter any amount of a hazardous substance in the work environment that could cause them harm.

127 EPA Timeline: Response to Events of September 11, 2001, Draft - 10/12/01
[*Internal EPA document abstracted into the following document at page 371*]
Cate Jenkins (July 4, 2003) Comments on the EPA Office of Inspector General's 1/27/03 interim report titled: "EPA's Response to the World Trade Center Towers Collapse." A DOCUMENTARY BASIS FOR LITIGATION
www.nycosh.org/environment_wtc/Jenkins-7-4-03-documentary-d.pdf
http://www.nyenvirolaw.org/PDF/Jenkins-7-4-03-documentary-d2.pdf

08:50 Headquarters EOC activated
09:01 Began coordination conference call between HQ and Region 2
09:10 Established conference call bridge using GETS system w/ Regions 1-4
10:00 Coordination began between EPA and New York and Virginia

[*9/11/01 afternoon events*]
Region 2 Deployed 4 On-Scene Coordinators (OSCs) to NY
Began 24-hour operations in Edison, NJ
Collected 4 dust samples in vicinity of WTC
Initiated daily ambient air monitoring program downwind from WTC
Coordinated with NYC and OSHA

Region 3
Deployed 4 OSCs: VA EOC, DC EOC, FEMA ROC, Ft. Meade
Deployed 4 START with OSC to Ft. Meade

Headquarters
Began 24-hour operation at Emergency Operations Center
Prepared for Continuity of Operations Plan (COOP) activation
Removed EPA's website to protect against hackers & secure data (OEI)
Staffed FEMA Emergency Support Team (EST)
Staffed FBI Strategic Information Operations Center (SIOC)
Took precautions to ensure payroll for all EPA employees
Discussion of permitting issues for air and waste with Regions 2 and 3 Administrator
Held 3 conference calls with all AAs and RAs
Sent 2 voicemail updates to all employees
President issues major disaster declaration for WTC - 7:30 pm
FEMA-1391-DR-NY

128 EPA Region 6 - Emergency and Rapid Response Services (ERRS) 3 SOLNBR PR-R6-06-10130
http://www.epa.gov/oamreg01/region6/PR-R6-06-10130/
EPA PROPOSED PERSONNEL RESPONSIBILITIES AND MINIMUM QUALIFICATIONS FOR REGION 6 ERRS REQUIREMENTS
http://www.epa.gov/oamreg01/region6/PR-R6-06-10130/qualifcation.pdf

The National Incident Management System (NIMS), as developed and administered by the Department of Homeland Security, provides the template on which the National response Plan (NRP) was built. To be compliant with the NIMS requirements, **non-government first responder personnel and disaster workers are required to take NIMS, NRP, and ICS training.**
...
Specific Site Personnel Responsibilities ... The Chemist shall provide the following services:
a. Prepare sampling plans for collection of multi-media samples (e.g. air, soil, water, and waste,). Oversee the implementation of sampling plans. Collect samples. ...
c. Calibrate, maintain, and use field screening devices/meters to conduct site surveys. Interpret data and evaluate hazards from field results. ...
e. **Perform field chemistry tests** (e.g. **pH**, presence of oxidizers, cyanide and sulfide compounds, flash point and/or flammability, and water solubility,) for the purpose of identifying hazardous characteristics of waste samples.
...
In Addition to Item 1 **the Level I Response Manager MUST possess the following**: ... **Knowledge of theory of operation and ability to calibrate and use field screening instrumentation** such as organic vapor analyzers, combustible gas indicators, toxic gas meters, portable gas chromatographs, **pH/Conductivity ... meters**, and radiation monitors to measure the presence of chemical, explosive and radiological hazards at cleanup sites. Ability to interpret data and evaluate hazards from survey results.

129 OSHA Regulations (Standards - 29 CFR), Standard Number: 1910.120 App E. Training Curriculum Guidelines ...
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9770

Site- specific training programs must be developed on the basis of a needs assessment of the hazardous waste site, RCRA/ TSDF, **or emergency response operation in accordance with 29 CFR 1910.120**.
...
b. Technical knowledge.

> (1) Type of potential exposures to chemical, biological, and radiological hazards; types of human responses to these hazards and recognition of those responses; principles of toxicology and information about acute and chronic hazards; health and safety considerations of new technology.
> (2) **Fundamentals of chemical hazards including but not limited to vapor pressure, boiling points, flash points, pH, other physical and chemical properties.**

130 U.S. Department of Labor Occupational Safety & Health Administration, Technical Enforcement and Assistance Guidelines for Hazardous Waste Site and RCRA Corrective Action Clean-up Operations, DIRECTIVE NUMBER: CPL 02-02-071
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=3061

> Appendix B -- **List of Equipment** Recommended for OSHA Personnel Conducting Inspections at Uncontrolled Hazardous Waste Sites ... A. **Sampling Equipment.** Sample bottles; ... Wipe test - Whatman 41 filter paper
> ... Shipping container(s) ... Miscellaneous Equipment ... Qualitative fit test equipment to be used consistent with 1910.134(f); first aid kit ... **pH paper** ...

131 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY OFFICE OF ENFORCEMENT ... MULTI-MEDIA INVESTIGATION EQUIPMENT CHECKLIST. http://www.epa.gov/Compliance/resources/publications/civil/programs/ mmmall.pdf

> Flashlights Tyvex suits, disposable gloves Rulers Desk blotters Chain-of-custody forms Ice chests for sample shipping (environmental) Packing material NEIC Procedures manual for shipping of samples and TSCA material Sample receipt forms Sample tags ... **pH paper/meter** ... Sampling gear Media-specific sampling gear ...

132 SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM PR-R7-05-10028. www.epa.gov/oamreg01/start10028/r7s3rfp.pdf

> Contractor shall propose whether one or more fully or partially equipped response vehicles is necessary. **Equipment in each emergency response vehicle(s) shall include the following as a minimum: ... Sampling Supplies ... pH Meter**, Conductivity Meter, ORP Meter Thermometer ... PCB, Cyanide and **pH Test Kits** ... Combustible Gas Indicator ... Oxygen Meter ... Organic Vapor Analyzer ... All appropriate calibration equipment and supplies ...

133 United Nations Environmental Programme (2006 or 2007) Training Manual for the Enforcement of Laws Implementing the Basel Convention.
The final version of the UNEP Training Manual may be downloaded from the Basel Convention webpage at:
Note that when the manual is actually downloaded, the title has been simplified to: "TRAINING MANUAL ON ILLEGAL TRAFFIC"
http://www.basel.int/legalmatters/illegtraffic/index.html

> 6.1.3.4 Field tests
> In many jurisdictions, the results of the field tests used to protect the safety of the investigative team may also be used as evidence of illegal trafficking. Meter readings for flammable vapours, radiological meter readings and pH tests can all be conducted without removing a chemical sample from the tanker. These safety tests can be conducted on exterior surfaces, ports, exposed hoses or on any leaks or ground discharges. While the primary purpose of such field tests is to protect the health and safety of those at the crime scene, the results may indicate the presence of some form of hazardous waste.
> ...
> 7.4 Arrival at the hazardous waste crime scene ...
> Those persons may have conducted initial field tests on the chemical evidence (for example, pH, L.E.L or lower explosive limit, radiological). If any such tests have been completed prior to the arrival of the investigator, the results and methods must be obtained as these may help determine the types of analysis that will need to be conducted on the chemical evidence. ...
> ...
> There are many basic forensic investigative tools that will be used at most environmental crime scenes. ... For a typical hazardous waste abandonment crime scene involving abandoned drums, the investigating team's equipment should include: ... pH paper and pH chart.
> ... Conduct a field pH test on the hazardous waste to assist in
> determining the types of chemical analysis which will be needed to
> further the investigation ...
> ...
> 7.9 Field tests
> Field tests at an environmental crime scene will assist the investigator in evaluating the degree of hazard associated with the working environment and may assist in determining which containers should be placarded for chemical sampling. ... (a) pH A simple pH field test will help determine the presence of acids or caustics. This is vital information for both the sampling team and analytical personnel. An extremely high or low pH will make the evidence collection process more difficult and time consuming. Hazardous waste with a high or low pH can affect the sampling technique, safety equipment degradation rates and breakthrough times, sampling containers and sampling tools. It is also a useful tool in the locating of sample points. Any liquid with a pH reading outside of the normal range of between 6.5 and 8.5 should be deemed suspicious and marked as a sample point by the crime scene investigation team. In addition, if the investigator suspects the presence of plating waste, a high pH may be indicative of the presence of cyanide. Environmental investigators should also be cognizant of the fact that laboratory personnel will require this information prior to the loading of these samples into sensitive analytical equipment. The pH readings can be obtained by using simple pH strips or the readings can be taken electronically through the use of a portable pH meter.

134 Occupational Safety & Health Administration, Additional World Trade Center Information, Monitoring and Sampling Results Summaries, Detailed Results: [Asbestos | Silica | **Metals** | Organics]
http://www.osha.gov/nyc-disaster/wtc-additional.html

> <u>Total Dust (PNOR)</u> A total of 176 samples (excluding bulk and blank samples) for total dust in and around the debris field were taken. 5 samples were found to be in excess of the PEL for Total dust (15mg/m^3). The highest exposure was found on one operator who was exposed at approximately 4X PEL.

> ...
> Inorganic Acids OSHA has taken approximately 255 samples for inorganic acids such as hydrochloric, phosphoric, and sulfuric acids. Four samples for sulfuric acid were found to exceed OSHA's permissible exposure limit (PEL) of 1 mg/m^3. Workers were sorting debris.
>
> Oxides of Nitrogen/Sulfur Sampling on grappler operators on the rubble pile, and on employees at the truck wash stations revealed trace levels of nitric oxide and nitrogen dioxide. SO2 personal and area results were found to be below OSHA limits.
>
> Metals OSHA has taken a total of 1331 samples (excluding bulk and blank samples) to monitor worker exposures to dusts, fumes, oxides, and other compounds of metals such as antimony, beryllium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, vanadium, zinc, cadmium, **magnesium**, and arsenic. To minimize the length of the "WTC OSHA Heavy Metal Monitoring Data tables" only the samples that showed detected results for these metals are listed. Results from these samples are generally well below the applicable OSHA limits. However, torch cutting and burning structural steel at the rubble pile have resulted in instances of overexposures as follows: copper (17); iron oxide (28); lead (19); zinc oxide (1), antimony (1); and cadmium (3). Accordingly, OSHA is recommending that workers engaged in these operations wear appropriate respiratory protection.

135 OSHA found no beryllium, so did not include it in the tables, but they discussed the fact that they had tested for it in their data summaries.

136 METAL & METALLOID PARTICULATES IN WORKPLACE ATMOSPHERES (ATOMIC ABSORPTION), Method no.: ID-121
http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html

> This method can determine the amount of specific metal and metalloid particulates in the workplace atmosphere. ... This method can also determine specific metals and metalloids contained in wipe and bulk samples. The identification and quantification of the particulate is directly determined as the element. The elements are:
>
> Aluminum (Al)
> Antimony (Sb)
> Barium (Ba)
> Bismuth (Bi)
> Cadmium (Cd)
> **Calcium (Ca)**
> Cesium (Cs)
> Chromium (Cr)
> Cobalt (Co)
> Copper (Cu)
> Gold (Au)
> Hafnium (Hf)
> Indium (In)
> Iron (Fe)
> Lead (Pb)
> Lithium (Li)
> Magnesium (Mg)
> Manganese (Mn)
> Molybdenum (Mo)
> Nickel (Ni)
> Platinum (Pt)
> **Potassium (K)**
> Selenium (Se)
> Silver (Ag)
> **Sodium (Na)**
> Tellurium (Te)
> Thallium (Tl)
> Tin (Sn)
> Titanium (Ti)
> Yttrium (Y)
> Zinc (Zn)
> Zirconium (Zr),
>
> ...
> When determining compliance with the **Ceiling PEL for sodium hydroxide**, take 15-min samples.
>
> Table 1 Air Contaminants - OSHA Permissible Exposure Limits* …
> Ca   Calcium oxide   5 mg/m^3 **...**
> K   Potassium hydroxide   2 mg/m^3 **...**
> Magnesium oxide fume   Total particulate   [15 mg/m^3] ...
> Na   Sodium hydroxide   2 mg/m^3

137 METAL AND METALLOID PARTICULATES IN WORKPLACE ATMOSPHERES (ICP [*inductively coupled argon plasma*] ANALYSIS), Method no.: ID-125G
http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html

> Table 1 Air Contaminants - OSHA Permissible Exposure Limits* …
> Ca   Calcium oxide   5 mg/m^3
> K   Potassium hydroxide --- 2 ...
> Na   ...
> Sodium hydroxide   2 ...

138 USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan. http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

Paul J. Lioy, Clifford P. Weisel, James R. Millette, *et al.* (July 2002) Characterization of the Dust/Smoke Aerosol that Settled East of the World Trade Center (WTC) in Lower Manhattan after the Collapse of the WTC 11 September 2001. Environmental Health Perspectives • VOLUME 110, NUMBER 7, 703.
http://ehpnet1.niehs.nih.gov/members/2002/110p703-714lioy/EHP110p703PDF.PDF

J. K. McGee, L. C. Chen, M. D. Cohen, G. R. Chee, C. M. Prophete, N. Haykal-Coates, S. J. Wasson, T. L. Conner, D. L. Costa, and S. H. Gavett (2003) Chemical Analysis of World Trade Center Fine Particulate Matter for Use in Toxicological Assessment. Environmental Health Perspectives, 11(7): 972
http://www.ehponline.org/members/2003/5930/5930.pdf

Cahill, T. A., Cliff, S.S., Shackelford, J.F., Meier, M., Dunlap, M., Perry, K.D., Bench, G., and Leifer, R. (2005). Very Fine Aerosols from the World Trace Center Collapse Piles: Anaerobic incineration? Advances in Chemistry. ACS symposium series, vol. 919, pp. 152-163.
http://cat.inist.fr/?aModele=afficheN&cpsidt=17307787

T. A. Cahill, S. S. Cliff, M. Jimenez-Cruz, J. F. Shackelford, M. Dunlap, M. Meier, P. B. Kelly, S. Riddle, J. Selco, G. Bench, P. Grant, D. Ueda, K. D. Perry, and R. Leifer. (2004). Analysis of Aerosols from the World Trade Center Collapse Site, New York, October 2 to October 30, 2001. Aerosol Science and Technology, 38; 165–183. http://www.ingentaconnect.com/content/tandf/uast/2004/00000038/00000002/art00012

L.-M. Yiin, A. Vette, V. Ilacqua, C. Quan, J. Gorczynski, M. Kendall, L. C. Chen, C. P. Weisel, B. Buckley, I. Yang, and P. J. Lioy (2004) Comparisons of the Dust/Smoke Particulate that Settled Inside the Surrounding Buildings and Outside on the Streets of Southern New York City after the Collapse of the World Trade Center, September 11, 2001. J. Air & Waste Manage. Assoc. 54:515–528 Paper and free abstract at:
http://www.awma.org/journal/ShowAbstract.asp?Year=&PaperID=1214

[EPA data compiled by their contractor Lockheed Martin. See pages 13-14, 127-128, and 157-158 of the PDF file itself (not the numbers marked on the pages) for sampling information for 9/11/01] Lockheed Martin Technology Services (July 17, 2002) DOCUMENT TRANSMITTAL UNDER WORK ASSIGNMENT # 00236, World Trade Center – Analytical Report for Metals collected 9/11/01-1/10/02. http://www.epaosc.org/doc_list.asp?site_id=WTC

139 National Institute of Standards and Technology (NIST) Federal Building and Fire Safety Investigation of the World Trade Center Disaster. Answers to Frequently Asked Questions. http://wtc.nist.gov/pubs/factsheets/faqs_8_2006.htm
[See full NIST report at the following URL. Note that the prefix is **not " www ". but instead " wtc "**]
http://wtc.nist.gov/

> NIST investigators and experts from the American Society of Civil Engineers (ASCE) and the Structural Engineers Association of New York (SEONY)—who inspected the WTC steel at the WTC site and the salvage yards—found no evidence that would support the melting of steel in a jet-fuel ignited fire in the towers prior to collapse.
>
> ...
>
> Under certain circumstances it is conceivable for some of the steel in the wreckage to have melted after the buildings collapsed. **Any molten steel in the wreckage was more likely due to the high temperature resulting from long exposure to combustion within the pile** than to short exposure to fires or explosions while the buildings were standing. ... **The melting point of steel is about 1,500 degrees Celsius** (2,800 degrees Fahrenheit). **Normal building fires** and hydrocarbon (e.g., jet fuel) fires generate temperatures up to about **1,100 degrees Celsius** (2,000 degrees Fahrenheit).

140 USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

> AVIRIS data collected on September 16, 2001, revealed a number of thermal hot spots in the region where the WTC buildings collapsed. Analysis of the data indicated temperatures greater than 800°F [*427 degrees Celsius*] in these hot spots (some over 1300°F) [*704 degrees Celsius*]. Over 3 dozen hot spots of varying size and temperature were present in the core zone of the WTC. By September 23, most of these fires that were observable from an aircraft had been eliminated or reduced in intensity.
>
> ...
>
> Table 1 Thermal Hot Spot Data [*Temperatures from 8 hot spots on September 16*]

A ...	[*727 °C*]
B ...	[*527 °C*]
C ...	[*627 °C*]
D ...	[*517 °C*]
E ...	[*437 °C*]
F ...	[*427 °C*]
G ...	[*747 °C*]
H ...	[*547 °C*]

141 T. A. Cahill, S. S. Cliff, M. Jimenez-Cruz, J. F. Shackelford, M. Dunlap, M. Meier, P. B. Kelly, S. Riddle, J. Selco, G. Bench, P. Grant, D. Ueda, K. D. Perry, and R. Leifer. (2004). Analysis of Aerosols from the World Trade Center Collapse Site, New York, October 2 to October 30, 2001. Aerosol Science and Technology, 38; 165–183. http://www.ingentaconnect.com/content/tandf/uast/2004/00000038/00000002/art00012

> The WTC plume [*1 mile north of Ground Zero in October 2001*] **resembled in many ways those seen from municipal waste incinerators and high temperatures processes in coal fired power plants**. . The size fractions above 1 micrometer contained finely powdered concrete, gypsum, and glass, with soot-like coatings and anthropogenic metals, but little asbestos. Composition in the very fine size range ($0.26 > D_p > 0.09$ µm) was dominated by sulfuric acid and organic matter, including polycyclic aromatic hydrocarbons (PAHs) and their derivatives, and glass-like silicon-containing aerosols. Many metals were seen in this mode, most, but not all, at low concentrations.
>
> ...
>
> Very high temperatures occurred in the burning floors of the buildings prior to collapse and during the first few days of active surface fires, **as shown by the melting of metals**. Later, infra-red surveys showed surface temperatures in the collapse pile were as high as 30K above ambient in October, and much higher sub-surface temperatures were inferred from the lower portions of removed steel beams glowing red. **The sub-surface of the collapse piles remained hot for months despite use of massive amounts of water to cool them, with the last spontaneous surface fire occurring in mid-December.**

142 T. A. Cahill, S. S. Cliff, M. Jimenez-Cruz, J. F. Shackelford, M. Dunlap, M. Meier, P. B. Kelly, S. Riddle, J. Selco, G. Bench, P. Grant, D. Ueda, K. D. Perry, and R. Leifer. (2004). Analysis of Aerosols from the World Trade Center Collapse Site, New York, October 2 to October 30, 2001. Aerosol Science and Technology, 38; 165–183. http://www.ingentaconnect.com/content/tandf/uast/2004/00000038/00000002/art00012

> In this work, we have isolated and characterized the nature of the aerosol plumes coming from the WTC collapse site in the period between October 2 and October 30, 2001. ... The coarse particulate mass, finer than typical soils, appeared to be derived from hot portions of the collapse pile itself as it persisted even after periods of rain and despite increasingly effective efforts to wet and cool the pile. The particles were primarily finely

> powdered concrete, gypsum from dry wall, and **rounded glass shards**, with a mass peak in the 2.5 to 5 µm diameter range, as well as above 12 µm which we did not measure.

[143] Wikipedia. Glass. http://en.wikipedia.org/wiki/Glass

> Pure silica (SiO2) has a melting point of about 2,000° C (3,600° F), and while it can be made into glass for special applications (see fused quartz), other substances are added to common glass to simplify processing. One is soda (sodium carbonate Na2CO3), which lowers the melting point to about 1,000° C (1,800° F). However, the soda makes the glass water-soluble, which is usually undesirable, so lime (calcium oxide, CaO), some MgO and aluminum oxide are added to provide for a better chemical durability. The resulting glass contains about 70 to 72 percent silica by weight and is called a soda-lime glass. Soda-lime glasses account for about 90 percent of manufactured glass.

[144] New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry U.S. Department of Health and Human Services (September 2002) Final Technical Report of the Public Health Investigation to Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan
http://www.epa.gov/wtc/panel/ATSDRFinal-report-lowermanhattan-02.pdf

> **Calcite (calcium carbonate) and portlandite (calcium hydroxide) are also components of concrete.** They occurred with similar frequency in the dust samples and were often colocated with the quartz. **Calcite ranged from an estimated 0.8%J to 19%J in outdoor areas, and from 0.02%J to 21%J in indoor areas. Portlandite ranged from an estimated 0.07%J to 6%J in outdoor areas and from 0.04%J to 8%J in indoor areas.**

[145] USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

> X-Ray Diffraction (XRD) analyses of WTC samples (Table 1, on the Integration of Results page) indicate that most samples contain varying amounts of crystalline quartz, gypsum, **calcite** [$CaCO_3$], anhydrite and amorphous material (e.g. XRD Figure 1). Other phases identified in small amounts include: muscovite, feldspar, magnesiohornblende, lizardite (non-asbestiform serpentine), dolomite, bassanite, illite, **portlandite** [$Ca(OH)_2$], larnite, polymorphs of calcium silicates, possible asbestiform chrysotile, and others. The results are reported as **major (>20% by weight), minor (>5% but <20%** by weight), and trace (<5% by weight).
> ...
> Table 1 [*only selected samples with "major" concentrations (>20%) calcite ($CaCO_3$) and "minor" concentrations (>5% to <20%) portlandite ($Ca(OH)_2$) included*]

Sample Number	Spectroscopy	XRD	Leach pH	Location
WTC01-04	gypsum, muscovite and/or **portlandite (tr)**, CH, Fe2+ (wk)	**Calcite - Major** Gypsum - Minor Anhydrite - Minor Quartz - Trace Muscovite - Trace Microcline - Trace *Major amorphous material	[*no pH testing reported*]	Battery Park, NE end 4506284N 583233E
WTC01-05	gypsum, muscovite and/or **portlandite (tr)**, CH, Fe2+(w	**Calcite - Major** Quartz - Minor Gypsum - Minor Anhydrite - Minor Calcium Sulfate Hydrate - Trace *Major amorphous ...	9.9	Broadway & Wall St. from Bank of NY
WTC01-20	gypsum, muscovite and/or portlandite (tr), CH, chrysotile (tr), Fe2+ (wk)	... *Very slight possibility of a trace of chrysotile ***Portlandite** and bassanite are **trace to minor** ...	11.8	Liberty & South End 2 World Financial Center: indoor sample
WTC01-36	gypsum, muscovite and/or portlandite (tr), CH, Fe2+, possible trace chrysotile	... **Portlandite - Minor** ... Chrysotile - Trace *possible trace chrysotile ...	11.8	South End & Albany (30th floor): Indoor sample
WTC01-37A	gypsum, muscovite, portlandite, Fe2+	... **Portlandite - Minor** Magnesiohornblende ...	[*no pH testing reported*]	concrete from WTC area
WTC01-37B	portlandite, Fe2+	Quartz - Major Orthoclase - Minor **Portlandite - Minor** ... Calcite – Trace ...	[*no pH testing reported*]	concrete from WTC area

[146] Hendrik G. van Oss (2005) USGS - Background Facts and Issues Concerning Cement and Cement Data. USGS Open-File Report 2005-1152 http://pubs.usgs.gov/of/2005/1152/2005-1152.pdf

Oxide Formula [*in cement clinker at 750 – 1000° C. prior to formation of the calcium-aluminum-silicate complexes at higher temperatures*]	Percentage by mass [*in pre-cement "clinker"*]
CaO *[calcium oxide]*	**63.4**
SiO_2	20.9
Al_2O_3	5.7
Fe_2O_3	2.9
MgO	1.9
$K_2O + Na_2O$ *[potassium oxide and sodium oxide]*	**0.6**
Other (incl. SO_3-)	3.6
H_20	1

...

Alkalis, particularly sodium (Na_2O) ... ... Approaches to controlling ASR reactions include selecting Portland cements having lower alkali contents (e.g., ASTM C-150 provides for a low-alkali cement designation if the cement has a **total alkali content (defined as $Na_2O + 0.658\ K_2O$) [*sodium oxide and potassium oxide*] content of 0.60% or less)** ... When a plant evaluates its raw materials, consideration is given not only to each material's potential contribution of major oxides (CaO, SiO_2, Al_2O_3, Fe_2O_3), but also to the content, if any, of undesirable trace elements (e.g., excess MgO, **alkalis**, toxic species).

...

Calcination: 750 – 1000 [*degrees Celsius*] Drive off carbon dioxide from carbonate minerals.

...

The main oxide in clinker and Portland cement is CaO ... The main CaO-bearing mineral in limestone and related rocks is calcite ($CaCO_3$), and calcination simply strips the carbon dioxide from this mineral (or any other carbonate minerals present): **$CaCO_3$ + heat → $CaO + CO_2 \uparrow$** .

[147] Lafarge North America, MSDS for all drywall products. http://www.lafargenorthamerica.com/wps/wcm/resources/file/ebb46e4ca8cd4c5/Drywall%20MSDS%205.pdf

Product Name(s): Lafarge Drywall ...

Gypsum (Calcium Sulfate)	70 – 90 [%]
Calcium Carbonate	60 – 65 [%]

...

Hazardous Decomposition: Thermal decomposition may yield sulfur oxides, and **calcium oxide fumes (above 825°C)**.

[148] Bibliography on Gypsum Drywall, Prepared by John Reindl, Recycling Manager, Dane County Department of Public Works, 1919 Alliant Energy Center Way, Madison, WI 53713-1400. http://www.p2pays.org/ref/02/01827.pdf

The chart lists the gypsum crystal modifiers as fine ground gypsum, **potassium sulfate**, aluminum sulfate, boric acid and organic retarder.

[149] OFI TESTING EQUIPMENT, INC. Material Safety Data Sheet. http://www.ofite.com/msds/205-26.pdf

CALGON POWDER,
Potassium Sulfate >95% [greater than 95%]
... **Hazardous Decomposition: Oxides of Sulfur and Potassium.**

[150] SDS Number: M00006, Product Name: Phosphate 2 Reagent, HACH LANGE GmbH http://shop.hach-lange.com/shop/action_q/download%3Bmsds/msds_document/en%252F106199%252Epdf/lkz/GB/spkz/en/TOKEN/9Y2FPMYDKJRC7J43KMHVwehfNeI/M/uS7RPw

COMPOSITION ... **Potassium Sulfate** >95% [*greater than 95%*]
... **Hazardous Decomposition:** Heating to decomposition releases toxic and/or corrosive fumes of: sulfur oxides carbon dioxide, carbon monoxide, **potassium oxide**

[151] Lou Bloomfield. How Everything Works: Making Physics out of the Ordinary. http://rabi.phys.virginia.edu/HTW/supplements/windows_and_glass.pdf
Homepage: http://rabi.phys.virginia.edu/HTW/

The principal addition to window glass is sodium oxide or soda (Na_2O). ... When soda is added to silica and the two are heated, the mixture melts at a temperature that is below the melting temperature of either material. It's a eutectic, a mixture that melts more easily than the materials from which it's made. **A mixture containing 25% soda by weight melts at a temperature of only 793 ° C.**

...

> Soda– silica glass can be made much less water-soluble by adding calcium oxide or lime (CaO) to it. Calcium oxide is an ionic solid, but it's not soluble in water and makes the glass much more durable. Soda–lime–silica glass is almost insoluble in water and is the principal commercial glass. Windows, bottles, and jars are all made of soda– lime– silica glass. ... 73% silica, 14% soda [*sodium oxide*], 9% lime [*calcium oxide*], 3.7% magnesia, and 0.3% alumina

[152] European Commission Directorate-General, JRC Joint Research Centre (October 2000) Integrated Pollution Prevention and Control (IPPC). Best Available Techniques in the Glass Manufacturing Industry. http://www.mu.sachsen-anhalt.de/start/fachbereich03/emissionsminderung/files/glass.pdf

> A number of different volatilisation [*sic*] processes can be distinguished in soda-lime glass: (a) Reactive volatilisation from the molten glass surface. The sodium oxide in the silicate melt reacts at the surface with water vapour: Na_2O (melt) + $H_2O \rightarrow 2$ NaOH (g). This type of volatilisation may be the major source of dust emissions in soda-lime glass furnaces.

[153] Carol M. Jantzen, John B. Pickett, Kevin G. Brown , and Thomas B. Edwards, Impact of Phase Separation on Waste Glass Durability, Westinghouse Savannah River Company. Contract No. DE-AC09-96SR18500, U. S. Department of Energy. http://sti.srs.gov/fulltext/ms9900333/ms9900333.pdf

> Phase separation is shown to have an adverse and unpredictable effect on durability of borosilicate nuclear waste glasses. ... Although waste glasses contain 15-20 components, many of the components are present in minor amounts. Greater than >95% of the glass chemistry is dominated by the seven major components, Na_2O- K_2O-Li_2O-SiO_2-Al_2O_3-B_2O_3-Fe_2O_3.
>
> ...
>
> [H]omogeneous glasses undergo ion exchange and matrix dissolution while crystallized glasses undergo accelerated grain boundary dissolution and phase separated glasses undergo preferential soluble phase dissolution. Crystallization and phase separation are normally detrimental to glass durability and are dependent on the volume fraction crystallized and/or the volume fraction phase separated.

[154] Brad Walker (2005) Techniques of Kiln-formed Glass. Abstracted and posted at: Warm Tips. A new glass kiln-forming tip each day http://www.warmtips.com/20051026.htm

> Devitrification, a whitish scum that sometimes appears on the top surface of glass that has been fired in the kiln, occurs when glass remains at too high a temperature for too long. ... Instead, the high temperature causes some of the elements in the glass to burn off. The glass crystallizes along the top surface, forming a crystal (called devitrite). A mild case of devitrification results in a dull whitish deposit on the glass, while more severe cases can cause the top surface to break down and even deteriorate completely.
>
> ...
>
> Although **devitrification can occur anywhere above about** 1100F/**600C**, it is much more likely to occur when the temperature exceeds 1300F/700C. The longer the glass spends at the higher temperature, the more likely it is to devitrify.

[155] USGS (February 5, 2002 is actual date, 11/15/01 date on report is falsified) Environmental Studies of the World Trade Center area after the September 11, 2001 attack. http://pubs.usgs.gov/of/2001/ofr-01-0429/

[*This study found up to 12% Na2O and 32% CaO in glass fibers in WTC dust. What is interesting is the fact that there was no detectable Na2O in the two glass sphere samples, and some of the glass fiber samples. The absence of Na2O indicates the probable volatilization of Na2O out of the glass spheres and glass fibers, contributing to the alkalinity of WTC dust.*]

> The **alkaline pH** of the leach solutions, coupled with the high concentrations of calcium, carbonate, and sulfate, are consistent with an origin resulting primarily from the **dissolution of** concrete, **glass fibers**, gypsum, and other material in the dusts.
>
> ...
>
> Table SEM-1. EDS analyses of representative phases given in oxide weight percent.

Analysis I.D.	Na_2O	MgO	Al_2O_3	SiO_2	SO_3	K_2O	CaO	TiO_2	MnO	FeO	Material
wtc 22 sp 5	2	11	12	44	trace	1	24	1	BDL	4	glass fiber
wtc 22 sp 1	trace	11	9	47	trace	1	32	trace	BDL	BDL	glass fiber
wtc 22 sp 2	12	2	3	71	trace	trace	11	trace	BDL	trace	glass fiber
wtc 3 sp 3	trace	11	11	43	trace	trace	32	1	BDL	BDL	glass fiber
wtc 3 sp 6	trace	11	10	44	trace	trace	32	trace	BDL	1	glass fiber
wtc 8 sp 1	BDL	8	9	43	trace	trace	36	1	BDL	1	glass fiber
wtc 15 sp 1	BDL	10	10	42	trace	trace	36	trace	trace	BDL	**glass sphere**
wtc 22 sp 4	BDL	12	8	47	trace	trace	31	BDL	BDL	BDL	**glass sphere**
wtc 8 sp 8	BDL	47	BDL	50	trace	BDL	trace	BDL	trace	2	chrysotile
wtc 14 sp 5	BDL	BDL	1	2	53	BDL	43	BDL	BDL	BDL	Gypsum/anhydrite

[156] T. A. Cahill, S. S. Cliff, M. Jimenez-Cruz, J. F. Shackelford, M. Dunlap, M. Meier, P. B. Kelly, S. Riddle, J. Selco, G. Bench, P. Grant, D. Ueda, K. D. Perry, and R. Leifer. (2004). Analysis of Aerosols from the World Trade Center Collapse Site, New York, October 2 to October 30, 2001. Aerosol Science and Technology, 38; 165–183. http://www.ingentaconnect.com/content/tandf/uast/2004/00000038/00000002/art00012

> In this work, we have isolated and characterized the nature of the aerosol plumes coming from the WTC collapse site in the period between October 2 and October 30, 2001. ... The coarse particulate mass, finer than typical soils, appeared to be derived from hot portions of the collapse pile itself as it persisted even after periods of rain and despite increasingly effective efforts to wet and cool the pile. The particles were primarily finely powdered concrete, gypsum from dry wall, and **rounded glass shards**, with a mass peak in the 2.5 to 5 μm diameter range, as well as above 12 μm which we did not measure.

[157] Lung Chi Chen (undated Power Point Presentation) Community Exposures to Particulate Matter Air Pollution from the World Trade Center Disaster. NYU-NIEHS Center of Excellence Department of Environmental Medicine SCHOOL OF NYU School of Medicine.
http://www.med.nyu.edu/environmental/assets/chen.pdf

> RESULTS: Melted Glass was Present in the Fallout Dust. [*photograph followed*]

[158] Byung Bae Park, Ruth D. Yanai, James M. Sahm, Benjamin D. Ballard and Lawrence P. Abrahamson (2004) Water, Air, and Soil Pollution 159: 209–224.
http://www.esf.edu/for/yanai/Publications/Wood_Ash-WASP.pdf

> The management of wood ash is an important factor in the environmental and economic analysis of wood burning. ... The **average pH of the wood ash was 10.6**, which was not as high as that found in other studies ...

[159] Table from: http://cavemanchemistry.com/ch120slides/tables/foil65.html
For discussion of the production of potash from wood ashes: http://cavemanchemistry.com/oldcave/projects/potash/
Kevin Dunn (2003) Caveman Chemistry, Universal Publishers for print edition:
http://www.universal-publishers.com/book.php?method=ISBN&book=1581125666

Substance	Percent Before/After Burning, Open Normal Fire %
Beech Wood, before burning	100.00
Flammable Compounds	99.42
Insoluble Ash	0.46
Potassium Carbonate	0.09
Sodium Carbonate	0.02
Potassium Sulfate	0.01

[160] Merck Chemical Index Online (2007) http://www.merckbooks.com/mindex/cdrom.html

> The technical grade (about 99% pure) is known as soda ash. Odorless, hygroscopic powder; alkaline taste; d: 2.53. mp 851 but begins to lose CO_2 even at 400 degrees. On exposure to air it will gradually absorb one mol water(SBOND)about 15%. Sol in glycerol; in 3.5 parts water at room temp, 2.2 parts water at 35 degrees. Insol in alcohol. Dec by acids with effervescence. Combines with water with evolution of heat. Its aq soln is strongly alkaline. pH 11.6.

[161] Merck Chemical Index Online (2007) *op. cit.*

[162] Mahendra K. Misra, Kenneth W. Ragland, Andrew J. Baker (1993) Wood Ash Composition as a Function of Furnace Temperature. Biomass and Bioenergy Vol. 4, No. 2, pp. 103-116. http://www.fpl.fs.fed.us/documnts/pdf1993/misra93a.pdf

> WOOD ASH COMPOSITION AS A FUNCTION OF FURNACE TEMPERATURE
> Low temperature ash was prepared at 500° C, and samples were heated in a tube furnace at temperature increments to 1400° C. ... The mass loss observed at temperatures over 600° C has been found to be due to the decomposition of carbonates of both calcium and potassium. ... It will be shown later that the mass loss observed in the temperature range of **650-900° C is predominantly due to the decomposition of $CaCO_3$**, and that **beyond 900° C is due to the decomposition of K_2CO_3** and in some cases, due to the dissociation of calcium and magnesium sulfate.
> ...
> The increase in calcium concentrations in Fig. 4 at temperatures below 900° C is primarily due to the decomposition of calcium carbonate and at temperatures beyond 900° C the increase is due to the **dissociation of potassium carbonate and simultaneous volatilization of potassium oxide formed after dissociation.**
> ...
> These results indicate that the **presence of increasing amounts of alkali compound can lower the decomposition temperature of $CaCO_3$**. This was confirmed in separate experiments where temperatures at the minima for pure $CaCO_3$ and for a $CaCO_3/K_2CO_3$ mixture were compared. ... it is clear that a presence of alkali carbonate accelerates the decomposition of calcium carbonate.
> ...
> In the absence of substantial XRD evidence, the process leading to a reduction in sodium concentrations in pine and oak ash is presumed to be similar to that of potassium, namely, **dissociation of sodium carbonate and subsequent volatilization of sodium oxide**.

[163] Fisher Scientific (2000) Material Safety Data Sheet ... Potassium Carbonate**.** https://fscimage.fishersci.com/msds/02576.htm

> Warning! Causes respiratory tract irritation. Maybe harmful if swallowed. Causes eye and skin irritation and possible burns. May cause severe digestive tract irritation with possible burns. ...
> Eye: Causes eye irritation. Causes an irritant and caustic action similar to that of potassium hydroxide.
> Skin: Causes an irritant and caustic action similar to that of potassium hydroxide.
> Ingestion: May cause severe gastrointestinal tract irritation with nausea, vomiting and possible burns. May be harmful if swallowed.
> Inhalation: Causes respiratory tract irritation.
> ... **Hazardous Decomposition Products:** Carbon monoxide, carbon dioxide, **oxides of potassium**.

[164] FMC Wyoming Corporation (2004) Material Safety Data Sheet **,** Sodium Carbonate. http://msds.fmc.com/msds/100000010373-MSDS_US-E.pdf

> HAZARDOUS COMBUSTION PRODUCTS: Fumes of sodium oxide. ... **HAZARDOUS DECOMPOSITION PRODUCTS**: Heated to decomposition, it emits fumes of **sodium oxide**. ... EYE EFFECTS: Severe irritant (rabbit) (Toxicology 23:281 (1982)) ... ACUTE EFFECTS FROM OVEREXPOSURE: May cause severe irritation of the eyes, including corneal opacities. Dusts and mists may be irritating to the skin, mucous membranes and upper respiratory tract.

[165] Heidi Dehncke-Fisher, Director (September 2006) Dust to Dust: The Health Effects of 9/11. Sundance Channel and CBS News Productions, 2006, Tinderbox Media Group, LLC. http://www.tinderboxfilms.com/

http://www.imdb.com/title/tt0869046/
http://en.wikipedia.org/wiki/Dust_to_Dust:_The_Health_Effects_of_9/11

> We've had concern, we're going to continue to monitor. But right now, as I will tell you, everything we're getting back from the sampling that we're doing, is below background levels.
>
> There is not a reason for the general public to be concerned. It's not going to be a particular hazard unless you have breathing difficulties, heart condition, then you shouldn't be out here walking around and trying to get exercise. So that's not appropriate, obviously.

[166] ANDREW C. REVKIN (September 14, 2001) THE CHEMICALS. Monitors Say Health Risk From Smoke Is Very Small. New York Times.
http://www.911ea.org/News_Stories_From_September_2001.htm

http://query.nytimes.com/gst/fullpage.html?sec=health&res=9500E2D91138F937A2575AC0A9679C8B63

> ... But over all, the danger was no greater than that on a smoggy day, some officials said.
> ...
> But tests of air and the dust coating parts of Lower Manhattan appeared to support the official view expressed by city, state and federal health and environmental officials: that health problems from pollution would not be one of the legacies of the attacks. Tests of air samples taken downwind of the smoldering rubble on Tuesday and Wednesday — mainly in Brooklyn — disclosed no harmful levels of asbestos, lead or toxic organic compounds, officials of the federal Environmental Protection Agency said yesterday.
> ...
> Continued monitoring of fine soot particles and other kinds of air contaminants by state environmental officials also showed "nothing out of the ordinary," a state official said. "We're not seeing any violations," the official said, "not seeing anything out of the ordinary, with the exception of small episodic spikes based on wind shifts or activity at ground zero."

[167] EPA Terminology Reference System. http://iaspub.epa.gov/trs/trs_proc_qry.navigate_term?p_term_id=5775&p_term_cd=TERM

> The concentration of a substance in an environmental media (air, water, or soil) that occurs naturally or is not the result of human activities. 2. In exposure assessment the concentration of a substance in a defined control area, during a fixed period of time before, during, or after a data-gathering operation.. (Source: Office of Communications, Education, and Media Relations: Terms of Environment: Glossary, Abbreviations, and Acronyms (Revised December 1997) Term Detail)
>
> In toxic substances monitoring, the average presence of a substance in the environment, originally referring to naturally occurring phenomena. (Source: Office of Ground Water and Drinking Water: A Dictionary of Technical and Legal Terms Related to Drinking Water Term Detail)
>
> Term used in a variety of situations, always as the constant or natural amount of a given substance, radiation, noise, etc.(Source: KORENa) (Source: European Environment Agency (EEA), European Topic Centre on Catalogue of Data Sources (ETC/CDS): General Multilingual Environmental Thesaurus Term Detail)
>
> The naturally-occurring level of organic compounds in the environment. (Source: State of South Carolina: Site Assessment and Remediation Program Glossary Term Detail)
>
> With respect to air pollution, amounts of pollutants present in the ambient air due to natural sources. (Source: State of Texas: Local Government Guide to the TNRCC Term Detail)

[168] National Safety Council. Environmental Health Center: Glossary. http://www.nsc.org/ehc/glossary.htm

> background level: In air pollution control, the concentration of air pollutants in a definite area during a fixed period of time prior to the starting up or on the stoppage of a source of emission under control. In toxic substances monitoring, the average presence in the environment, originally referring to naturally occurring phenomena.

American Meteorological Society Glossary. amsglossary.allenpress.com/glossary/browse

> Concentration of background pollution. Compare ambient air.

The University of New South Wales, Sydney, Australia. http://www.odour.unsw.edu.au/odour-terms.html

> background level - a typical level of a chemical in the environment. Background often refers to naturally occurring or uncontaminated levels. Background levels in one region of the state may be different than those in other areas.

EDP Health and Safety Consultants. Health & Safety Terms. www.edp-uk.com/glossaries/terms.htm

> The normal or typical level of a chemical in the environment, often referring to the naturally occurring level

[169] One EPA test showed asbestos at 4.49% in dust at Murray and West Sts. on 9/11/01. There were not only above background and health-based levels of asbestos in air as tested, but also the testing was not sensitive enough to even get down to the low levels constituting background for asbestos. Later during the voluntary residential cleanup program, EPA had to design new methods to test for asbestos in air to get closer to those related to background, but even then was unable to test at the low levels constituting background.

[170] Lockheed Martin Technology Services (June 2003) Document Transmittal under Work Assignment #0-236. World Trade Center Emergency Response - Analytical Report. EPA On Scene Coordinator Website. http://www.epaosc.org/doc_list.asp?site_id=WTC

[171] EPA Office of Inspector General (August 21, 2003) Evaluation Report EPA's Response to the World Trade Center Collapse: Challenges, Successes, and Areas for Improvement Report No. 2003-P-00012. http://www.epa.gov/oig/reports/2003/WTC_report_20030821.pdf

> [p. i]
> EPA's early public statements following the collapse of the WTC towers reassured the public regarding the safety of the air outside the Ground Zero area. However, when EPA made a September 18 announcement that the air was "safe" to breathe, it did not have sufficient data and analyses to make such a blanket statement. At that time, air monitoring data was lacking for several pollutants of concern, including particulate matter and polychlorinated biphenyls (PCBs). Furthermore, The White House Council on Environmental Quality influenced, through the collaboration process, the information that EPA communicated to the public through its early press releases when it convinced EPA to add reassuring statements and delete cautionary ones.
> ...
> [*p. 8*]
> EPA used various methods to inform the public after September 11, including attending public forums; having interviews with newspaper, **television**, and radio reporters; and posting information on its public web site. Our analysis focused primarily on the information provided through press releases since the Agency develops its position through a deliberative process that represents the Agency's official position.
> ...
> [*p. 11*]
> Table 2-2: Outdoor Sampling Timeline for Pollutants of Concern

Pollutant	Sampling Source	Sampling Started	Results Available[1]
Lead	Dust	September 11	September 12
Asbestos	Bulk Dust Ambient Air	September 11 September 12	September 12 September 13
...	...	...	...

> ...
> [*p. 17*]
> Cautionary statements in a draft version of the September 13, 2001, press release (see Appendix H) were removed and replaced with more reassuring statements. For example, the second clause of the caption to the draft press release, which noted that EPA was testing for environmental hazards, was replaced with a statement reassuring the public about environmental hazards. Further, the press release did not contain a statement in the draft version that EPA considered asbestos hazardous in this situation.
> ...
> [*p. 26*]
> We were unable to determine when EPA first told the public that they should obtain professional cleaning for WTC-contaminated indoor spaces. The earliest instance we could locate was on October 26, 2001, when the EPA Administrator recommended professional cleaning in a **televised interview on MSNBC**:
> ...
> [*p. 73, Appendix B*]
> Details on Scope and Methodology
> Objective 1. Did the available monitoring data and analyses of that data support EPA's major public communications regarding air quality and associated health risks resulting from the collapse of the WTC towers?
>
> We requested all data and correspondence used to support **"major" EPA pronouncements regarding air quality**. We defined "major" as press releases, testimony, **television**, and other public appearances.
> ...
> [*p. 93, Appendix K*]
> On September 13, 2001, 14 air samples were collected from 26 Federal Plaza, 290 Broadway, and Chase Manhattan Plaza, and analyzed for asbestos. All samples were analyzed by TEM and the results converted to PCM equivalent readings in fibers per cubic centimeter (f/cc). One of the 14 samples exceeded the New York City standard for asbestos clearance of .01 f/cc
> ...
> [*p. 134*]
> We disagree with the assertion that EPA's statement about the air being safe to breathe would clearly be understood by New Yorkers as applying exclusively to asbestos. The press release sentence which preceded the subject statement asserts that New Yorkers are "not being exposed to excessive levels of asbestos or other harmful substances . . . ." The same press release also states that sample tests results are "below established levels of concern for asbestos, lead and volatile organic compounds."

[172] EPA September 13 2001 press release, included as Appendix H in IG report. Also available at the following website: http://www.epa.gov/wtc/stories/headline_091301.htm

> EPA Response to September 11. EPA Initiates Emergency Response Activities, Reassures Public About Environmental Hazards
> ...
> At the request of the New York City Department of Health, EPA and the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) have been on the scene at the World Trade Center monitoring exposure to potentially contaminated dust and debris. Monitoring and sampling conducted on Tuesday and Wednesday have been very reassuring about potential exposure of rescue crews and the public to environmental contaminants.
>
> EPA's primary concern is to ensure that rescue workers and the public are not exposed to elevated levels of asbestos, acidic gases or other contaminants from the debris. Sampling of ambient air quality found either no asbestos or very low levels of asbestos. Sampling of bulk materials and dust found generally low levels of asbestos.
>
> The levels of lead, asbestos and volatile organic compounds in air samples taken on Tuesday in Brooklyn, downwind from the World Trade Center site, were not detectable or not of concern.
>
> Additional sampling of both ambient air quality and dust particles was conducted Wednesday night in lower Manhattan and Brooklyn, and results were uniformly acceptable.

[173] Comprehensive Environmental Response, Compensation, and Liability Act, CERCLA (December 11, 1980) incorporating the National Contingency Plan (NCP). U.S. Code, Title 42--The Public Health and Welfare. http://www.access.gpo.gov/uscode/title42/chapter103_subchapteri_.html
http://www.epa.gov/superfund/programs/recycle/tools/cercla/

[174] When the Federal Emergency Management Administration (FEMA) was activated by the President on 9/11/01, Emergency Support Function #10 was invoked by FEMA, which brought in EPA under its NCP authority. For more information on the responsibilities of EPA under FEMA when there has been a catastrophic release of hazardous substances, see Section V of the following report: Cate Jenkins (July 4, 2003) Comments on the EPA Office of Inspector General's 1/27/03 interim report titled: "EPA's Response to the World Trade Center Towers Collapse" - A DOCUMENTARY BASIS FOR LITIGATION.
www.nycosh.org/environment_wtc/Jenkins-7-4-03-documentary-d.pdf
http://www.nyenvirolaw.org/PDF/Jenkins-7-4-03-documentary-d2.pdf

[175] See earlier reference describing how different offices at EPA are separately responsible for administering the different environmental statutes.

[176] EPA Office of Solid Waste (May 19,1980) § 261.22 Characteristic of corrosivity. *Federal Register*, Vol. 45, No.98, p. 33122. www.Heinonline.org

Title 40 of the CFR: Protection of Environment - PART 261.22. http://www.epa.gov/epahome/cfr40.htm]

> § 261.22 Characteristic of corrosivity. ...
> a) A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:
> (1) It is aqueous and **has a pH less than or equal to 2 or greater than or equal to 12.5** ...
> (2) It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F) ...
> (b) A solid waste that exhibits the characteristic of corrosivity has the EPA Hazardous Waste Number of D002.

[177] EPA, Office of Solid Waste, OSWER (May 2,1980) Background Document, Resource Conservation and Recovery Act Subtitle C -Hazardous Waste Management, Section 3001 - Identification and Listing of Hazardous Waste. 5261.22 -Characteristic of Corrosivity. NTIS Order Number: PB81-184 319. Available from the National Technical Information Service (www.NTIS.gov) by TELEPHONE ONLY (800/553-6847) because this document is before 1990, the earliest date that NTIS posts information on their web site.

> **Studies indicate that pH extremes above 11.5 and below 2.5 generally are not tolerated by human corneal (eye) tissue** (3). ... These limits were chosen in an attempt to balance the following considerations: sensitive human tissue may be damaged when contacted with substances exhibiting pH levels below 2.5 or above 11.5:
> ...
> Upon consideration of these comments and after further deliberation, the Agency has decided to extend the range of acceptable pH levels by decreasing the lower limit from pH 3.0 to 2.0 and increasing the upper limit from pH 12.0 to 12.5. With respect to the upper limit, the Agency agrees with the commenters that **otherwise non-hazardous lime stabilized sludges and wastes should not be designated as hazardous**. Accordingly, the Agency has adjusted the upper limit to pH 12.5 to exclude such wastes from the system.
> ...
> **Although eye tissue is damaged when the pH is above 11.5, normal skin tissue is clearly less sensitive than eye tissue.** Consequently, increasing tie **upper pH limit to 12.5 should not significantly increase the likelihood of damage to skin.**
> ...
> (a) Direct Measurement of Tissue Damage
> **The Agency considered proposing a corrosive characteristic which would directly address tissue damage. A standard technique referenced by Federal agencies and several States employs the application of the suspected corrosive to the bare, intact skin of albino rabbits.** The animals are exposed for a specified period of time after which an assessment of tissue damage is made (16, 17, 18). Conduction of the test requires maintenance of special facilities and the use of skilled personnel to evaluate the extent of injury. The Agency believes that performing this type of testing on each waste stream would add little to the scope of the corrosivity definition and be **unnecessarily burdensome to many members of the regulated community**. For waste disposal purposes, relating tissue damage to an easily measurable characteristic such as pH is

> the more practical approach because the hydrogen ion or hydroxyl ion concentration is related to the degree of injury. **The pH provision will not encompass all substances that damage tissue, but corrosive substances often display other hazardous characteristics that will bring them into the hazardous waste net.** For instance, corrosive metal salts such as the arsenicals, chromates and mercurials probably will be covered by the toxicity characteristic.
>
> ...
>
> (c) Corrosiveness of Solids
> The Agency considered making the pH provision of the corrosiveness characteristic applicable to wastes in solid form which are capable of forming aqueous solutions of low or high pH once disposed. Estimates in the Agency's possession, however, indicate that approximately 90% of all hazardous wastes are in liquid or in semi-liquid form (19).
>
> ...
>
> 8. Tissue Damage – [*public comment*] The regulations should address tissue damage in a more direct manner.
> **Some comments stated that the corrosiveness of some substances which damage human tissue will not be adequately indicated by a pH measurement. As discussed previously, the Agency considered adopting the skin corrosion test referenced by the Food and Drug Administration and the Department of Transportation**, but concluded that relating tissue damage to an easily measurable characteristic such as pH is a more reasonable approach for waste disposal purposes. Not all substances capable of damaging human tissue will be encompassed by the pH provision. However, wastes may display one or more of the other hazardous characteristics or possess qualities which cause them to be listed as hazardous wastes. **Several comments mentioned the Consumer Product Safety Commission detergent toxicity survey which found a relationship between pH and corrosiveness to tissue, but did not find a correlation strong enough to use for regulation of detergent products.** The Agency believes that inasmuch as its pH provision addresses not just tissue damage but also such things as the solubilization of toxic materials and the causation of dangerous chemical reactions, use of pH as a barometer of tissue damage is both reasonable and justified.
>
> ...
>
> [*Reference*] 3. Encyclopedia of Occupational Health and Safety. Volume 1. Geneva, International Labor Office, 1971-72. pp. 220-221. ...
>
> ...
>
> A number of commenters argued that the **proposed upper pH limit of 12.0 would include waste lime** [*"waste lime" is actually a euphemism for cement kiln dust, discussed briefly elsewhere in this complaint*] and many lime treated wastes and sludges which generally have a pH between 12.0 and 12.5 and which can be put to agricultural and other beneficial uses. Many of these commenters suggested raising the upper pH limit to 12.5 while others suggested raising the limit to 13.0.

178 International Labour [*sic*] Office (1971, 1972) Chemical Burns. *In:* Encyclopaedia of Occupational Health and Safety, Volume I – A – K, pages 220 - 221 International Labour Office, CH 1211 Geneva 22, Switzerland, 1971. Special McGraw-Hill Edition, 1972, Library of Congress Card Number: 74-39329, International Standard Book Number: 07-079555-X.

> Burns, chemical
> Most chemical burns result from the action of corrosive substances which destroy tissue at the point of contact. The skin, eyes and digestive system are the most commonly affected parts of the body. The corrosives may be either acid or alkali, the main feature being the hydrogen or hydroxyl concentration. Extremes above pH 11.5 or below 2.5 are not tolerated by the body and will almost always result in irreversible tissue damage. An outstanding feature of chemica [*sic*] burns is the fact that tissue destruction is progressive: acids tend to be neutralised [*sic*] by the available or exposed tissue whereas alkalis continue to cause damage unless neutralised by other means.

179 Desoille, H., Cremmer, G., Cifuentes, J. (1965) Traitement d'urgence des brûlures cutanées par acides forts et bases fortes. [*Experimental Study of Emergency Treatment of Cutaneous Burns by Strong Acids and Strong Bases.*] Note INS No. 420-38-65. Cahiers de notes documentaries, No. 38, 3.

[*This same study apparently was published in another journal as follows*: H DESOILLE , G CREMER , J CIFUENTES (1964) [*Experimental Study of Emergency Treatment of Cutaneous Burns by Strong Acids and Strong Bases.*] Mal Prof. 1964 Dec ;25:703-10 14270472. Mesh-terms: Acids; Burns, Chemical; Caustics; Potassium; Quaternary Ammonium Compounds; Rabbits; Sodium; Therapeutics]

180 Roser, J. (1967) Schütze deine Augen vor Verätzungen. Verlag Tribune, Berlin

181 Andrew P. Worth and Mark T.D. Cronin (2001) The use of pH measurements to predict the potential of chemicals to cause acute dermal and ocular toxicity. Toxicology 169: 119–131.

> According to the first decision rule, which is applied to all observations, seven observations with pH values > 10.5 are placed in node 3 and are predicted to be corrosive. The remaining 37 observations are placed in node 2 and subjected to a second decision rule. Application of the second rule leads to 13 observations with pH values < 3.9 being placed in node 4 and being predicted to be corrosive. The remaining 24 observations are placed in node 5 and are predicted to be non-corrosive. The numbers above each node show how many observations (chemicals) are sent to each node, and the histograms illustrate the relative proportions of corrosive and non-corrosive chemicals in each node. The CT [*classification tree*] for skin corrosion potential can be summarised in the form of PM 1 [*predictive model 1*].
>
> **If pH < 3.9 or if pH > 10.5, then predict as C** [*corrosive*]; otherwise, predict NC [*non corrosive*]. (PM 1)
>
> ...
>
> Indeed, a number of chemicals with intermediate pH values are corrosives (Fig. 2), skin irritants (Fig. 3) or eye irritants (Fig. 4), which indicates that some chemicals elicit their corrosive or irritant effects by mechanisms other than a pH-dependent mechanism. This is especially true of chemically-induced skin and eye irritation, which are known to be associated with an inflammatory response in which the chemically- induced release of 'primary' cytokines leads to the synthesis and release of 'secondary' cytokines that help to maintain the inflammatory response.

182 EPA also did not include the relevant sections of the ILO encyclopedia in the regulatory docket for its Corrosivity Characteristic regulation. In late 1980, I transferred into the Listing Section of the Waste Characterization Branch, Characterization and Assessment Division,[182] Office of Solid Waste (OSW), working on another regulation. The representative from EPA's Office of General Counsel responsible for overseeing RCRA listing regulations and my superior instructed that no published materials should be included in the official docket for my rulemaking, since the public could get these materials from a library. An organization tried to obtain copies of the published materials from us through the Freedom of Information Act (FOIA). I was told not to supply these published materials, even in response to the FOIA request. Thus, the public was effectively hindered from obtaining EPA's full supporting information for comment.

[183] Listed below are key EPA staff involved with RCRA Corrosivity Characteristic during and prior to 1980, its reaffirmation in 1996, and the expanded falsified claims that a pH of 12.5 protects all types of tissues in the 1993 Report to Congress . Many of the key staff responsible for the Corrosivity Characteristic have also been involved in the UN and OECD negotiations (discussed later). This is not an exhaustive list, and represents only my personal recollection and limited inquiry

> Steven Silverman, Esq., EPA Office of General Counsel, responsible for overseeing the legal aspects of the corrosivity characteristic in 1980 as a lawyer within EPA's Office of General Counsel, with continuing responsibilities to this day overseeing RCRA regulatory development, interpretation, and guidance to current time period.
>
> Matthew A. Straus, who in 1980 was Chief, Listing Section, Waste Characterization Branch, Characterization and Assessment Division, OSW. 2001-present, EPA Advisor to the Assistant Administrator, Office of Solid Waste and Emergency Response. At first this was Marianne Horinko, now it is Susan Bodine. During the Clinton Administration, 1995-2001, Vice President of Regulatory Affairs, Don Clay Associates. 6/90 to 3/95, Director/Deputy Director of the Waste Management Division from 3/87 to 5/90, Deputy Director of the Characterization and Assessment Division, now the Hazardous Waste Identification Division, where he was "one of the key negotiators of the Basel Treaty (which the U.S. never ratified) concerning the Transboundary Movement of Hazardous Waste. 1/74 to 2/87, at EPA worked on the original hazardous waste identification rules (1980) which included the Definition of Solid Waste that gave exemptions from hazardous waste regulations, later giving additional exemptions in 1985. Mr. Straus returned to OSW in the second Bush administration as an advisor, along with Marianne Horinko who also had been with Don Clay Associates during the Clinton administration. At the same time, Marianne Horinko was appointed as the Assistant Administrator, Office of Solid Waste and Emergency Response, and responsible for decisions in the WTC cleanup under the NCP and FEMA Support Function #10.
>
> David Friedman, Chief [section responsible for methods and toxicology during 1980 time period. Up to approximately 2005, Mr. Friedman was in EPA's Office of Research and Development and may have retired recently.
>
> Alan S. Corson, Chief, Waste Characterization Branch during 1980 time period
>
> John P. Lehman, Director, Characterization and Assessment Division, OSW during 1980 time period
>
> Reva Rubenstein, Ph.D., toxicology responsibilities as staff member during 1980 time period. Within months of finalization of the corrosivity characteristic and other listings under RCRA, received a position as director of either all or some parts of the National Solid Waste Management Association.
>
> Judith Bellin, Ph.D., toxicology responsibilities as staff member during 1980 time period.

> Greg Helms, around 1992-3 was Chief of the Characteristics Section [or some similar name] under the Waste Characterization Branch. After Sections were eliminated in a reorganization, he remained as a senior staff person responsible for hazardous waste characteristics to this day. He has participated in international programs under the OECD and UN for the Globally Harmonized Guidelines for toxicity and shipment of hazardous wastes across borders, and has gone on international travel for this purpose. He was the primary staff person for the 1996 Scoping Study which reaffirmed contention that a pH of 12.5 was protective for dermal corrosion, and that RCRA regulations did not need to set the corrosivity characteristic at pH 11.5 to protect the eyes. He personally was very knowledgeable about computer searches during this time period, and around 1996 distributed an email to our whole division (if not all of OSW) informing us of a new EPA library service that allowed searching the whole text of scientific studies, not just the abstracts. The time period for preparation of the Scoping Study was transitional as to availability of technical literature and information on the internet. Even past 1996, however, hard copies of 2 newsletters were circulated to senior staff, namely the publication "Inside EPA" and "Pesticide and Toxic Chemical News." There was always an attached "buck slip" where staff would check off their names before giving the copy to another staff member. These 2 publications would have given details on the progress of the new test guidelines being developed by OPPTS on dermal and eye corrosion/irritancy.
>
> Rick Brandes, Chief, Waste Characterization Branch during 1992 (or before) until about 2000. Then Lillian Bagus, then Gail Ann Cooper, and currently in acting capacity, James Michael.
>
> Dave Bussard, Director, Hazardous Waste Identification Division until April 2000, then Robert Dellinger to present.
>
> Director, Office of Solid Waste, OSWER – Michael Shapiro, Ph.D. during 1993 to 1996 time period, Elizabeth Cotsworth, (up until about 2001 – 2002, maybe later); Robert Springer (2002 – 2003); Matt Hale (current)
>
> William Schoenborn, technical staff, team leader, mining exemption group, Municipal and Industrial Solid Waste Division (MISWD), OSW. Now in the Permits and State Programs Division, OSW.
>
> Robert Dellinger, Deputy Director, MISWD, 1989 – 1996. Director, MISWD 1996 – April, 2001. Director, Hazardous Waste Identification Division, April 2001 to present.
>
> Bruce Weddle, Director, MISWD 1989 or before to about 1996.
>
> Rick Picardi worked on international issues in the Hazardous Waste Identification Division.

[184] EPA, Office of Solid Waste, OSWER (May 2,1980) Background Document ... Identification and Listing of Hazardous Waste. 5261.22 -Characteristic of Corrosivity. *op. cit.* See excerpted language in the first citation of this reference.

[185] Lime is either calcium oxide ($Ca(OH)_2$) or calcium hydroxide ($Ca(OH)_2$). Calcium hydroxide is referred to as "hydrated lime," but is used interchangeably with calcium oxide.

[186] EPA Office of Solid Waste (September 13, 1979) Criteria for classification of solid waste disposal facilities and practices; final, interim final, and proposed regulations. Federal Register 53438 – 53464. At pp. 55439, col. 1; 53455, col. 2; 53463, col. 1; and 53464, col. 2. www.heinonline.org

> H. Application to Land Used for the Production of Food-Chain Crops (Section 257.3 – 5) ... the Agency believes that food-chain land application practices which comply with these criteria will pose no reasonable probability of adverse effects on public health and the environment. ...
>
> Sewage sludge applied to the land surface or incorporated into the soil must be treated by a Process to Significantly Reduce Pathogens, Aerobic digestion, air drying, anaerobic digestion, composting, lime stabilization, or other similar techniques will satisfy this requirement. In addition, public access to the site must be controlled for at least 12 months, and grazing by animals whose products are consumed by humans must be prevented for at least one month.
>
> Septic tank pumpings must be treated by one of the Processes to Significantly Reduce Pathogens ...
>
> ...
>
> § 257.3 – 6 Disease
>
> (1) Sewage sludge that is applied to the land surface or is incorporated into the soil is treated by a Process to Significantly Reduce Pathogens prior to application or incorporation. ... Processes to Significantly Reduce Pathogens are listed in Appendix II, Section A. ...
>
> Appendix II A. Processes to Significantly Reduce Pathogens ...
>
> Lime Stabilization: Sufficient lime is added to produce a pH of 12 after 2 hours of contact. ...

[187] EPA Office of Solid Waste (2007) Title 40, Code of Federal Regulations, PART 257—CRITERIA FOR CLASSIFICATION OF SOLID WASTE DISPOSAL FACILITIES AND PRACTICES. http://www.epa.gov/epahome/cfr40.htm

> § 257.3-6 Disease. ...
>
> (1) Sewage sludge that is applied to the land surface or is incorporated into the soil is treated by a Process to Significantly Reduce Pathogens prior to application or incorporation. Public access to the facility is controlled for at least 12 months, and grazing by animals whose products are consumed by humans is prevented for at least one month. Processes to Significantly Reduce Pathogens are listed in appendix II, section A. ...
>
> ...
>
> A. Processes To Significantly Reduce Pathogens (PSRP) ...
>
> 5. **Lime stabilization—Sufficient lime is added to the sewage sludge to raise the pH of the sewage sludge to 12 after two hours of contact.**

[188] EPA Office of Water. Title 40, Code of Federal Regulations, Subchapter O - Sewage Sludge, Part 503. http://www.epa.gov/epahome/cfr40.htm

> § 503.32 Pathogens. ...
>
> (a) Sewage sludge—Class A. ... 4) Class A—Alternative 2. ... (ii)(A) The pH of the sewage sludge that is used or disposed shall be raised to above 12 and shall remain above 12 for 72 hours. (B) The temperature of the sewage sludge shall be above 52 degrees Celsius for 12 hours or longer during the period that the pH of the sewage sludge is above 12.
>
> ...
>
> (8) Class A—Alternative 6. ... (ii) Sewage sludge that is used or disposed shall be treated in a process that is equivalent to a Process to Further Reduce Pathogens, as determined by the permitting authority.
>
> ...
>
> Appendix B to Part 503—Pathogen Treatment Processes
>
> A. Processes To Significantly Reduce Pathogens (PSRP) ...
>
> 5. **Lime stabilization—Sufficient lime is added to the sewage sludge to raise the pH of the sewage sludge to 12 after two hours of contact.** ...

[189] M. Drabkin and E. Rissmann (November 1987) Waste Minimization Audits at Generators of Corrosive and Heavy Metal Wastes. Hazardous Waste Engineering Research Laboratory, EPA, Cincinnati Ohio 45268. Publication Number EPA/600/S2-87/055. http://www.epa.gov/nscep/

> The combined **spent pickle liquor** and rinse water waste stream from the HF/HNO_3 pickling operations has a pH of about 2 and contains dissolved metals, nitrate and fluoride. ... The combined spent acid rinse water waste and the treated Kolene rinse water are pumped to a mix tank where slaked lime is added. **The final pH after lime addition is about 8**. The addition of lime causes the heavy metals present to precipitate as hydroxides and the fluoride to precipitate as calcium fluoride.

[190] Mohn, Michael F. (1992) Method for stabilizing metals in wastewater sludge. United States Patent 5259975. http://www.freepatentsonline.com/5259975.html

> Metal-bearing wastewaters produced in industry have traditionally been treated by the **addition of lime (calcium hydroxide)** or caustic (sodium hydroxide) to precipitate metal hydroxide solids out of solution. The resulting solids are then separated from the clear water by settling or flotation. ... Large amounts of these sludges are produced daily as a waste product from many different types of manufacturing processes involving metal fabrication, plating, finishing, etc.
>
> ...
>
> The effluent wastewater stream is traditionally treated in a clarifier with either caustic (NAOH) or **lime ($Ca(OH)_2$)**. The amount of caustic or lime added to the wastewater stream will vary depending upon the initial, pretreatment pH of the water. The objective, though, is to raise the pH to a value corresponding to the minimum solubility of the resulting hydroxide solids generated from the chemical precipitation reaction of the metal ion(s) and free hydroxyl ion. **The desired pH is typically around 9**.
>
> ...

Example 1
A sample of **waste pickle liquor** was obtained from a specialty steel mill located in Reading, PA. The pickle liquor contained hydrochloric and sulfuric acids, as well as large amounts of dissolved metals (see Table I, below) and relatively small amounts of alkaline cleaner waste. This steel mill currently **treats this waste pickle liquor by adjustments with lime to a pH of 9**

191 Danny. M. McDonald, John A. Webb, Jeff Taylor (2006) Chemical Stability of Acid Rock Drainage Treatment Sludge and Implications for Sludge Management. Environ. Sci. Technol. 40, 1984-1990.

To assess the chemical stability of sludges generated by neutralizing acid rock drainage (ARD) with alkaline reagents, synthetic ARD was treated with hydrated lime (batch and high-density sludge process), limestone, and two proprietary reagents (KB-1 and Bauxsol). ... A higher neutralization potential (e.g., a greater content of unreacted neutralizing agent) makes sludges inherently more chemically stable. Thus, when ARD or any acidic metalliferous wastewater is treated, a choice must be made between efficient reagent use and resistance to acid attack.

...

ARD maybe extremely toxic to the environment, and must be treated before it can be reused or discharged from a site. The most common active treatment method is to increase the pH with an alkaline reagent such as hydrated lime, precipitating a sludge composed of amorphous ferric oxyhydroxide, often with significant concentrations of heavy metals (e.g., copper and zinc) and amorphous aluminum hydroxide. Crystalline gypsum may also be present in the sludge.

...

TABLE 1. Details of Neutralization Procedures ...

	neutralization reagent	**final treatment pH** ...
run 1	15 wt % hydrated lime slurry	**10.0**4
run 2	15 wt % hydrated lime slurry	**9.57**
run 3	15 wt % limestone slurry	**5.17**
	15 wt % hydrated lime slurry	**9.55**
run 4	15 wt % limestone slurry	**5.17**
	15 wt % hydrated lime slurry	**9.11**

...

The recycled sludge raised the pH in reactor 1 to between 6.7 and 7.2. A 10 wt % hydrated lime slurry was pumped into reactor 2 to increase the pH to 9 to complete the treatment. ...

192 Zhuang JM, Walsh T. (2004) Lignor process for acidic rock drainage treatment. Environ Technol. 2004 Sep;25(9):1031-40.

The process using lignosulfonates for acidic rock drainage (ARD) treatment is referred to as the Lignor process. Lignosulfonates are waste byproducts produced in the sulfite pulping process. ... The Lignor process involves metal sorption with lignosulfonates, **ARD neutralization by lime to about pH 7, pH adjustment with caustic soda to 9.4 - 9.6**, air oxidation to lower the pH to a desired level, and addition of a minimum amount of FeCl3 for further removal of dissolved metals.

193 Alves Lde C, Cammarota MC, De Franca FP (2006) Reduction on the anaerobic biological activity inhibition caused by heavy metals and sulphates in effluents through chemical precipitation with soda and lime. Environ Technol. 2006 Dec;27(12):1391-400.

The School of Chemistry Environmental Technology Laboratory generates 43.4 1 of effluent with low pH (0.7) and high contents of COD (1908 mgO2 l(-1)), phenol (132.1 mg l (-1)), sulfate (36700 mg l(-1)) and heavy metals (28.2 mg Hg l(-1); 82.1 mg Cr(total) l(-1); 30.8 mg Cu l(-1); 57.4 mg Fe(total) l(-1); 16.2 mg Al l(-1)) weekly. These data show that this effluent presents high toxicity for biological treatment, with a physical-chemical step being necessary before a biological step. Preliminary studies showed that the most toxic constituents of the effluent were sulfate, phenol and total chromium. In this work, a chemical precipitation step with sodium hydroxide or lime was evaluated for the toxicity reduction on anaerobic microbial consortium. These experiments were carried out with increasing concentrations of alkalis in the effluent in order to obtain pH initial values of 8-12. ... The toxicity on the anaerobic sludge was studied employing specific methanogenic activity (SMA) analysis of raw and treated effluent (after chemical precipitation step). The SMA experiments showed that **chemical precipitation at pH 8 reduces the toxic effect of the effluent** on anaerobic microbial consortium three times (with soda) and thirteen times (with lime). These results indicate that **precipitation with lime is more efficient at toxicity removal, however the produced sludge volume is around two times higher than that produced with soda**.

194 EPA Office of Solid Waste (May 19, 1980) Part III. Hazardous Waste Management System: Identification and Listing of Hazardous Waste. Action: Revisions to final rule and interim final rule and request for comments. Federal Register, 45(98) 33084 – 33133, at pp. 33101 – 33102.
www.HeinOnline.org

7. Sewage Sludge. Unlike the proposed regulation this regulation does not exclude from regulation under Subtitle C sewage sludge from publicly-owned treatment works (POTW's). ...

Finally, other commenters objected to the proposed exclusion of sewage sludge from POTW's and urged that this exclusion be dropped. They claimed that POTW sludge often is very contaminated and thereby can be a hazardous waste. They urged that it not enjoy an arbitrary exclusion. EPA has thoroughly re-examined this issue in light of the comments and **has decided not to exclude POTW sludge and not to add exclusions for any other types of sludge.**

The regulation of sewage sludge is necessarily a complex matter because such sludges fall within the jurisdiction of several Federal environmental programs. Under Section 1004(27) of RCRA, the definition of "solid wastes" specifically includes "sludge from a water treatment plant." In defining "sludge," Section 1004(26A) includes wastes from a "municipal wastewater treatment plant."

Because of these very clear statutory expressions, EPA must regulate sewage sludge under RCRA – either under Subtitle D, where it has already promulgated regulations covering sewage sludge (see 44 FR 53438 et. seq.), or under Subtitle C where these sludges that are deemed by EPA to be hazardous wastes should be regulated. ...

... In addition EPA establishes, under Section 405 of the Clean Water Act (CWA), guidelines from the disposal and utilization of sewage sludge. ... Sewage sludge often contains valuable organic matter and plant nutrients, and it may be distributed to the public as a soil conditioner or fertilizer. Such distribution of sewage sludge may be regulated under the Consumer Product Safety Act (CPSA) or the Toxic Substances Control Act (TSCA), in addition to Section 405 of the CWA.

Where such overlapping jurisdiction exists, EPA seeks to integrate and coordinate its regulatory actions to the extent feasible. ... Section 1006 of RCRA specifically recognizes the need to integrate the solid and hazardous waste programs with other EPA regulatory programs.

To that end EPA has decided to develop a comprehensive set of regulations to deal with sewage sludge management. Such regulations would be co-promulgated under RCRA (Subtitles C and D), the Clean Water Act, the marine Protection, Research and Sanctuaries Act and possibly the Toxic Substances Control Act and/or the Consumer Product Safety Act. These regulations will address sewage sludge from both private and public sources, including septic tank pumpings.

... The Agency has issued and is developing regulations **which will eventually be part of the comprehensive sewage sludge regulation**. For example the Agency promulgated Criteria for the Classification of Solid Waste Disposal Facilities and Practices (44 FR 53438) on September 13, 1979. These regulations, which apply to sewage sludge, include special provisions for the land application of solid waste to food chain crops and for the prevention of disease from pathogens contained in sewage sludge and septic tank pumpings. EPA Issued the Criteria under the authority of Sections 1008(a)(3) and 4004(a) of RCRA as well as Section 405(d) of the CWA. ...

... **Once such a regulation is in place, sewage sludge will be exempted from coverage under other sets of regulations. In particular sewage sludge that qualifies as a hazardous waste will be exempted from this Part and Parts 262 through 265 once this separate sewage sludge regulation, which will provide an equivalent level of protection, is issued in final form**.

Pending promulgation of this comprehensive sewage sludge regulation, sewage sludge will not be specifically excluded from Subtitle C. Like any other solid waste, sewage sludge that exhibits any of the characteristics of hazardous waste established in this regulation must be managed as a hazardous waste. ...

... Some commenters urged EPA to list sewage sludge as a hazardous waste, contending that is was particularly hazardous when used in the growing of food chain crops because of the potential plant uptake of cadmium, PCB's and other contaminants. The Agency has decided not to specifically list sewage sludge as a hazardous waste at this time.

It is difficult to make general determinations about the hazardousness of sewage sludge ... Determinations about the hazardousness of sewage sludge must, therefore, involve the making of some distinctions between types of sludge. ... In addition it should be recognized that the particular hazard identified by the commenters, namely uptake of contaminants in food-chain crops, is being addressed by existing regulations. ... In addition, it is developing regulations covering the distribution and marketing of sewage sludge ... EPA believes that these regulations address ...

[195] EPA Office of Solid Waste (May 19, 1980) Part III. Hazardous Waste Management System: Identification and Listing of Hazardous Waste. Action: Revisions to final rule and interim final rule and request for comments. Federal Register, 45(98) 33084 – 33133, at pp 33120, col. 2.
www.HeinOnline.com

§ 261.4 Exclusions ...
(b) Materials which are not hazardous wastes. ...
(2) Solid wastes generated by any of the following and which are returned to the solids as fertilizers:
  (i) The growing and harvesting of agricultural crops.
  (ii) The raising of animals, including animal manures.
(3) Mining overburden returned to the mine site.
(4) Fly ash waste, bottom ash wastes, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels.
(5) Drilling fluids, produced waters and other wastes associated with the exploration, development, or production of crude oil, natural gas or geothermal energy.

[*Note that the fertilizer exemption has be modified and expanded to address additional environmental concerns. See:*]EPA Office of Solid Waste (2007) Title 40: Protection of Environment, PART 261—Identification and Listing of Hazardous Waste
http://www.epa.gov/epahome/cfr40.htm

§ 261.4 Exclusions. (a) Materials which are not solid wastes. The following materials are not solid wastes for the purpose of this part:
... (20) Hazardous secondary materials used to make zinc fertilizers, provided that the following conditions specified are satisfied:
(i) Hazardous secondary materials used to make zinc micronutrient fertilizers must not be accumulated speculatively, as defined in §261.1 (c)(8).
(ii) Generators and intermediate handlers of zinc-bearing hazardous secondary materials that are to be incorporated into zinc fertilizers must: (A) Submit a one-time notice ... (B) Store the excluded secondary material in tanks, containers, or buildings ... [*etc.*]

[196] These were co-promulgated regulations under both § 258 of RCRA and § 405 of the Clean Water Act (CWA), that set standards for the treatment and agricultural use of sewage sludges.

EPA Office of Solid Waste (September 13, 1979) Criteria for classification of solid waste disposal facilities and practices; final, interim final, and proposed regulations. Federal Register, 44(179): 53437 – 53464, at pp. 53439, col. 1 – 2; 53449, col. 1 – 3; 53455, col. 2; 53464, col. 2.
www.HeinOnline.org

C. Section 405(d): Sludge Disposal Guidelines

Under Section 405(d) of the Clean Water Act EPA issues guidelines for the disposal and utilization of sludge. Under Section 405(e) of the CWA owners and operators of publicly owned treatment works (POTW's) **must dispose of sludges from such works in accordance with those guidelines. Criteria designed to avoid a reasonable probability of adverse effects on health or the environment from disposal of sludge on land are clearly within the scope of this provision of the CWA.**

D. Copromulgation of the Criteria ... The criteria which EPA promulgates today are designed to fulfill or partially fulfill the requirements of each of the provisions discussed above. ... It should be pointed out that these criteria are not necessarily the only guidelines to be promulgated under Section 405(d) of the CWA. These criteria apply where the owners and operators of POTW engage in the placement of sludge on the land. ...

> ...
> III. General Approach ... In terms of the three statutory provisions authorizing this regulation, the criteria define an open dump (RCRA Section 1008(a)(3) and the effects which must be avoided by POTW owners and operators (CWA Section 405).
> ...
> IV. The Criteria ... H. Application to Land Used for the Production of Food - Chain Crops (Section 257.3 – 5) ...
>
> ... **Application of solid waste to agricultural lands may also be an environmentally acceptable method of disposal. However, when improperly managed, the application of solid waste to agricultural lands can create a potential threat to the human food chain through the entry of toxic elements, compounds, and pathogens into the diet**. ... However, the Agency believes that food-chain land application practices which comply with these criteria will pose no reasonable probability of adverse effects on public health or the environment. ...
>
> In their role as guidelines under Section 405 of the Clean Water Act the criteria define the responsibility of owners and operators of POTW's when they apply sewage sludge directly to the land. ... This section of the criteria is being issued today as an "interim final" regulation. ... As proposed, this section of the criteria addressed four general categories of pollutants: (1) Cadmium; (2) pathogens; (3) pesticides and persistent organics; (4) ingestion of toxic organic chemicals and heavy metals (especially PCB's and lead). In the final regulation this section addresses cadmium and PCB's. Pathogens are considered under the disease criterion (§ 257.3 – 6). Lead, pesticides and persistent organics will not be addressed at this time because current information available to the Agency is inadequate to support specific standards. EPA will investigate the possibility of adding more pollutants to the criteria at a later date.
> ...
>
> Sewage sludge applied to the land surface or incorporated into the soil must be treated by a Process to Significantly Reduce Pathogens. Aerobic digestion, air drying, anaerobic digestion, composing, **lime stabilization**, or other similar techniques will satisfy this requirement. ...
> ...
> § 257.4 [*Part 257 is under the RCRA authority*] Effective date. These criteria become effective October 15, 1979. ... Appendix II. A. Processes to Significantly Reduce Pathogens ... **Lime stabilization: Sufficient lime is added to produce a pH of 12** after 2 hours of contact. ...

197 The May 19, 1980 *FR* notice, *op. cit.*, also contained any introductory section (preamble) with extensive discussions, over 28 column inches, about how RCRA was asserting its authority over sewage sludges. Some of these discussions were excerpted in an earlier reference. The *FR* notice discussed the rationale not exempting sewage sludges from the group of Characteristics listings because they were often admixed with hazardous materials from industrial sources. There was no mention in the *FR* notice of the fact that these same sewage sludges were being exempted by fiat by raising the pH level in the Background Document for the Corrosivity Characteristic. This would have been a logical place to have done so.

The extended discussions about sewage sludge in the May 19, 1980 *FR* notice drew attention to the fact that there already were comprehensive RCRA regulations for the disposal of sewage sludges in municipal landfills (including lime stabilized sludges) under RCRA § 258. However, it claimed that there was no comprehensive rule under the CWA yet for the land application of these sludges in agriculture, and it was imposing the Characteristics Listings until there were. This is untrue, because on September 13, 1979 the same rule that finalized the criteria for disposal of these sludges in landfills under RCRA § 258 also co-promulgated comprehensive criteria for the use of these same sludges in agriculture under § 405 of the CWA.

This apparently was an additional strategy to support raising the pH level to 12.5. (In addition to the false claim that the ILO encyclopedia said a pH of 12.5 was not corrosive to the skin, discussed earlier.) This was a subtle argument that the Extraction Procedure Characteristic was needed as protection against toxic metals and pesticides in sewage sludges applied to food crops, and then of course implicitly the Corrosivity Characteristic would need to apply to sewage sludges as well. But this is untrue. The Extraction Procedure Characteristic would provide no additional protection. This is because the September 13, 1979 regulations under § 405 of the CWA were far more protective, specifying total concentrations of metals instead of a dilute leachate test.

In 1986 OSW tested municipals sludges using a test procedure similar to the Extraction Procedure. This was the new Toxicity Characteristic Leaching Procedure which also used a 20:1 dilution of slightly acidic water as the leaching solution. None of the municipal sewage sludges failed. See:

> BIOSOLIDS REFERENCE SHEEBIOSOLIDS SHEET EPPA REGIION VIIIIII 999 18th St., Denver, CO 80202 Mr. Robert Brobst, http://www.epa.gov/region8/water/biosolids/biosolidsdown/handbook/handbook2.pdf
>
> Table 2.3-2 presents the results of studies which were conducted in 1985-86 by the OSW. The studies were used to determine if the TCLP and TC regulatory limits would cause municipal sewage biosolids to be classified as a hazardous waste. The Association of Metropolitan Sewerage Agencies (AMSA) and the OSW analyzed split samples from 12 POTWs using identical analytical methodology.
>
> None of the biosolids tested by the laboratories had TCLP extract concentrations that exceeded the proposed TC regulatory levels. For most contaminants, except metals, there were non-detects in the TCLP extracts and very few contaminants were detected by either laboratory on the same biosolids sample. The importance to POTW operators is two-fold. First, TCLP information may be helpful when establishing a public education program. Uninformed citizens may think that biosolids are hazardous by nature and a threat to human health and the environment. The results of this study indicate otherwise. Second, the 12 POTWs involved in the study were in urbanized areas and accepted from 5% to 90% of their flows from industrial sources. It is quite likely that biosolids from small and medium size POTWs would produce TCLP extract concentrations lower than the biosolids analyzed in the study, and thus have a better chance of passing the TCLP test.

In addition, there were no discussions whatsoever in the Background Document of the adverse consequences that would occur if lime stabilized sludges were not disposed of properly or not used in a controlled manner in agriculture. This is highly inconsistent with EPA's final comprehensive regulations for sewage sludges that were published on, which stated that sewage sludges could endanger human health and the environment if not managed according to the criteria set for in the final rules under the CWA (§ 405) and RCRA (§ 258) published on 9/13/79.

There are several other options available under RCRA if EPA wanted to exempt lime-stabilized sewage sludges. There never was a need to raise the pH to 12.5 for the universe of all alkaline wastes in order to accommodate lime-stabilized sewage sludge use in agriculture, opening the door to the possibility of mismanagement of other wastes with a pH of 12.5 and higher

EPA can defer regulation from one section of RCRA to another, such as excluding sewage sludges from a hazardous waste regulation under § 261 of RCRA because there already were comprehensive regulations under § 258 of RCRA. The May 19, 1980 FR notice even stated that it intended to defer regulation of sewage sludges used in agriculture to the CWA, but falsely claimed that no such regulations existed yet. A whole category of lime-stabilized sludges (but not with a pH over about 9) from the iron and steel industry are now exempted from RCRA, as well as other wastes. See below:

> EPA Office of Solid Waste (2007) Title 40: Protection of Environment, PART 261— Identification and Listing of Hazardous Waste http://www.epa.gov/epahome/cfr40.htm
>
> § 261.3 Definition of hazardous waste.
> (c) (2) (ii) The **following solid wastes are not hazardous** even though they are generated from the treatment, storage, or disposal of a hazardous waste, unless they exhibit one or more of the characteristics of hazardous waste: ... (A) Waste pickle liquor sludge generated **by lime stabilization** of spent pickle liquor from the iron and steel industry (SIC Codes 331 and 332).

EPA can also defer regulation to another statutory authority other than RCRA. EPA has long deferred RCRA regulations of polychlorinated biphenyls (PCB's) to the Toxic Substances Control Act (TSCA), exempting it from the Characteristics Listings:

> [*Note, very recently PCB's will again come under control of RCRA.*] EPA Office of Solid Waste (2007) Title 40: Protection of Environment, PART 261—Identification and Listing of Hazardous Waste. http://www.epa.gov/epahome/cfr40.htm
> ...
> § 261.8 PCB wastes regulated under Toxic Substance Control Act.
> The disposal of PCB-containing dielectric fluid and electric equipment containing such fluid authorized for use and regulated under part 761 of this chapter and that are hazardous only because they fail the test for the Toxicity Characteristic (Hazardous Waste Codes D018 through D043 only) are exempt from regulation under parts 261 through 265, and parts 268, 270, and 124 of this chapter, and the notification requirements of section 3010 of RCRA.

Regulations for the management and disposal of asbestos wastes comes under the Clean Air Act regulations instead of RCRA. Asbestos is not even included on the list of hazardous substances in Appendix VIII to § 261 of RCRA.

198 EPA Office of Solid Waste (November 15, 1996) Hazardous Waste Characteristics Scoping Study. http://www.epa.gov/epaoswer/hazwaste/id/char/scopingp.pdf

> The ignitability, corrosivity, and reactivity (ICR) characteristics are essentially unchanged since their initial promulgation in 1980.
> ...
> Potential limitations of pH as an adequate indicator of corrosivity. Excludes corrosive non-liquids pH limits may not effectively protect against some types of injury Corrosion to materials other than steel is not directly addressed Solubilization of non-metals (e.g., by organic solvents) is not addressed Excludes irritants and sensitizers pH test methods may not accurately predict hazards
> ...
> **pH limits may not cover some hazards**. EPA originally proposed pH limits of 12.0 or greater and 3.0 or less, and a majority of commenters argued that these limits were too stringent. The commenters argued that the limit of 12.0 or greater would regulate as hazardous many lime-stabilized wastes and sludges, thereby discouraging use of a valuable treatment technique, and that the pH limit of 3.0 or less would regulate a number of substances generally thought to be innocuous (e.g., cola drinks) and many industrial wastewaters prior to neutralization. EPA agreed with these commenters and promulgated pH limits of 12.5 or greater and 2.0 or less in the 1980 final rule.
>
> **The more stringent proposed pH limits were based on studies of eye tissue damage. These studies indicated that pH extremes above 11.5 and below 2.5 generally are not tolerated by human corneal tissue.** [*Reference*]**8** **EPA decided that basing pH limits on eye tissue damage was unnecessarily conservative. Thus, eye damage is a hazard not fully addressed by the corrosivity characteristic.**
> ...
> [*Reference*]**8** U.S. Environmental Protection Agency, Office of Solid Waste, Background Document: Resource Conservation and Recovery Act, Subtitle C-Identification and Listing of Hazardous Wastes, Section 261.22-Characteristic of Corrosivity, May 2, 1980, p. 5. [*This EPA background document cited the ILO Encyclopaedia of Occupational Safety and Health, discussed and cited earlier, as its source for information on the pH of corrosive materials.*]
> ...
> Use of pH as an indicator has limitations. EPA chose pH as a measure of corrosivity because "wastes exhibiting low or high pH can cause harm to human tissue, promote the migration of toxic contaminants from other wastes, react dangerously with other wastes, and harm aquatic life."[13] **The ability of some substances to damage human tissue, however, may not be adequately indicated by a pH measurement. Other regulatory and advisory bodies (e.g., DOT, OSHA, Basel Convention) use criteria based on full thickness destruction of human skin.**

199 EPA Office of Solid Waste (September 25, 1996) Notice of Data Availability and Public Meeting on Environmental Release Descriptions Supporting the Hazardous Wastes Characteristics Scoping Study. Federal Register, 61: 50295. http://www.gpoaccess.gov/fr/index.html

EPA Office of Solid Waste (November 15, 1996) Notice of Data Availability on the Hazardous Waste Characteristics Scoping Study. Federal Register, 61: 58549. http://www.gpoaccess.gov/fr/index.html

A list of records in the official docket for the 1996 Hazardous Waste Scoping Study may be found at: www.regulations.gov
In the search criteria, make the following entries:

1. **IMPORTANT: UNCHECK "Documents Open for Public Comment"**
2. Choose Environmental Protection Agency for "Agency."
3. Choose "ALL" for Document Type
4. Enter "scoping study" for Keyword

DOCKET - RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
E-mail: rcra-docket@epa.gov
Web address(s): www.epa.gov/epaoswer/osw/ric.htm
Hours and Location: open to the public from 8:30 a.m. to 4:30 p.m., Monday through Friday.
EPA West Building, Room 3334 [Temporary Location]

1301 Constitution Avenue, NW
Washington, DC 20460
If you are going to visit the EPA Docket Center, please make an appointment so that the material you wish to view is ready when you arrive

[200] EPA Office of Solid Waste (January 4, 1985) Hazardous Waste Management System; Definition of Solid Waste, Final Rule. Federal Register Vol. 50(3) 613-668, at pp, 663 – 664, 651. www.heinonline.org

[201] As of 1985, lime-stabilized/treated sewage sludges were exempted from RCRA hazardous regulations by the newly promulgated "Definition of a Solid Waste." These regulations exempted all types of sludges from RCRA regulations if they were reclaimed and only hazardous because they were a "characteristic" waste. "Reclaimed" was defined in 1985 as a subset of the broader category "recycled." "Recycled" includes use, reuse, as well as reclamation. "Use" is not the same as "reclaimed." Thus the "use constituting disposal" provisions do not apply to sewage sludges that are processed with value added and sold as soil amendments/liming agents.

EPA Office of Solid Waste (January 4, 1985) Hazardous Waste Management System; Definition of Solid Waste, Final Rule. Federal Register Vol. 50(3) 613-668, at pp, 663 – 664, 651. www.heinonline.org

> ...
> § 261.2 Definition of solid waste. ...
> (c) Materials are solid wastes if they are recycled—or accumulated, stored, or treated before recycling— as specified in paragraphs (c)(1) through (4) of this section. ...
> (1) Used in a manner constituting disposal. ...
> (2) Burning for energy recovery. ...
> (3) Reclaimed. Materials noted with a "*" in column 3 of Table 1 are solid wastes when reclaimed (except as provided under §261.4(a)(17)). **Materials noted with a "—" in column 3 of Table 1 are not solid wastes when reclaimed**. ...
> (4) Accumulated speculatively. ...
> ...

Table 1				
	Use constituting disposal ...	Energy recovery/ fuel ...	Reclamation ...	Speculative Accumulation ...
...	...	...	...	...
Sludges exhibiting a characteristic of hazardous waste	(*)	(*)	—	(*)
...	...	...	...	...

> ...
> (4) A material is "reclaimed" if it is processed to recover a usable product, or if it is regenerated. ...
> (7) A material is "recycled" if it is used, reused, or reclaimed.
> ...
> § 261.3 Definition of hazardous waste. ...
> (c)(2) ... (However, materials that are reclaimed from solid wastes and that are used beneficially are not solid wastes and hence are not hazardous wastes under this provision unless the reclaimed material is burned for energy recovery or used in a manner constituting disposal.)

Municipal wastewater/sewage treatment sludges that are used as soil amendments and/or for their liming properties are clearly value-added reclaimed materials and sold to individual consumers in garden supply stores as well as used in commercial agriculture. See the following references:

Richard C. Stehouwer and Kirsten E. Macneal (2004) Heavy Metals in the Environment. Effect of Alkaline-Stabilized Biosolids on Alfalfa Molybdenum and Copper Content J. Environ. Qual. 33:133–140. http://jeq.scijournals.org/cgi/reprint/33/1/133

> Alkaline-stabilized biosolids (ASB) must be given particular consideration in assessment of Mo risk because the high pH of these biosolids could increase Mo and decrease Cu uptake by forage legumes.
> ...
> Table 1. Chemical characteristics of alkaline-stabilized biosolids used in 1999 and 2000. ...
> pH 12.3 [*1999*] 12.3 [*2000*]
> ...
> The ASB used in this experiment was produced by the N-Viro (Toledo, OH) process, which involves treating dewatered sewage sludge with an alkaline admixture to generate high pH and temperature followed by accelerated drying. Chemical characteristics of the ASB are given in Table 1. The alkaline admixture consisted of flue gas desulfurization by- products supplemented with additional quicklime (CaO) or hydrated lime [$Ca(OH)_2$] to achieve necessary pH and temperature limits. Flue gas desulfurization by-products generally consist of coal combustion ash, gypsum, and alkalinity in the form of $Ca(OH)_2$ and $CaCO_3$ ...

N-Viro International Corporation (2000)Toledo, OH. http://www.nviro.com/facility%20references/facs/toledo.htm

> Since December of 1989 N-Viro International Corporation has operated the City of Toledo's sludge-to-soil processing facility, which is located between a golf course and two popular marinas. The N-Viro facility treats approximately 150 wet tons per day, or approximately 40,000 tons annually, of anaerobically digested sludge. N-Viro developed the Class A, Advanced Alkaline Stabilization with Subsequent Accelerated Drying (AASSAD) process to treat the city's sludge and convert the material to a licensed aglime, N-Viro Soil™ (NVS), that is sold to area farmers. The operators use a variety of alkaline admixtures in the process including lime kiln dust and fluidized bed ash from area power generators.

[202] EPA Office of Water (November 15, 1996) Proposed National Pollutant Discharge Elimination System General Permit and Reporting Requirements for the Final Beneficial Reuse or Disposal of Municipal Sewage Sludge. Federal Register, Volume 61, Number 222: 58550-58554.
http://www.epa.gov/fedrgstr/EPA-WATER/1996/November/Day-15/pr-21063.html

> All other TWTDS must apply for a permit. A TWTDS is defined in 40 CFR Subparts 122.2 and 501.2 as ``a POTW or any other sewage sludge or waste water treatment devices or systems, regardless of ownership (including federal facilities), used in the storage, treatment, recycling, and **reclamation of municipal or domestic sewage**, including land dedicated for the disposal of sewage sludge.

[203] National Research Council (1996) Use of **Reclaimed Water and Sludge** in Food Crop Production. Committee on the Use of Treated Municipal Wastewater Effluents and Sludge in the Production of Crops for Human Consumption Water Science and Technology Board Commission on Geosciences, Environment, and Resources National Research Council. National Academy Press. http://www.epa.gov/owmitnet/mtb/biosolids/useofmid/index.htm

> Adequacy of Existing Regulations for Pathogens in **Reclaimed Water and Sludge**
> Municipal wastewater contains a variety of pathogenic (infectious) agents. **When reclaimed water or sludg**e is used on fields producing food crops, the public health must be protected. This can be achieved by proper wastewater or sludge treatment and site management that reliably reduces the pathogens to acceptable levels.
> ...
> There have been no reported outbreaks of infectious disease associated with a population's exposure—either directly or through food consumption pathways—to adequately treated and properly distributed **reclaimed water or sludge applied to agricultural land**. Reports and available epidemiological evidence from other countries indicate that agricultural reuse of un-treated wastewater can result in infectious disease transmission.
> ...
> CONCLUDING REMARKS
> In summary, society produces large volumes of treated municipal wastewater and sewage sludge that must be either disposed of or reused. While no disposal or reuse option can guar-antee complete safety, the use of these materials in the production of crops for human consumption, when practiced in accordance with existing federal guidelines and regulations, presents negligible risk to the consumer, to crop production, and to the environment. Current technology to remove pollutants from wastewater, coupled with existing regulations and guidelines **governing the use of reclaimed wastewater and sludge in crop production**, are adequate to protect human health and the environment. Established numerical limits on concentration levels of pollutants added to cropland by sludge are adequate to assure the safety of crops produced for human consumption.

[204] EPA Office of Water (January 2007) NPDES PART II STANDARD CONDITIONS. http://www.epa.gov/ne/npdes/permits/generic/PartIIfinal2007.pdf

> Publicly Owned Treatment Works (POTW) means any facility or system used in the treatment (including recycling and **reclamation) of municipal sewag**e or industrial wastes of a liquid nature which is owned by a "State" or "municipality". ... Treatment works treating domestic sewage means a POTW or any other sewage sludge or wastewater treatment devices or systems, regardless of ownership (including federal facilities), used in the storage, treatment, recycling, and **reclamation of municipal or domestic sewag**e, including land dedicated for the disposal of sewage sludge.

[205] World Health Organization (2002) Developing Human Health-related Chemical Guidelines for Reclaimed Water and Sewage Sludge Applications in Agriculture. http://www.epa.gov/region8/water/biosolids/WHO_report.pdf

> By critically reviewing the technical issues involved in the development of guidelines for cropland application of **reclaimed wastewater and sewage sludge**, the World Health Organization may direct the attention of interested parties to safeguard these practices worldwide.

[206] EPA Office of Solid Waste (May 19, 1980) Part III. Hazardous Waste Management System: Identification and Listing of Hazardous Waste. Action: Revisions to final rule and interim final rule and request for comments. Federal Register, 45(98) 33084 – 33133, at pp. 33101 – 33102. www.HeinOnline.org

> The Agency has issued and is developing regulations **which will eventually be part of the comprehensive sewage sludge regulation**. For example the Agency promulgated Criteria for the Classification of Solid Waste Disposal Facilities and Practices (44 FR 53438) on September 13, 1979. These regulations, which apply to sewage sludge, include special provisions for the land application of solid waste to food chain crops and for the prevention of disease from pathogens contained in sewage sludge and septic tank pumpings. EPA Issued the Criteria under the authority of Sections 1008(a)(3) and 4004(a) of RCRA as well as Section 405(d) of the CWA. ...
> ... **Once such a regulation is in place, sewage sludge will be exempted from coverage under other sets of regulations. In particular sewage sludge that qualifies as a hazardous waste will be exempted from this Part and Parts 262 through 265 once this separate sewage sludge regulation, which will provide an equivalent level of protection, is issued in final form**.
> Pending promulgation of this comprehensive sewage sludge regulation, sewage sludge will not be specifically excluded from Subtitle C. Like any other solid waste, sewage sludge that exhibits any of the characteristics of hazardous waste established in this regulation must be managed as a hazardous waste. ...

[207] EPA Office of Water (Feb. 19, 1993) Federal Register, 58: 9387. www.HeinOnline.org

EPA Office of Water. Title 40, Code of Federal Regulations, Subchapter O - Sewage Sludge, Part 503. http://www.epa.gov/epahome/cfr40.htm

[208] Precedents were already set for such deferrals from RCRA to the CWA, because in 1990 there was a major deferral of the § 261 Corrosivity Characteristic under RCRA to the CWA for sewage wastewater under the § 268 RCRA Land Disposal Restriction. In 1990, OSW deferred regulating wastewaters that met the RCRA Corrosivity Characteristic under the RCRA Land Disposal Restrictions to the CWA and Safe Drinking Water Act authorities.

EPA Office of Solid Waste (June 1, 1990) Land Disposal Restrictions for Third Third Scheduled Wastes; Rule. Federal Register, 55:22520 – 22720, at: 22653 - 22659: www.HeinOnline.org

> d. Agency Framework for Addressing Treatment Stands for Characteristic Wastes and Integrating them With Other Regulatory Programs. The Agency believes that it has authority to apply LDR [*land disposal restriction*] requirements at the point of waste generation for characteristic wastes and that such an approach will generally better achieve the goals of the LDR program. ... EPA recognizes, however, that there are many far-

> reaching policy considerations respecting the actual implementation of this approach. ... many of these potentially affected subtitle D units contain wastes that are regulated, in art, under the National Pollutant Discharge Elimination System (NPDES) and pretreatment programs under sections 301, 304, 307, and 402 of the CWA, and the Underground Injection Control (UIC) program under the SDWA [*Safe Drinking Water Act*]. Requiring treatment below characteristic levels or imposing a dilution prohibition would require significant changes to the operations of these facilities and create problems of regulatory integration.
> ...
> Section 1006(b) of RCRA requires the Agency to integrate "for the purposes of administration and enforcement" RCRA subtitle C with the goals and policies of other portions of RCRA, as well as other statutes administered by EPA. ...
> ...
> In addition, EPA discusses the exclusions for some of these requirements for certain practices regulated under the CWA and SDWA. ... As a result, EPA is not imposing treatment standards below characteristic levels for such wastewaters. Based on the information in the rulemaking record virtually all wastewaters are managed in the context of CWA treatment impoundments or UIC wells. ...EPA has considered the advantages of additional treatment, with the difficulties in (1) implementing a requirement to treat below characteristic levels and (2) the effect of such a rule on overlapping federal environmental programs. ... Requiring levels of treatment below the characteristic level would also have specific disruptive impact on practices regulated, in part, under the CWA.

[209] Comprehensive Environmental Response, Compensation, and Liability Act (December 11, 1980) U.S. Code, Title 42--The Public Health and Welfare.
http://www.access.gpo.gov/uscode/title42/chapter103_subchapteri_.html
http://www.epa.gov/superfund/programs/recycle/tools/cercla/

> Chapter 103--.Subchapter I--Hazardous Substances Releases, Liability, Compensation.
> Sec. 9601. Definitions. For purpose of this subchapter-- ...
> (14) The term ``hazardous substance'' means (A) any substance designated pursuant to section 311(b)(2)(A) of the Federal Water Pollution Control Act (33 U.S.C. 1321(b)(2)(A)), (B) any element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title, (C) **any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act** (42 U.S.C. 6921) (but not including any waste the regulation of which under the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.) has been suspended by Act of Congress), (D) any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act (33 U.S.C. 1317(a)), (E) any hazardous air pollutant listed under section 112 of the Clean Air Act (42 U.S.C. 7412), and (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act (15 U.S.C. 2606). The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).
> ...
> Sec. 9602. Designation of additional hazardous substances and establishment of reportable released quantities; regulations ...
> (b) Unless and **until superseded by regulations** establishing a reportable quantity under subsection (a) of this section for any hazardous substance as defined in section 9601(14) of this title, (1) **a quantity of one pound**, or (2) for those hazardous substances for which reportable quantities have been established pursuant to section 1321(b)(4) of title 33, such reportable quantity, shall be deemed that quantity, the release of which requires notification pursuant to section 9603(a) or (b) of this title.
> ...
> Sec. 9652. Effective Dates; Savings Provisions
> (a) Unless otherwise provided, **all provisions of this chapter shall be effective on December 11, 1980**.

[210] The "Reportable Quantity" was changed from one pound to 100 pounds in 1985.

EPA Office of Emergency Response (May 25, 1983) Notification Requirements; Reportable Quantity Adjustments, Proposed Rule. Federal Register, 48: 23552 – 23605, at pp. 23552 – 23523, 23566, 23571, 23595, 23602, . www.HeinOnline.org

> The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Pub. L. 96-510), 42 U.S.C. § 9601 et seq., enacted on December 11, 1980, establishes broad federal authority to deal with releases or threats of releases of hazardous substances from vessels and facilities. The Act specifies an initial list of 696 hazardous substances (Section 101(14)). EPA may designate additional hazardous substances (Section 102).
> The Act requires the person in charge of a vessel or facility to notify the National Response Center ("NRC") immediately when there is a release of a designated hazardous substances in an amount equal to or greater than the reportable quantity for that substance (Section 103 (a) and (b) [1]). Section 102(b) of CERCLA establishes RQs [*Reportable Quantities*] for releases of designated hazardous substances at one pound, unless other reportable quantities were assigned under Section 311 of the Clean Water Act. Section 102 authorizes EPA to Adjust all of these reportable quantities.
> ...
> D. Special Types of Substances
> Several types of substances, notably unlisted ICRE [*Ignitable, Corrosive, Reactive, and Extraction Procedure Toxicity Characteristic*] wastes and radionuclides, pose special problem for RQ adjustment and require separate discussion.
> 1. Unlisted RCRA Wastes (ICRE) Wastes). As noted previously, **the CERCLA hazardous substances include hazardous wastes which exhibit the characteristics of ignitability, corrosivity, reactivity, and extraction procedure toxicity, but which are not specifically listed as hazardous wastes. These are commonly known as unlisted ICRE wastes (see 40 CFR 261.20 through 40 CFR 261.21). These wastes were all given a statutory RQ of one pound under CERCLA.**
> The Agency is proposing an RQ of 100 pounds for the unlisted hazardous wastes exhibiting the characteristics of ignitability, corrosivity, and reactivity (40 CFR 261.21, 261.22, and 261.23).
> ...
> § 302.4. Designation of hazardous Substances
> (a) Listed Hazardous Substances. The elements and compounds and hazardous wastes appearing in Table 302.4 are designated as hazardous substances under Section101(14) of the Act.

> (b) Unlisted Hazardous Substances. A solid waste, as defined in 40 CFR 261.2, which is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b), **is a hazardous substance under Section 101(4) of the Act if it exhibits any of the characteristics identified in 40 CFR 261.20 through 261.24**.

EPA Office of Emergency Response (April 4, 1985) Notification Requirements; Reportable Quantity Adjustments, Final Rule and Proposed Rule. Federal Register, 50: 13456 – 13522, at 13460, 13474, 13499.

211 EPA Office of Emergency Response. Protection of Environment. Code of Federal Regulations, 40 CFR §300 CHAPTER I. http://www.epa.gov/epahome/cfr40.htm

> SUBCHAPTER J -- SUPERFUND, EMERGENCY PLANNING, AND COMMUNITY RIGHT-TO-KNOW PROGRAMS
> PART 300 -- NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN
> ...
> §300.3 Scope.
> (a) The NCP applies to and is in effect for: ...
> (2) **Releases into the environment of hazardous substances**, and pollutants or contaminants which may present an imminent and substantial danger to public health or welfare of the United States.
> ...
> §300.5 Definitions. ...
> **Hazardous substance as defined** by section 101(14) of CERCLA, means: Any substance designated pursuant to section 311(b)(2)(A) of the CWA; any element, compound, mixture, solution, or substance designated pursuant to section 102 of CERCLA; **any hazardous waste having the characteristics** [*which includes the Corrosivity Characteristic with pH of 12.5 as trigger*] **identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act** (but not including any waste the regulation of which under the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.) has been suspended by Act of Congress); any toxic pollutant listed under section 307(a) of the CWA; any hazardous air pollutant listed under section 112 of the Clean Air Act (42 U.S.C. 7521 et seq.); and any imminently hazardous chemical substance or mixture with respect to which the EPA Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act (15 U.S.C. 2601 et seq.). ...
> ...
> Subpart E -- Hazardous Substance Response -- §300.400 General.
> (a) This subpart establishes methods and criteria for determining the appropriate extent of response authorized by CERCLA and CWA section 311(c): (1) When there is a **release of a hazardous substance into the environmen**t;
> ...
> §300.410 Removal site evaluation.
> (b) A removal site evaluation of a release identified for possible CERCLA response pursuant to §300.415 shall, as appropriate, be undertaken by the lead agency as promptly as possible. The lead agency may perform a removal preliminary assessment in response to petitions submitted by a person who is, or may be, affected by a **release of a hazardous substance, pollutant, or contaminant** pursuant to §300.420(b)(5).
> ...
> (f) **A removal site evaluation shall be terminated when** the OSC or lead agency determines:
> (1) There is no release;
> (2) The source is neither a vessel nor a facility as defined in §300.5 of the NCP;
> (3) The release involves neither a hazardous substance, nor a pollutant or contaminant that may present an imminent and substantial danger to public health or welfare of the United States;
> ...
> § 302.4 Designation of hazardous substances.
> (a) Listed hazardous substances. The elements and compounds and hazardous wastes appearing in table 302.4 are designated as hazardous substances under section 102(a) of the Act.
> (b) Unlisted hazardous substances. A solid waste, as defined in 40 CFR 261.2, which is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b), **is a hazardous substance under section 101(14) of the Act if it exhibits any of the characteristics identified in 40 CFR 261.20 through 261.24.**
> ...
> Table 302.4--List of Hazardous Substances ...
> Unlisted Hazardous Wastes ...*
> **Characteristic of Corrosivity**. ...

212 EPA Emergency Response Program. What Substances Are Covered? http://www.epa.gov/superfund/programs/er/triggers/haztrigs/whatsub1.htm#hazard

> Hazardous Substance Definitions
> CERCLA section 103 release reporting requirements apply to "hazardous substances." How are CERCLA hazardous substances defined? CERCLA section 101(14), as amended, defines "hazardous substance" by referencing other environmental statutes, including:
>
> - CWA sections 311 and 307(a);
> - CAA section 112;
> - RCRA section 3001; and
> - TSCA section 7. [*TSCA section 7 chemicals do not include and corrosive category.*]
>
> CERCLA section 102(a) also gives EPA authority to designate additional hazardous substances not listed under the statutory provisions cited above. [*There has never been an action by the Administrator independently after a release to add any substance to the list.*] There are currently about 800

213 EPA, Office of Solid Waste, OSWER (December 31, 1993) Report to Congress – Cement Kiln Dust Waste. http://www.epa.gov/epaoswer/other/ckd/cement2.htm

> Major results and conclusions from the evaluation of potential danger to human health and the environment from the management of CKD are presented below. ... **The pH of CKD leachate measured in laboratory tests typically ranged from 11 to 13**. High pH levels in ground water and

> surface water may result in a variety of adverse effects, including the mobilization of certain metals and other constituents that could pose toxicological problems, **human tissue burns (at pH levels above 12.5 or more)**, corrosion in pipes, and objectionable taste in drinking water. In addition, high pH levels could cause a wide variety of adverse ecological effects.

214 Eastern Research Group (2001) FINAL Analysis of Groundwater Monitoring Data Submitted by the American Portland Cement Alliance Response to EPA Contract No. 68-W-99-001 WA 231. http://www.epa.gov/epaoswer/other/ckd/ckd/gw_analysis.pdf

> [*Provides real examples where groundwater was contaminated with pH levels of greater than 12.5 from cement kiln dust leachates.*]

215 EPA, Office of Solid Waste, OSWER (1997)Technical Background Document: Population Risks from Indirect Exposure Pathways, and Population Effects from Exposure to Airborne Particles from Cement Kiln Dust Waste. http://www.epa.gov/epaoswer/other/ckd/cement4.htm

> [*p. 3-1*] Chapter 3 Population Effects Due to PM [*particulate matter*] Exposures ... The objective of this analysis is to estimate the risks to populations exposed to airborne particulate matter released from CKD waste management units at cement facilities. ...
> [*p. 3-3*] Identify an Appropriate "Risk Descriptor" for PM Exposures ... the Agency characterized population effects in terms of exposures to both PM_{10} and $PM_{2.5}$. ... the Agency used the National Ambient Air Quality Standards ...
> ...
> Emissions – CKD Pile Wind and Bulldozer Erosion ...
> Since CKD is predominantly less than 75 micrometers (μm) in diameter, the threshold friction velocity for the smallest distribution mode included on the graph (0.1mm or 100 μm) was selected. However, the resulting threshold friction velocity, 0.25 meters per second (m/s), first appeared to be quite low relative to those reported in AP-42 for use in the emissions equation. Furthermore, EPA believed that the natural tendency of CKD to crust when exposed to moisture will tend to increase the threshold friction velocity for weathered surfaces. After further investigation into the properties of soils with physical characteristics similar to those found in CKD piles, a value of 0.75 (based on data for silt loam soil) was chosen for the threshold friction velocity.

216 Furthermore, the 1997 risk assessment for CKD "doctored" the EPA peer-reviewed dust exposure model in order to decrease the projected inhalation exposures from piles of CKD to below levels of concern. In order to do this, EPA changed the actual measured small sizes of CKD particles to much larger sizes, that of a sandy loam soil, so that the model would not show the particles becoming airborne from dust piles to as great an extent.

Changing the input into an established peer-reviewed EPA model to get the desired outcome has been used at least once for another hazard evaluation for a RCRA regulation. Around 2000, as a member of the paint hazardous waste listing team (Robert Kayser was the Team Leader, Waste Characterization Branch, Hazardous Waste Identification Division, OSW), I was asked by Charlotte Bertrand (Economics, Methods and Risk Analysis Division, OSW) to provide the sizes of particles of organics pigments for modeling airborne wind erosion emissions from piles containing organic pigment wastes. I provided textbook information, including tables, showing small sizes for organic pigments, smaller than inorganic pigments, to be used as an input parameter into the established EPA mathematical model. Because of the small particle size for organic pigments, a high enough risk from wind erosion from waste piles resulted. I was told that they would not use these input values and/or modeling results as a basis for listing organic pigment wastes as hazardous, because a decision had already been made not to list any waste from paint production.

EPA, Office of Solid Waste, OSWER (1997)Technical Background Document: Population Risks from Indirect Exposure Pathways, and Population Effects from Exposure to Airborne Particles from Cement Kiln Dust Waste. op. cit.

217 LaFarge North America. MSDS, Blended Supplemental Cementacious Material (SCM).
www.lafargenorthamerica.com/wps/wcm/resources/file/eb8a9045eb37551/Portland%20Cement%20MSDS%205.pdf

> Calcium oxide, % by weight, 1 – 55% ...
> pH (in water): 8 – 11 ...

Titan Cement Company. MSDS, Portland Cement. http://www.titanamerica.com/products/msds/pdf/titan_Portland_cement.pdf

> Portland cement is a light gray or white powder. When in contact with moisture in eyes or on skin, or when mixed with water, portland cement becomes highly caustic (pH>12) and will damage or burn (as severely as third degree) the eyes or skin. Inhalation may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system or may cause, or may aggravate, certain lung diseases or conditions. Use exposure controls or personal protection methods described in Section 10.

Roanoke Cement, A Titan America Business. MSDS. Cement Kiln Dust. http://www.titanamerica.com/products/msds/pdf/rcc_cement_kiln_dust.pdf

> Cement kiln dust is a gray or tan powder. When in contact with moisture in eyes or on skin, or when mixed with water, cement kiln dust becomes caustic (pH>11) and may damage or burn (as severely as third degree) the eyes or skin. Inhalation may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system or may cause, or may aggravate, certain lung diseases or conditions.
> ...
> (Acute/Chronic) Exposure to airborne dust may cause immediate or delayed irritation or inflammation of the cornea. Eye contact by larger amounts of dry powder or splashes of wet cement kiln dust may cause effects ranging from moderate eye irritation to chemical burns and blindness.
> ... pH (IN WATER): 12 to 13

218 J. Spoo and P. Elsner (2001) Cement burns: a review 1960–20. Contact Dermatitis, Volume 45 Page 68
http://www.blackwell-synergy.com/doi/full/10.1034/j.1600-0536.2001.045002068.x

> The skin, eye and respiratory tract are the organ systems most prone to damage by ready-mixed cement or cement dust. Damage to the respiratory epithelium may become life-threatening (6). So-called cement burns do not relate to skin damage caused by thermal effects, but are due instead to

irritation or alkaline burns of the upper skin layers. The skin lesions induced are classified in degree according to the depth of the damage. ... Clinical symptoms and signs were described uniformly: pain, burning sensations, erythema and tissue defects (erosions, ulcerations, necroses) were mentioned in almost all cases. In several reports edema and vesicles were described, whereas pruritus or hypesthesias were rare. ... A survey of local and systemic treatment and of surgical debridement or skin grafting is given in Fig. 5. It is clear that skin grafting was necessary in 1/4 of the cases reported. Information on the mean duration of the healing process was available for 29 persons (62%), and amounted to 6 weeks. ... As mentioned above, 4 cases of exposure to cement powder used for marking playing fields have been described (27, 28). All those affected were of school age. Skin lesions on the thighs were induced by falling on the touchline and moistening of the dry powder by sweat or rain. The scrotal skin was also involved in 1 case. ... Typical features of cement burns are damage to the horny layer by abrasion, occlusion and wetness, and possible progressive damage to deep skin layers by the alkalinity of cement.

219 Stephen J Nervi, MD, Robert A Schwartz, MD, MPH,, Franklin Desposito, MD, Mark A Hostetler, MD, MPH. (2006) Burns, Chemical. Emedicine. http://www.emedicine.com/ped/topic2735.htm

Common sources of alkalis (bases)
- Drain or oven cleaners may contain sodium or potassium hydroxide.
- Cleaners and detergents may contain ammonia or any of the sodium or potassium polyphosphates.
- Household bleach or pool chlorination system or tablets may contain sodium or calcium hypochlorite.
- Cement, mortar, or plaster may contain calcium hydroxide or oxide.

220 Julius Mwaiselage, Magne Bråtveit, Bente E Moen, Yohana Mashalla (2005) Respiratory symptoms and chronic obstructive pulmonary disease among cement factory workers. Scand J Work Environ Health 31(4):316–323

The exposed workers had more chronic cough (odds ratio (OR) 4.5, 95% confidence interval (95% CI) 1.9–10.4], chronic sputum production (OR 10.8, 95% CI 4.4–26.4.), dyspnea (OR 5.3, 95% CI 1.9–15.2), work related shortness of breath (OR 4.8, 95% CI 1.6–14.2), and chronic bronchitis (OR 5.5, 95% CI 2.0–15.3) than the controls. Chronic cough, chronic sputum production, dyspnea, work-related shortness of breath, and chronic bronchitis were significantly related to cumulative dust exposure of 20.0–99.9 and ≥100.0 versus <20.0 mg/m^3- years.
...
Although there is evidence of an increased prevalence of respiratory symptoms among exposed cement workers, the level of the risk of developing chronic obstructive pulmonary disease (COPD) has been uncertain, as only two such studies have been performed in the cement industry
...
A total of 120 full-shift personal "total" cement dust measurements were carried out for 80 randomly selected workers from the 8 occupational groups using closed faced 37-mm Millipore samplers connected to a sampling pump. Overall, the concentrations of nine total dust samples were considered to be outliers and were removed during the analysis. ... The cumulative total dust exposure for each worker was calculated as the sum of the products of the arithmetic mean of the dust concentration and the years worked in the specific work area, expressed as mg/m^3-years.

221 Julius Mwaiselage, Magne Bråtveit, Bente E Moen, Yohana Mashalla (2004) Cement dust exposure and ventilatory function impairment: An exposure-response study. Journal of Occupational and Environmental Medicine, 46(7) 658 – 667.

We investigated cumulative total cement dust exposure and ventilatory function impairment at a Portland cement factory in Tanzania. All 126 production workers were exposed. The control group comprised all 88 maintenance workers and 32 randomly chosen office workers. Exposed workers had significantly lower forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), peak expiratory flow rate (PEF), FEV_1/FVC, FVC%, FEV_1% and PEF%, than controls adjusted for age, duration of employment, height, and pack-years. Cumulative total dust exposure was significantly associated with reduced FVC, forced expiratory volume in 1 second, and peak expiratory flow rate adjusted for age, height and pack-years. Cumulative total dust exposure more than 300 mg/m year versus lower than 100 mg/m years was significantly associated with increased risk of developing airflow limitation (odds ratio = 9.9). The current occupational exposure limit for total cement dust (10 mg/m^3) appears to be too high to prevent respiratory health effects among cement workers.
... Exposed cement workers have significantly lower ventilatory function indices than control workers. [*references cited*]

222 Stephen R. Gomez (1992) Respiratory health effects of alkali dust in residents near desiccated Old Wives Lake – Saskatchewan. Archives of Environmental Health, Volume: 47 , Number: 5 , Page: 364. http://www.findarticles.com/p/articles/mi_m0907/is_n5_v47/ai_12908570/print

Moreover, Old Wives Lake contained elevated levels of sodium cations and sulfate anions and **had a pH of 9.5**. ... Since late 1987, prevailing northwest winds across this arid alkali surface have raised much dust. **Exposure to the airborne alkali has caused (a) weight loss and nasal and eye irritation in livestock; (b) increased nasal, throat, and eye irritation; and (c) respiratory problems in residents.** Seasonal wind and climate patterns indicated that maximum exposure occurred in late spring and in late summer/early autumn. ... Total dust concentration ranged from undetectable to 0.6 mg/m^3 at five sites in the control area and from undetectable to 1.6 mg/m^3 at four sites near Old Wives Lake. The corresponding respirable dust fractions were undetectable to 0.2 mg/m^3 and undetectable to 0.8 mg/m^3 for control and test sites respectively. ...

223 EPA Office of Solid Waste and Emergency Response (undated) Cement Kiln Dust Waste, Cement Kiln Dust Legislative and Regulatory Time Line. http://www.epa.gov/epaoswer/other/ckd/

October 12, 1980—Congress enacts the Solid Waste Disposal Act Amendments of 1980 (Public Law 96-482) which amends RCRA. Among the amendments, Section 3001(b)(3)(A)(i-iii)—frequently referred to as the Bevill Amendment—temporarily exempts three special wastes from hazardous waste regulation until further study can be completed. Cement kiln dust is one of the wastes exempted. At the same time, Section 8002(o) requires EPA to study CKD and submit a Report to Congress evaluating the status of its management and potential risk to human health and the environment by October 1983. EPA is also required to make a regulatory determination (within six months of the completing the Report to Congress) as to whether CKD warrants regulation under RCRA Subtitle C or some other set of regulations.

[224] It is reasonable to assume that EPA staff worked closely with Congress and agreed to all aspects of the SWDA of 1980, based on personal past experience. I was a staff person when Congress was drafting new hazardous waste amendments, the Hazardous and Solid Waste Amendments of 1986 (HSWA). Staff at all levels in my branch drafted position papers, agreements and promissories to Congress for the deadlines in HSWA for completion of regulations for specific industries, indicating which industries should be regulated, etc.

[225] EPA, Office of Solid Waste, OSWER (February 7, 1995) 40 CFR Part 261 Regulatory Determination on Cement Kiln Dust; Final Rule. *Federal Register*, Vol 60(25) 7365 – 7377. http://www.gpoaccess.gov/fr/advanced.html

> While CKD itself does not exhibit the RCRA Subtitle C hazardous waste characteristic of corrosivity (40 CFR 261.22) 2, EPA's data show that mixtures of CKD and water often exhibit the characteristic of corrosivity. In particular, **runoff from precipitation that contacts CKD storage and waste piles generates considerable volumes of wastewater. EPA data show that the pH level in such precipitation runoff typically exceeds 12.5** standard units, the standard for the corrosivity characteristic for hazardous wastes (40 CFR 261.22).
> ...
> **pH of CKD leachates** (using standard EPA leach test procedures) are typically between **11 and 13** standard units. In addition, the elevated pH of a CKD water mixture is a prominent factor in 10 out of 14 cases of damage (documented and potential) to surface water and/or ground water. In six of these cases, including the ground water damages described for the two plants listed on the NPL, **CKD-water mixtures are reported to have a pH exceeding the EPA standard of 12.5 for corrosive hazardous waste** (40 CFR 261.22).

[226] EPA, Office of Solid Waste, OSWER (August 20, 1999) Standards for the Management of Cement Kiln Dust; Proposed Rule. *Federal Register* Vol. 64(161) 45631 – 45697. http://www.epa.gov/epaoswer/other/ckd/ckd/ckd-fr.pdf

[227] International Labor Organization (1971-1972), *op. cit.*

[228] OECD (May 12, 1981) Test Guideline 404 'Acute Dermal Irritation/Corrosion'

> A. INTRODUCTION, PURPOSE, SCOPE, RELEVANCE, APPLICATION AND LIMITS OF TEST.
> In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant or corrosive effects on skin of mammal is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of the skin to the test substance.
> DEFINITIONS
> Dermal irritation is the production of reversible inflammatory changes in the skin following the application of a test substance.
> Dermal corrosion is the production of irreversible tissue damage in the skin following the application of a test substance.
> PRINCIPAL OF THE TEST METHOD
> The substance to be tested is applied in a single dose to the skin of several experimental animals, each animal serving as its own control. The degree of irritation is read and scored at specified intervals and is further described to provide a complete evaluation of the effects. The duration of the study should be sufficient to evaluate fully the reversibility or irreversibility of the effects observed. ...
> **Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 or less or 11.5 or greater, need not be tested for primary dermal irritation, owing to their predictable corrosive properties.**

OECD (May 12, 1981) Test Guideline 405 'Acute Eye Irritation/Corrosion'

[229] Organization for Economic Co-operation and Development (undated) Draft Test Guideline Proposal 404, 405 and 429. http://www.oecd.org/LongAbstract/0,2546,en_2649_34377_1816704_1_1_1_1,00.html

> Test Guideline 404 'Acute Dermal Irritation/Corrosion' was first adopted in 1981 and was revised in 1992. Likewise, Guideline 405 'Acute Eye Irritation/Corrosion' was adopted in 1981 and revised in 1987. ... For several years consensus has existed that all existing information on a test substance should be evaluated prior to undertaking either in vivo dermal or eye irritation/corrosion studies of that substance. ... These testing strategies were subsequently affirmed and expanded in the Harmonised [*sic*] Integrated Hazard Classification System for Human Health and Environmental Effects of Chemical Substances, as endorsed by the 28th Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, in November 1998. ... The two Guideline proposals were **circulated for expert review in March 2000. Ten Member Countries (Australia, Austria, Canada, Finland, France, Germany, Italy, the Netherlands, the United Kingdom, and the United States) provided comments** on Test Guidelines 404 and 405 and their respective attachments (entitled Supplements). The draft proposed guidelines and supplements were revised in the light of the comments received, and the revised draft documents [ENV/JM/TG(2001)2] were submitted for review at the 13th WNT in May 2001. **Written comments on these documents were received from three Member Countries (Germany, the Netherlands, and the United States)**. During the meeting these, and additional oral, comments were discussed, and appropriate changes made to the draft documents. Subsequently, the National Coordinators approved the revised proposals and their respective supplements during this meeting.

[230] OECD (July 17, 1992) OECD Guideline for Testing of Chemicals. 404. Acute Dermal Irritation/Corrosion. [*Not available on the internet*]

> This updated version of the original guideline 404 (adopted in 1981) is the outcome of a meeting of OECD experts held in Paris in May 1991. ... The main differences between this and the original version of the guideline are a) the inclusion of data from *in vitro* tests in the information on which a decision not to proceed to an *in vivo* test can be based; and b) the possibility to use one animal in a first step of the *in vivo* procedure allowing certain chemicals to be exempted from further testing. ...
> INITIAL CONSIDERATIONS
> 4. In the interests of animal welfare, it is important that the unnecessary use of animals is avoided, and that any testing which is likely to produce severe responses in animals is minimised [*sic*]. Consequently, test materials meeting any of the following criteria should not be tested in animals for dermal irritation/corrosion:

> i) **materials that have predictable corrosive potential based on structure-activity relationships and/or physicochemical properties such as strong acidity or alkalinity, e.g., when the material to be applied has a pH of 2 or less or 11.5 or greater (alkaline or acidic reserve (1) should also be taken into account)** ...

[231] United Nations Environment Programme. 1987. Cairo guidelines and principles for the environmentally sound management of hazardous wastes. Decision 14/30 of the Governing Council. 17 June 1987. as cited in: OECD WORKSHOP (October 28-29, 1999) THE ENVIRONMENTALLY SOUND MANAGEMENT OF RECOVERABLE WASTES (ESM) Cancún, Mexico. http://www.oecd.org/dataoecd/62/0/2744032.pdf

[232] United Nations Environment Programme (February 5, 1992) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. http://www.basel.int/text/documents.html

> Scope of the Convention
> 1. The following wastes that are subject to transboundary movement shall be "hazardous wastes" for the purposes of this Convention:
> (a)Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III
> ...
> ANNEX I CATEGORIES OF WASTES TO BE CONTROLLED ...
> Y34 **Acidic solutions or acids in solid form**
> Y35 **Basic solutions or bases in solid form**
> ...
> ANNEX III LIST OF HAZARDOUS CHARACTERISTICS ...
> 8 H8 Corrosives
> **Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue**, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.
> ...
> ANNEX VIII LIST A
> Wastes contained in this Annex are characterized as hazardous under Article 1, paragraph 1 (a), of this Convention, and their designation on this Annex does not preclude the use of Annex III to demonstrate that a waste is not hazardous. ...
> A4090 **Waste acidic or basic solutions**, other than those specified in the corresponding entry on list B (note the related entry on list B B2120)
> ...
> ANNEX IX LIST B
> Wastes contained in the Annex will not be wastes covered by Article 1, paragraph 1 (a), of this Convention unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic. ...
> B2120 **Waste acidic or basic solutions with a pH greater than 2 and less than 11.5, which are not corrosive or otherwise hazardous (note the related entry on list A A4090)**

[233] United Nations Environment Programme (February 5, 1992) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. *op. cit.*

[234] Key EPA OSW staff with responsibilities for representing the U.S. in both Basel Convention (UN) and Cairo Convention (OECD) negotiations during 1992 to present time periods were described in an earlier reference under the section describing the falsification of the RCRA Corrosivity Characteristic.

[235] Organization for Economic Co-operation and Development (undated) Draft Test Guideline Proposal 404, 405 and 429, *op. cit.*

[236] United Nations. Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Historical background. http://www.unece.org/trans/danger/publi/ghs/histback_e.html

> The work about the elaboration of the GHS began with the premise that existing systems should be harmonized in order to develop a single, globally harmonized system to address classification of chemicals, labels, and safety data sheets. ... The technical focal points for completing the work were: ... the Organization for Economic Cooperation and Development (OECD) for the classification of health and environmental hazards ...

[237] OECD (May 12, 1981) Test Guideline 404 'Acute Dermal Irritation/Corrosion,' *op. cit.*
OECD (May 12, 1981) Test Guideline 405 'Acute Eye Irritation/Corrosion, *op. cit*

[238] OECD (1999) OECD SERIES ON TESTING AND ASSESSMENT Number 16. Detailed Review Document on Classification Systems for Skin Irritation/Corrosion in OECD Member Countries. http://www.olis.oecd.org/olis/1999doc.nsf/LinkTo/env-jm-mono(99)6

Agency	pH
OECD, EU, Norway	**≤2, ≥11.5, buffering**
UN transport	**-**
Canada workplace	**≤2, ≥11.5, buffering**
Canada pesticides	**Roughly ≤2, ≥11.5**
US CPSC	**-**
US EPA pesticides & industrial chemicals	**≤2, ≥11.5**
US FDA policy	**-**
US OSHA	**-**

...
pH Extreme
Extremes of pH are identified by Canadian pesticides and workplace, EU, OECD, and US EPA pesticides and industrial chemicals as indicating potential severe dermal effects (Table 1). All of these but Canadian pesticides point out that a **pH less than or equal to 2 or greater than or equal to 11.5 may be associated with serious dermal effects**. EU and OECD emphasize the importance of knowing something about the buffering capacity of test materials with a pH extreme. Other authorities do not us pH extreme.
...
Authorities vary in the factors that are considered before in vivo testing. All the various initial considerations currently being used by different authorities all seem to have a rational basis. They include: historical human experience, SAR, pH extremes, acute dermal toxicity findings, results of in vitro test results. The more information that is reviewed, the more likely preliminary hazard decisions can be made that would obviate the need for any in vivo dermal testing, an obvious benefit.

Human experience with irritating and corrosive materials is not extensive, but it can be very illuminating when it exists; after all, the responses are in the species of concern. SAR can be helpful in identifying certain potentially corrosive and irritating substances, like organic peroxides and other groupings. Extremes of pH (< 2, > 11.5) are good indicators of corrosivity, especially when buffering capacity is considered. However, without consideration of acid and alkaline reserve, deviations from expectation may be noted.

239 OECD (August 14, 2001) Environment Directorate Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology. OECD Series on Testing and Assessment Number 33: Harmonized Integrated Classification System for Human Health and Environmental Hazards of Chemical Substances and Mixtures. http://www.epa.gov/oppfod01/harmonization/docs/harmointeg.pdf

Several factors should be considered in determining the corrosion and irritation potential of chemicals before testing is undertaken. Existing human experience and data including from single or repeated exposure and animal observations and data should be the first line of analysis, as it gives information directly referable to effects on the skin. In some cases enough information may be available from structurally related compounds to make classification decisions. Likewise, **pH extremes like ≤ 2 and ≥ 11.5, may indicate dermal effects, especially when buffering capacity is known, although the correlation is not perfect. Generally, such agents are expected to produce significant effects on the skin**. It also stands to reason that if a chemical is highly toxic by the dermal route, a dermal irritation/corrosion study may not be practicable since the amount of test substance to be applied would considerably exceed the toxic dose and, consequently, would result in the death of the animals.
...
Tiered testing and evaluation of **dermal corrosion** and irritation potential ...
pH with buffering → **pH ≤ 2 and ≥ 11.5** → **Classify as corrosive**
...
pH extremes like ≤ 2 and ≥ 11.5 may indicate strong local effects, especially in combination with assessment of acid or **alkaline reserve**,
...
Chapter 3.3: HARMONISED SYSTEM FOR THE CLASSIFICATION OF CHEMICAL MIXTURES WHICH CAUSE SKIN AND EYE CORROSION/IRRITATION ...
A mixture is considered corrosive (Skin Category 1, Eye Category 1) if it has a pH of 2 or less or 11.5 or greater.

240 European Union (2002) Implementing the Globally Harmonised System of Classification and Labelling of Chemicals (GHS). http://ec.europa.eu/enterprise/reach/ghs_en.htm

It was agreed at the 2002 UN World Summit on Sustainable Development in Johannesburg that the GHS should be implemented worldwide, with a target date of 2008. The GHS will provide harmonised [*sic*] health and safety information for chemical substances and mixtures. The European Commission has stated (in the explanatory memorandum to the proposed amendment of Directive 67/548/EEC, which was adopted at the same time as the REACH proposal) that it would come forward with the necessary legislative proposal. It is the aim that the GHS implementing legislation is adopted at the same time as the final REACH legislation.

241 This applies if the receiving country is party to the Basel Convention.

242 EPA Office of Solid Waste (undated EPA Website) International Waste Activities. Chapter 1. A. Introduction to Hazardous Waste Identification. http://www.epa.gov/osw/internat/hwid-intro2.htm

Exclusions
The second step in the hazardous waste identification process is determining whether a solid or hazardous waste exclusion in §261.4 of the regulations applies to a given material. If such an exclusion applies, then the material is released from RCRA jurisdiction and is not subject to regulation as a hazardous waste ...

B. Applicability of Import & Export Requirements ... Importers and exporters must know if the waste they handle is hazardous under RCRA. If the waste is not a hazardous waste or is exempt from regulation, the RCRA import and export regulations do not apply. Therefore, RCRA import or export regulations do not apply to the following materials: ... For example, suppose a US generator produces a characteristic sludge that will be reclaimed in Canada. In this case, the generator need not comply with the export requirements because the sludge is not a solid waste. (See Table 1 earlier in this Chapter.) RCRA excludes characteristic sludges that are reclaimed from the definition of solid waste in §261.2, whether the reclamation occurs within or outside of the United States. EPA discusses this concept in the Federal Register from April 12, 1996:

"The Agency wishes to point out that a relatively narrow set of hazardous secondary materials are not defined as solid wastes and, therefore, are not hazardous wastes when recycled in a particular manner (e.g., listed commercial chemical products that are to be reclaimed). Thus, these materials would not be subject to the export requirements. Exporters of such materials, nevertheless, should keep in mind that they have the burden of proof to show that such materials are to be recycled in a manner bringing them outside the scope of solid waste (61 FR 16290, 16307; April 12, 1996)."
...

> First, Part 262, Subpart H applies only to waste shipments between OECD countries. For purposes of Subpart H, OECD countries include Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States (§262.58(a)(1)).
> ...
> Q: Are characteristic by-products subject to exporting requirements?
> A: If characteristic by-products are exported for reclamation, they are not solid wastes and not subject to exporting requirements (§261.2). Generators exporting characteristic by-products for reclamation must document that the material is not a solid waste (Monthly Hotline Report Question; September 1986). If exporters send these materials for disposal, they are subject to the export regulations.

243 Elizabeth A. Cotsworth, Director, Office of Solid Waste, EPA (April 13, 2000) Letter to Garcia regarding hazardous waste exports. http://yosemite.epa.gov/osw/rcra.nsf/ea6e50dc6214725285256bf00063269d/a3db865b007c9ccc8525693600683cfa!OpenDocument

> Thank you for your letter of December 15, 1999, in which you expressed concern regarding hazardous waste exports to developing countries. Your correspondence was referred to me by the White House.
> ...
> Since the U.S. is not currently a party to the Basel Convention, there must be a bilateral agreement between us and the importing country that is consistent with the requirements of the Convention.
> ...
> In fact, except for some wastes sent to Canada, all 1995 U.S. hazardous waste exports were for recycling. However, despite our best efforts to regulate hazardous waste exports, we periodically uncover cases of hazardous wastes being illegally exported to other countries under the guise of recycling.

244 EPA Office of Solid Waste (August 17, 1999) Request for Information Concerning Transfrontier Movements of Wastes Destined for Recovery Operations within the OECD Area. *Federal Register*, Vol. 64, No. 158, 44722 – 44730. http://www.epa.gov/fedrgstr/EPA-WASTE/1999/August/Day-17/f21311.htm

> The Basel Convention establishes a system for controlling transboundary movements of hazardous wastes and other wastes for both final disposal and recycling (note: recycling is considered a type of disposal under the Convention).
> ...
> TABLE 4.—BASEL ANNEX IX LISTINGS PARTIALLY COVERED BY OECD AMBER LISTINGS ...
> AB110 Basic solutions...........2120 Waste acidic or basic solutions with a pH greater than 2 and less than 11.5, which are not corrosive or otherwise hazardous (note the related entry on Annex VIII: A4090).
> ...
> AD110 Acidic solutions.......... B2120 Waste acidic or basic solutions with a pH greater than 2 and less than 11.5, which are not corrosive or otherwise hazardous (note the related entry on Annex VIII: A4090).
> …
> Regarding replacement of the OECD green, amber, and red lists with Basel Convention Annexes VIII and IX, general concerns have been expressed that use of the Basel lists could affect the flow of secondary materials and wastes throughout the OECD area. EPA is interested in specific, concrete examples of these concerns in addition to the following information: … For any and all items listed on the OECD green, amber, and red lists, and Basel Convention Annexes VIII and IX, the Agency is interested in any and all reasonably available information on: (i) established and anticipated future trade patterns within the OECD area, (ii) economic value of the trade in these wastes and materials, (iii) volumes of the wastes and materials moving within the OECD area, and (iv) any other relevant information. Of particular importance is information on secondary materials which, when recycled in certain ways, are excluded from the definition of solid waste under RCRA (e.g. characteristically hazardous sludges which, when reclaimed (including when exported within the OECD area for reclamation), are not solid wastes). Because these materials are not solid wastes in the U.S., but may be considered solid and hazardous waste in other OECD countries (and could therefore be subject to C(92)39 in those countries), EPA has no knowledge of the volume and economic value of this trade, and therefore does not fully understand how substitution of the Basel lists for the OECD lists could affect transboundary movements of these materials

245 Key EPA OSW staff with responsibilities for representing the U.S. in both Basel Convention (UN) and Cairo Convention (OECD) negotiations during 1992 to present time periods include, to the best of my recollection without extensive research:

> Rick Picardi worked on international issues in the Hazardous Waste Identification Division. He said that he was unaware that the UN/OECD had set the pH level at 11.5 for skin corrosion, and that it contradicted with what OSW had claimed in the Background Documentation for the 40 CFR § 261.22 Corrosivity Characteristic. In early February 2007 he said he was unaware of the difference between the Corrosivity Characteristic pH levels and the UN/OECD levels. He referred me to Greg Helms as possibly having worked on characteristics issues at the international level.
>
> Greg Helms, around 1992-3 was Chief of the Characteristics Section [or some similar name] under the Waste Characterization Branch. After Sections were eliminated in a reorganization, he remained as a senior staff person responsible for hazardous waste characteristics to this day. He has participated in international programs under the OECD and UN for the Globally Harmonized Guidelines for toxicity and shipment of hazardous wastes across borders, and has gone on international travel for this purpose. He was the primary staff person for the 1996 Scoping Study which reaffirmed contention that a pH of 12.5 was protective for dermal corrosion, and that RCRA regulations did not need to set the corrosivity characteristic at pH 11.5 to protect the eyes.
>
> When I spoke to Greg Helms on 1/29/07 about the falsification of the 1971-72 ILO encyclopedia, and the falsifications in the 1993 Report to Congress on cement kiln dust, he was very knowledgeable on several issues. He brought up the subject of the new in *vitro tests* for skin corrosion, describing them as "ingenious" using cores of flesh from slaughter houses, measuring the rate of penetration of corrosive substances. He pulled from his desktop a bound copy of the 1996 Characteristics Scoping Study and quickly found the section where it said that a pH level of 11.5 was only intended to protect the eyes. I told him that the UN/OECD had set the level for skin corrosion at pH 11.5. At that point he claimed he was unaware of the fact. On his own initiative, he then pulled from his desktop a bound version of the 2003 United Nations "Globally Harmonized System of Classification and Labelling of Chemicals (GHS)" and began looking for the UN/OECD corrosivity level for skin. .His copy of the UN GHS had numerous colored plastic Post-it tabs with hand written labels like "Toxicity." I told him to find the statement in the text part of the document,

> because I saw him looking only at the different flow charts, and I had never seen the pH criteria of 11.5 in flow chart before. I offered to find the relevant section for him. He declined, and continued to look only at the flow charts. He quickly found the pH criteria of 11.5 in one of the flow charts and marked it with a green highlighter.
> The UN GHS 2003 document download page may be found at: http://www.unece.org/trans/danger/publi/ghs/ghs_rev00/00files_e.html
>
> I told Greg Helms that I would email him a copy of the original 1971-72 ILO encyclopedia, the 1993 Report to Congress on CKD, as well as the 1981 regulations under EPA's Pesticide Program which classified skin corrosion as presumptively occurring at pH 11.5, which I did by email within a few minutes of speaking with him.

246 The OSW intranet "Share Drive" (available only internally within OSW) contained 4329 files when downloaded in early March 2007. Only one document directed compared the different pH levels (pH 12.5 for RCRA, pH 11.5 for Basel Convention). This document was dated 7/17/98, apparently prepared by a contractor (SAIC) in support of the data solicitation in EPA's August 17, 1999 Federal Register notice requesting information from the regulated community on its current exports of RCRA Characteristic Wastes, cited in a previous reference. Many different copies of the same 7/17/98 document were found in different file folders in the OSW "Share Drive" showing that it was universally noted and kept for retention by different OSW staff persons responsible for international waste activities. It included a long tabular comparison of all types of hazardous wastes definitions under RCRA compared to the Basel Convention. The following was the entry regarding the difference in the pH levels:

> [*SAIC, presumed author of report*] (July 17, 1998) Comparison of Basel Convention Annex VIII Definition to RCRA and Other U.S. Environmental Regulations ...
> At the Fourth Meeting of the Conference of Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, the parties to the Basel Convention adopted an amendment to the Convention which creates two annexes: Annex VIII and Annex IX. Annex VIII contains a list of wastes that are determined by parties to the Convention to be characterized as hazardous, therefore are within the scope of the Convention. Annex IX contains the list of wastes that are not characterized as hazardous, therefore are beyond the scope of the Convention.
>
> EPA must determine the regulatory status of each waste in Annex VIII under U.S. environmental regulations prior to developing implementing legislation for the U.S. to ratify the Basel Convention. This report provides an initial analysis of how each of the wastes listed in Annex VIII is regulated under RCRA and if applicable, other environmental laws such as the Clean Water Act (CWA) and the Toxic Substances Control Act (TSCA).
> ...

Annex VIII Code and Definition	Applicable RCRA Code, definition, and notes
... A4090: Waste acidic or basic solutions, other than those specified in the corresponding entry on list B (note the related entry on list B B2120)	... Any waste with pH less than 2 or greater than 12.5 would meet the corrosivity characteristic (D002). Five K-wastes and five U-wastes are listed as hazardous because they are corrosive. Certain acids and caustics are excluded from solid waste regulation when reclaimed regardless of their pH: spent sulfuric acid (40 CFR§261.4(a)(7), and certain spent caustics from petroleum refining (40 CFR §261.4(a)(17)). Waste B2120 includes waste solutions with pH greater than 2 and less than 11.5.

A draft training manual e under the authorship of the Basel Convention Secretariat of UN Environment Programme gives a false level for the pH of alkaline corrosive wastes in an example. The draft training manual claims the level is pH 12.5 for a plating solution, when in fact the Basel Convention level is pH 11.5, as per Annex VIII of the Basel Convention adopted in 1998. Although this draft manual had no date on the document itself, the file date was 9/12/2003. This exact same draft that was on the OSW share drive is currently posted as a download on the .Phillipine Economic Zone Authority website at: http://environment.peza.gov.ph/downloads

The suspect paragraphs were probably authored by staff in the Hazardous Waste Identification Division, OSW, EPA, and circulated to other UN countries for comment. By 1998, the Basel Convention had been amended to include specific trigger level for corrosivity, and clearly stated that 11.5 was the pH for alkaline corrosivity. The following is the false characterization of the Basel Convention trigger level for alkaline corrosive hazardous wastes.

> DRAFT
> United Nations Environment Programme Basel Convention Secretariat TRAINING MANUAL for the Enforcement of Laws Implementing the Basel Convention with guidance for the safe and effective detection, investigation, and prosecution of illegal traffic and disposal of hazardous wastes
> ...
> Hazardous wastes are defined and identified in several basic ways. First, a waste may be listed as hazardous in national law or the Basel Convention Annex. These lists describe the hazardous waste as either a chemical compound or waste from a specific industrial process. Wastes on these lists are designated by codes beginning with the letters F, K, P, or U, and followed by a number, maintained by transportation and environmental regulatory agencies or ministries.
>
> Second, a waste may be classified as hazardous if it has the hazardous characteristics of ignitability, corrosiveness, reactivity, or toxicity set forth in the **Basel Convention Annex** and national law or regulation. Common examples include: (1) for Ignitibility: petroleum solvents, waste paint thinners, acetones with flashpoints less than 140 degrees Fahrenheit; (2) for Corrosivity: metal plating solution wastes with a Ph between 0 and 2 or **greater than 12.5**; (3) for Reactivity: waste peroxides and shock sensitive materials; and (4) Toxicity: lead oxides and other wastes from metal refining are classified as hazardous if they exceed specified concentrations.

This language and false pH level of 12.5 is not in the final version of the UNEP Training Manual may be downloaded from the Basel Convention webpage at: http://www.basel.int/legalmatters/illegtraffic/index.html
Note that when the manual is actually downloaded, the title has been simplified to: "TRAINING MANUAL ON ILLEGAL TRAFFIC"

247 EPA Office of Pesticide Programs (October 24, 1984) 40 CFR Part 158. Data Requirements for Pesticide Registration; Final Rule. *Federal Register* 49(207) 42856 – 42905. www.Heinonline.org

Also, due to their predictable corrosive properties, strongly acidic or alkaline test substances need not be tested for primary eye and primary dermal irritation. For regulatory purposes, the Agency [*speaking for the whole of EPA, not just the Office of Pesticide Programs and Office of Toxic Substances*] assumes these substances are corrosive. ... Information derived from primary eye and primary dermal irritation studies serves to identify possible hazards from exposure of the eyes, associated mucous membranes and skin.

...

§ 158.135 Toxicology data requirements ...

Kind of data required	(b) Notes	
Acute testing		...
Acute oral toxicity – rat	(1)	...
Acute dermal toxicity	(1), (**2**)	...
Acute inhalation toxicity – rat	(16)	...
Primary eye irritation – rabbit.	(**2**)	...
Primary dermal irritation	(1), (**2**)	...
...	...	...

...

(1) Not required if test material is a gas or highly volatile.

(**2**) **Not required if test material is corrosive to skin or has pH less than 2 or greater than 11.5**

[248] EPA Office of Pesticides (November 1982) Pesticide Assessment Guidelines, Subdivision F. Hazard Evaluation: Human and Domestic Animals. EPA Publication No. EPA 540/ 9-82-025. NTIS Doc. No. PB 83-153916NTIS Number PB83-153916. Available from the National Technical Information Service (www.NTIS.gov) by TELEPHONE ONLY (800/553-6847) because this document is before 1990, the earliest date that NTIS posts information on their web site.

Subdivision F supports the data requirements of 40 CFR Part 158. ...

§ 81-4 Primary eye irritation. ...

(b) Purpose. In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant and/or corrosive effects on eyes of mammals is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of the eyes and associated mucous membranes to the test substance.

(c) Definitions.

(1) "Eye corrosion" is the production of irreversible tissue damage in the eye ...

(2) "Eye irritation" is the production of reversible changes in the eye ...

(d) Standard of the test method. ...

(2) **Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 of less or 11.5 or greater, need not be tested owing to their predictable corrosive properties.**

(3) Materials which have demonstrated definite corrosion or severe irritation in a dermal study need not be further tested for eye irritation. It may be presumed that such substances should produce similarly severe effects in the eyes.

...

§ 81-5 Primary dermal irritation. ...

(b) Purpose. In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant and/or corrosive effects on skin is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of the skin to the test substance. ...

(c) Definitions. (1) "Dermal corrosion" is the production of irreversible tissue damage in the skin ...

(2) "Dermal irritation" is the production of reversible inflammatory changes in the skin ...

(d) Principle of the test method. (1) The substance to be tested is applied in a single dose to the skin of several experimental animals, each animal serving as its own control. The degree of irritation is read and scored at specified intervals and is further described to provide a complete evaluation of the effects. The duration of the study should be sufficient to permit a full evaluation of the reversibility or irreversibility of the effects observed but need not exceed 14 days.

(2) When testing solids (which may be pulverized if considered necessary), the test substance should be moistened sufficiently with water or, when necessary, a suitable vehicle, to ensure good contact with the skin. ...

(3) Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 of less or 11.5 or greater, need not be tested owing to their predictable corrosive properties.

[249] EPA Office of Pesticide Programs (January 17, 2007) 40 CFR Part 158.Electronic Code of Federal Regulations (e-CFR) BETA TEST SITE, e-CFR. http://www.access.gpo.gov/nara/cfr/cfr-table-search.html

§ 158.340 Toxicology data requirements. ...

Kind of data required	(b) Notes	...
Acute testing		...
Acute oral toxicity – rat	(1)	...
Acute dermal toxicity	(1), (**2**)	...
Acute inhalation toxicity – rat	(16)	...
Primary eye irritation – rabbit.	(**2**)	...
Primary dermal irritation	(1), (**2**)	...
...	...	

...

(1) Not required if test material is a gas or highly volatile.

(**2**) **Not required if test material is corrosive to skin or has pH less than 2 or greater than 11.5**

[250] EPA Office of Pesticide Programs (July 3, 1975) Title 40 of the Code of Federal Regulations, Subchapter E – Pesticide Programs, Part 162 – Regulations for the Enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act. *Federal Register* Volume 40(129) 28241 – 28286. www.heinonline.org

§ 162.10 Labeling requirements. ...

Hazard indicators	Toxicity categories			
	I	II	III	IV
Oral LD_{50}	Up to and including 50 mg/kg	From 50 mg/kg thru 500 mg/kg	From 500 mg/kg thru 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC_{50}	Up to and including .2 mg/liter	From .2 mg/kg thru 2 mg/liter	From 2. mg/kg thru 20 mg/liter	Greater than 20 mg/liter
Dermal LD_{50}	Up to and including 200 mg/kg	From 200 mg/kg thru 2000 mg/kg	From 2,000 mg/kg thru 20,000 mg/kg	Greater than 20,000 mg/kg
Eye effects	Corrosive; corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irrigation reversible within 7 days	No irritation
Skin effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

...

(h) Warnings and precautionary statements. ... Precautionary statements by toxicity category [from table] Toxicity category I ... Skin and eye local effects. Corrosive, causes eye and skin damage (or skin irritation). Do not get in eyes, on skin, or on clothing. Wear goggles or face shield and rubber gloves when handling. Harmful or fatal if swallowed (Appropriate first aid statement required.)

[251] EPA Office of Pesticides (November 1982) Pesticide Assessment Guidelines, Subdivision F. Hazard Evaluation: Human and Domestic Animals, *op. cit.*

[252] EPA Office of Pesticide Programs (October 24, 1984) 40 CFR Part 158. Data Requirements for Pesticide Registration; Final Rule, op. cit.

> During 1975 to 1981, EPA issued or made available several subparts of the Guidelines for Registering Pesticides in the United States which described, with more specificity, the kinds of data that must be submitted to satisfy the requirements of the registration regulations. These guidelines included sections detailing what data are required and when, the standards for conducting acceptable tests, guidance on the evaluation and reporting of data, and examples of acceptable protocols.
>
> In October 1981, EPA decided that it was impractical and unnecessary to include in a regulation most of the detailed technical and scientific information contained in the guidelines. EPA recognized that it was inappropriate to set forth most of the guidelines material (e.g., test protocols and provisions for evaluating and reporting data) as regulations ...
>
> Therefore, in 1981 EPA decided to reorganize the guidelines and limit the regulation to a concise presentation of the data requirements and when thy must be fulfilled; thus the data requirements for pesticide registration pertaining to all former subparts of the guidelines are now specified in Part 158. ...

[253] Office of Technology Assessment, U.S. Congress (February 1986) Alternatives to Animal Use in Research, Testing, and Education (Washington, DC: U.S. Government Printing Office, OTA-BA-273, . Library of Congress Catalog Card Number 85-600621. For sale by the Superintendent of Documents U.S. Government Printing Office, Washington, DC 20402. http://govinfo.library.unt.edu/ota/Ota_3/DATA/1986/8601.PDF http://www.wws.princeton.edu/ota/disk2/1986/8601/8601.PDF

> Substances with certain properties-*e.g.*, a caustic pH-could be assumed to be eye irritants and not tested. ... A substance shown to be highly corrosive to skin will be highly irritating to the eye and thus might not be tested. Similarly, **a substance with a pH of 2 or less (strongly acid) or 11.5 or more (strongly alkaline) is assumed to be highly irritating or corrosive to skin or eye and need not be tested** (38,54). The cornea tolerates substances with a pH ranging from 3 to 11 variably, with the severity of a reaction depending in large part on a substance's ability to affect protein structure or function (17,35).

[254] Office of Technology Assessment, U.S. Congress (September 1995) Screening and Testing Chemicals in Commerce, OTA-BP-ENV-166. http://govinfo.library.unt.edu/ota/Ota_1/DATA/1995/9553.PDF

> Furthermore, **if the pH is less than 2 or greater than 11.5 eye testing is not performed**, because it would be painful to the animal and results, based upon past experiences, would most likely show the material to be at least a severe irritant. ...

[255] EPA is organized into different "Offices" which are each individually responsible for developing regulations pursuant to the different environmental statutes.

The Office of Prevention, Pesticides and Toxic Substances (OPPTS) is broken down into 3 separate offices: The Office of Pesticide Programs (OPP) is responsible for administering both the Federal Insecticide, Insecticide and Rodenticide Act (FIFRA). The Office of Pollution Prevention and Toxics (OPPT) is responsible for administering the Toxic Substances Control Act (TSCA). The Office of Science Coordination and Policy (OSCP) is a coordinating program under OPPTS.

The Office of Solid Waste and Emergency Response (OSWER) is broken down into several offices for administering the Superfund programs as well as hazardous waste regulations, Brownfield remediation, federal facility cleanups, etc. The Office of Solid Waste (OSW) is responsible for administering the Resource Conservation and Recovery Act (RCRA), which includes hazardous waste regulations.

[256] EPA Office of Prevention, Pesticides and Toxic Substances (August 1998) Final Health Effects Test Guidelines, OPPTS 870.2400, **Acute Eye Irritation** http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Series/870-2400.pdf

[*The language in the 1996 proposed regulations is identical to that which has been abstracted here. See:*] EPA Office of Prevention, Pesticides and Toxic Substances (June 1996) Public Draft. Health Effects Test Guidelines, OPPTS 870.2400, **Acute Eye Irritation**
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Drafts/870-2400.pdf

> (b) Purpose. (1) In the assessment and evaluation of the toxic characteristics of a substance, determination of the irritant and/or corrosive effects on eyes of mammals is an important initial step. Information derived from this test serves to indicate the existence of possible hazards likely to arise from exposure of **the eyes and associated mucous membranes** to the test substance.
> ...
> (e) Initial considerations. (1) **Strongly acidic or alkaline substances, for example, with a demonstrated pH of 2 or less or 11.5 or greater, need not be tested owing to their predictable corrosive properties. Buffer capacity should also be taken into account.**

257 EPA Office of Prevention, Pesticides and Toxic Substances (August 1998) Final Health Effects Test Guidelines OPPTS 870.2500 **Acute Dermal Irritation**
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Series/870-2500.pdf

> [*The following language is identical to the 1996 proposal.*]
> (c) Definitions. The definitions in section 3 of TSCA and in 40 CFR Part 792—Good Laboratory Practice Standards (GLP) ...
> **Dermal corrosion is the production of irreversible tissue damage in the skin** following the application of the test substance.
> Dermal irritation is the production of reversible inflammatory changes in the skin following the application of a test substance.
> ...
> (d) Principle of the test methods. (1) The substance to be tested is applied in a single dose to the skin of several experimental animals, each animal serving as its own control (except when severe irritation/corrosion is suspected and the stepwise procedure is used (see paragraph (f)(1)(iii) of this guideline)). The degree of irritation is read and scored at specified intervals and is further described to provide a complete evaluation of the effects. The duration of the study should be sufficient to permit a full evaluation of the reversibility or irreversibility of the effects observed but need not exceed 14 days.
> ...
> (e) Initial considerations. (1) **Strongly acidic or alkaline substances, for example with a demonstrated pH of 2 or less, or 11.5 or greater, need not be tested for primary dermal irritation, owing to their predictable corrosive properties**.

EPA OPPTS Harmonized Test Guidelines.
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Summary/summchge.htm

> The major focus of this project has been to harmonize these Toxicology Test guidelines with the OECD guidelines and within EPA between the Offices of Pesticide Programs (OPP) and the Office of Pollution Prevention and Toxic Substances (OPPT).
> ...
> Below is a summary overview of the major changes made in EPA guidelines in response to public comments following their draft publication in 1996 (U.S. EPA, 1996a(1)), to SAP comments (U.S. EPA, 1996b(2)) and in response to continuing changes in OECD guidelines. Many of the changes which preceded the proposed drafts in 1996, are not re-stated here. There is also a summary of the status of ongoing efforts with OECD in updating guidelines, and a list of prospective areas where updating seems likely.

258 EPA National Pollution Prevention and Toxics Advisory Committee (October 6, 2005) How can EPA more efficiently identify potential risks and facilitate risk reduction decisions for non-HPV existing chemicals? Developed by Broader Issues Work Group (BIWG) National Pollution Prevention and Toxics Advisory Committee (NPPTAC). National Pollution Prevention and Toxics Advisory Committee (NPPTAC) January 2006, Meeting.
http://www.epa.gov/oppt/npptac/meetings/summaryjan2006.pdf

Hazard category	Criteria
1 Corrosive Including subcategories A, B, and C; see Chapter 3.2, Table 3.2.1	1. For Substances and Tested Mixtures: • **Human experience showing irreversible damage to the skin; • Structure/activity or structure property relationship to a substance or mixture already classified as corrosive; • pH extremes of < 2 and > 11.5 including acid/alkali reserve capacity**; • Positive results in a valid and accepted in vitro skin corrosion test; or • Animal experience or test data that indicate that the substance/mixture causes irreversible damage to the skin following exposure of up to 4 hours (See Table 3.2.1). 2. If data for a mixture are not available, use bridging principles in 3.2.3.2. 3. If bridging principles do not apply, (a) For mixtures where substances can be added: Classify as corrosive if the sum of the concentrations of corrosive substances in the mixture is > 5% (for substances with additivity); or (b) For mixtures where substances cannot be added :> 1%. See 3.2.3.3.4.

259 Title 40 of the CFR: Protection of Environment - PART 370. http://www.epa.gov/epahome/cfr40.htm

> HAZARDOUS CHEMICAL REPORTING: COMMUNITY RIGHT-TO-KNOW ...
> Hazard category means any of the following:
> (1) **Immediate (acute) health hazard**, including highly toxic, toxic, irritant, sensitizer, **corrosive, (as defined under §1910.1200 of Title 29** of the Code of Federal Regulations) and other hazardous chemicals that cause an adverse effect to a target organ and which effect usually occurs rapidly as a result of short term exposure and is of short duration;

260 OSHA. Hazard Communication. - 1910.1200. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099

> "Health hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "**health hazard**" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, **corrosives**, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and **agents which damage the lungs, skin, eyes, or mucous membranes.**
> ...

> "**Corrosive**:" A chemical that causes visible destruction of, **or irreversible alterations in, living tissue by chemical action at the site of contact**. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours.

[261] OSHA (September 5, 2006) DRAFT GUIDANCE FOR HAZARD DETERMINATION FOR COMPLIANCE WITH THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) U.S. Department of Labor, Occupational Safety and Health Administration http://www.osha.gov/dsg/hazcom/GHD100203.html

> CORROSIVE
> **Corrosion - irreversible tissue injury**
> The HCS [Hazard Communication Standard] definition for corrosive is "A chemical that causes visible destruction of, **or irreversible alterations in, living tissue by chemical action at the site of contact.** For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces."
>
> **Corrosion is manifested by ulcers, cell death, and scar formation.** The site of a corrosive effect can be any place on the body that the chemical contacts. This is often the skin or eye but can also be any mucous membrane (such as the mouth or esophagus if swallowed and the nose and trachea if inhaled).
>
> ...
> **The standard toxicology test for corrosivity uses white rabbits ...**

[262] OSHA (December 1, 1988) Standard Interpretations - Hazard determination criteria for corrosive liquids. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=19724

> Question 2: Would pH measurements define corrosivity of that product or would there be other test methods?
>
> Answer: The pH is a measure of the acidity or alkalinity of a solution. **Although pH is a characteristic of a corrosive liquid, it would not define corrosivity, as a corrosive material can be liquid or solid. Titanium tetrachloride is an example of a solid corrosive material. To make a thorough and defensible hazard determination, not only pH but all relevant data available must be examined.**

[263] OSHA (May 5, 1995) Standard Interpretations - Response to IDLH or Potential IDLH atmospheres. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=21788

> CLARIFICATION OF 1910.120:
> Attached for your reference is a copy of an August 15, 1994, letter to Ms. Peg Seminario of the AFL-CIO that provides OSHA's current interpretation of the HAZWOPER standard as it relates to IDLH operations. ... **Fire fighters** are often involved in emergency response operations when serving as members of an organized HAZMAT team, and as such, would be covered by the HAZWOPER standard. ...
> ...
> **"IDLH" or Immediately dangerous to life or health means an atmospheric concentration of** any toxic, **corrosive** or asphyxiant substance that poses an immediate threat to life or **would cause irreversible or delayed adverse health effects** or would interfere with an individual's ability to escape from a dangerous atmosphere."

[264] FEDERAL HAZARDOUS SUBSTANCES ACT, Codified at 15 U.S.C. 1261−1278. (Public Law 86-613; 74 Stat. 372, July 12, 1960, as amended). Definition of corrosive is at 15 U.S.C. 1261(i). www.cpsc.gov/businfo/fhsa.pdf

> DEFINITIONS ... The term ''**hazardous substance**'' means: 1. (A) Any substance or mixture of substances which (i) is toxic, (ii) **is corrosive**, (iii) is an irritant, (iv) is a strong sensitizer, (v) is flammable or combustible, or (vi) generates pressure through decomposition, heat, or other means, if such substance or mixture of substances may cause substantial personal injury or substantial illness during or as a proximate result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children. ...
> (i) The term **''corrosive'' means any substance which in contact with living tissue will cause destruction of tissue by chemical action**

[265] Requirements1 under the Federal Hazardous Substances Act: Labeling and Banning Requirements for Chemicals and Other Hazardous Substances, 15 U.S.C. § 1261 and 16 C.F.R. Part 1500. http://www.cpsc.gov/BUSINFO/regsumfhsa.pdf#search=%22%20%22corrosive%22%20site%3Acpsc.gov%22

> **To require labeling**, a product must first be toxic, **corrosive**, flammable or combustible, an irritant, or a strong sensitizer, or it must generate pressure through decomposition, heat, or other means. ... A product is **corrosive if it destroys living tissue such as skin or eyes by chemical action**. Tests for corrosivity are at 16 CFR 1500.41 [*and*] and 1500.42.

[266] Title 16 CFR Ch. II, § 1500.42. http://www.access.gpo.gov/nara/cfr/cfr-table-search.html

> § 1500.42 Test for eye irritants. ... (a)(1) **Six albino rabbits are used for each test substance**. ... The test material is placed in one eye of each animal ...

[267] USGS (2005) Progress in the Evaluation of Alkali-Aggregate Reaction in Concrete Construction in the Pacific Northwest, United States and Canada. Contributions to Industrial-Minerals Research Chapter K of Contributions to Industrial-Minerals Research, USGS Bulletin 2209–K. http://pubs.usgs.gov/bul/b2209-k/b2209k.pdf

> **The typical pH of pore solutions in concrete is about 12 to 13.**

[268] C.P. Atkins and J.D. Scantlebury (1995) The Activity Coefficient of Sodium Chloride in a Simulated Pore Solution Environment. J. Corrosion Science Engineering, Volume 1 Paper 2. http://www.jcse.org/Volume1/paper2/v1p2.html

> **[*C*]oncrete pore water is approximately pH 13.6**

[269] CorrosionSource.com The Corrosion Journal for the Online Community. http://www.corrosionsource.com/corrosioneering/journal/Jul02_Tullmin/Jul02_Tullmin_2.htm

> Without the ingress of corrosive species into concrete during its service life, or contamination of the mix ingredients by corrosive species, reinforcing steel tends to passivate in concrete. This passivation effect, brought about by the alkaline concrete pore solution, results in negligible corrosion rates. ... **the concrete pore solution pH is usually reported to range from 12-14**.

[270] Type into a search engine the following string: concrete + "pore water" + "pH"

[271] Hendrik G. van Oss, USGS (2005) Background Facts and Issues Concerning Cement and Cement Data, Open-File Report 2005-1152 http://pubs.usgs.gov/of/2005/1152/2005-1152.pdf

> Free lime in hardened concrete is not particularly desirable because it increases the chemical reactivity of the surface (including along cracks) and can leach out in an unsightly fashion. On the other hand, by maintaining a high pH in the aqueous phase, free lime can help protect steel reinforcing bars (rebar) in the concrete from corrosion should water and oxygen reach the rebar via cracks.

[272] Nabil Grace, Jim Hanson (October, 2004) Inspection and Deterioration of Bridge Decks Constructed Using Stay-In-Place Metal Forms and Epoxy-Coated Reinforcement. Submitted to Roger D. Till, Engineer of Structural Research Testing and Research Section Construction and Technology Division Contract # 2002-0134, Department of Civil Engineering Lawrence Technological University Southfield, MI. http://www.michigan.gov/documents/mdot_RC-1455_Part1_112594_7.pdf

> Although the shrinkage associated with carbonation can actually increase the chemical stability and strength of concrete (Kosmatka and Panarese 1988), the lower pH present after this reaction can allow corrosion of the reinforcing steel (**corrosion can begin when the pH reaches values less than approximately 11.5**) (Mays 1992).

[273] Broomfield, John (1996) The Repair of Reinforced Concrete. The Building Conservation Directory
http://www.buildingconservation.com/articles/concrete/concrete.htm

[274] Bernard Erlin, William Hime (August, 2004) Carbonation of concrete. http://findarticles.com/p/articles/mi_m0NSX/is_8_49/ai_n6170202
http://www.hanleywood.com/default.aspx?page=cgconstruction

[275] American Concrete Institute (2005) Committee 318. 318-05: Building Code Requirements for Structural Concrete and Commentary. http://www.concrete.org/bookstorenet/ProductDetail.aspx?itemid=31805

> Carbonation of concrete is another cause of steel corrosion. When concrete carbonates to the level of the steel rebar, the normally alkaline environment, which protects steel from corrosion, is replaced by a more neutral environment. ... The first defense against corrosion of steel in concrete is quality concrete and sufficient concrete cover over the reinforcing bars. ... Adequate cover over reinforcing steel is also an important factor. Chloride penetration and **carbonation will occur in the outer surface** of even low permeability concretes. Increasing the cover will delay the onset of corrosion. For example, the time for chloride ions to reach a steel rebar at 2 inches from the surface is four times that with a 1 inch cover. ACI 318 recommends **a minimum of 1.5 inches of cover for most structures**, and increases it to 2 inches of cover for protection from deicing salts. ACI 357 recommends 2.5 inches of minimum cover in marine environments.

[276] National Ready Mixed Concrete Association. CIP 25, Corrosion of Steel in Concrete http://www.nrmca.org/converted_pdfs/original%20cips/25.pdf

[277] David Park, USGS (2003) Aqueous species oscillations within transport calculation. Email interchange on use of USGS PHREEQC model. http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqc/mail/msg00567.html

278 USGS (2002) Implosion, Earthquake, and Explosion Recordings from the 2000 Seattle Kingdome Seismic Hazards Investigation of Puget Sound (Ships), Washington. Open-File Report 02-123. http://geopubs.wr.usgs.gov/open-file/of02-123/of02-123.pdf

279 USGS (1998) Crushed Cement Concrete Substitution for Construction Aggregates— A Materials Flow Analysis. USGS Circular 1177, p. 8. http://pubs.usgs.gov/circ/1998/c1177/c1177.pdf

> For the category "road base and others," crushed cement concrete must have the appropriate physical properties that permit servicing that particular end use. For both road base and fill material, fines may be a problem where drainability is required. Washing the crushed cement concrete to remove fines may be required, but this adds to the cost of using crushed cement concrete. Dissolution of the crushed cement concrete can occur over time in a fill or road base application, so the soundness of the concrete may be an important factor for these end uses. Soundness is a test that measures the aggregate's general resistance to environmental exposure, including heating and cooling, wetting and drying, and freezing and thawing. If dissolution occurs, a possible consequence is an **elevation of ground-water pH by the leaching of calcium hydroxide from the cement paste.** If this ground water contacts air, calcium carbonate will precipitate out of the solution, possibly clogging drainage systems. Contact between vegetation and the high-pH ground water may cause vegetation damage (Snyder, 1995, p. 3).

280 USGS. (2001 assumed date from report number) Report for 2001RI1801B: Treatment of Roadway Runoff. http://water.usgs.gov/wrri/01grants/prog-compl-reports/2001RI1801B.pdf

> Few studies have been done regarding the long-term ability of crushed concrete to raise the pH of influent water.
>
> One study was carried out by the Minnesota Department of Transportation [*Sadecki, et al., 1996*], where they analyzed the pH of effluent water leaching from stockpiles of salvaged crushed concrete of unknown age during precipitation events. Over the course of the 14 month monitoring period, the effluent pH decreased from slightly greater than 10 to slightly greater than 9, with the median effluent pH for the coarse concrete being 9.8, and 9.3 for the fine concrete. [***This is a false statement by USGS, because one pH value was 12 from the Minnesota/Sadecki study. See the other Minnesota study published in 1995 (Snyder, et al., 1995) cited later in this reference section which describes the exact same study as finding pH levels "in the 11 to 12 range.***]
>
> ...
>
> Aggregate-containing concrete bed depths of 1.5, 3, and 6-inches were analyzed for their removal capacities of trace metals concentrations typically found in Rhode Island roadway runoff [*Robbins study*]. ... Two recent studies were done at the University of Rhode Island analyzing the use of concrete to raise the pH of influent water. In Kueddelsmann's study (1999), the highest effluent pH observed from the concrete was **slightly less than 11.5**. In Robbins' study (2001), the **lowest effluent pH observed was slightly above 11, with the highest effluent pH of about 12.3**. ... Kueddelsmann used a uniform U.S. Standard #4 sieve size for her crushed concrete whereas Robbins used a 16x40 sieve size. The smaller concrete particle size had a larger surface area and may in turn raise the effluent pH higher than the larger concrete particle size.

281 Takao Gotoh, Takashi Nishimura, Minoru Nakata, Yuzuru Nakaguchi, and Keizo Hiraki (2002) Air Pollution by Concrete Dust from the Great Hanshin Earthquake. J. Environ. Qual. 31:718–723. http://jeq.scijournals.org/cgi/reprint/31/3/718

> Air pollution in the areas affected by the Great Hanshin Earthquake (Hyogo, Japan) of 17 Jan. 1995 was quite serious. We performed three investigations of dust. In the first investigation, we measured the total suspended particulate (TSP) concentration in the greatly damaged areas, located around the Sannomiya Station where a few hundred thousand people walked by during the daytime of 3 February. The maximum concentration at five points reached 150 μg/m^3. In the second investigation, eight samples, which were classified into three groups (concrete, mortar, and soil dusts) as sources, were analyzed elementally by X-ray fluorescence. The elements found in concrete dust (Ca and S) were similar to those found in mortar dust. These differed from those found in soil dust (Ti, Fe, and Zr). The elements found in soil dust were important from the viewpoint of heavy metal contamination. In the third investigation, **the alkalinity of concrete dust was observed by dissolution. This solution was equivalent to pH 11 to 12** and electrical conductivity 20 to 30 μS/m.
>
> ...
>
> Twenty-five percent of those who replied to the British Medical Research Council (BMRC)-type questionnaire complained about worsening health after the earthquake, and 67% of them complained about respiratory problems. ... But the relation between the weakening of the environment after earthquake and the weakening of health was not clear until now. This work emphasizes the fourth investigation of concrete dust due to the destruction and demolition of buildings detailed from the viewpoint of alkaline pollution in the devastated area.
>
> ...
>
> pH and Conductivity of Collected Dust
>
> We measured the pH and electric conductivity (EC) values of the dust at five points around five demolition work sites, two of which were located around JR Sannomiya Station, two around JR Rokkomichi Station (Nada-Ku), and one located 1 km southwest of Sannomiya station on 16 Feb. 1995. The following results were obtained. **All the measured pH values of the dust collected at the five points exceeded 11.5** and all the measured EC values exceeded 20 μS/m. From these results, it was suspected that these areas were polluted by alkaline concrete dust resulting from the demolition of deserted buildings. In order to find the relation between the concrete dust and alkalinity, we measured the pH and EC values of aqueous solutions, prepared by dissolving about 10 mg of each the three concrete dust samples (A, B, and C) shown in Table 2 into 10 mL of distilled water.
>
> ...
>
> We measured the TSP concentration in the devastated areas with a laser dust monitor and analyzed the component elements of such dust. The following results were obtained. First, in the area around Sannomiya Station shown in Fig. 3, where the demolition of the deserted buildings was conducted simultaneously and in a relatively small area, the maximum value of TSP concentration reached 150 μg/m^3. The average value at five points exceeded 100 μg/m^3. The few hundreds of thousands of people who walked through the area were exposed to high concentrations of dust during the demolition work.
>
> ...
>
> In order to find the pH and EC [*electrical conductance*] values of standard concrete materials, we measured the pH and EC values of **new concrete block, which was produced in June 1999** in a laboratory at Kobe University, and an **old concrete block, which was produced in June 1985 in the same laboratory for a compression test and was kept in the same room for 14 yr.** After pulverizing pieces of these blocks, the powder was

> passed through a sieve (0.053 mm), and about 10 mg was dissolved in 10 mL of distilled water for measurement with pen-type pH and EC meters. Three samples were taken from different parts of each block. As shown in Fig. 4, although the EC values of the three samples were similar to one another, the pH values were scattered but with a similar trend. ... The pH values of the A, B, and C samples shown in Fig. 4 were analogous to those of the **two blocks (pH = 11.6–12.6)**, [***old block pH values 11.6, 12.0, 12.1, new block pH 12.2, 12.3 and 12.6***]but the EC values were all higher (EC = 20 μS/m). Therefore, in the greatly damaged areas, many people were exposed to high concentrations of suspended dust, which changed into alkaline solutions with high EC values by dissolution in water.

[282] Gotoh, T. (1999). Presumption of alkaline pollution due to concrete dust by dissolving buildings since Hanshin earthquake disaster. (In Japanese.) 32nd Annu. Meeting Rep. for Safety Eng. Corona Sha, Tokyo.

[283] Takao Gotoh, Takashi Nishimura, Minoru Nakata, Yuzuru Nakaguchi, and Keizo Hiraki (2002), *op. cit.*

[284] Sadecki, R.W., Busacker, G.P., Moxness, K.L., Faruq K.C., and Allen, L.G. (1996) An investigation of water quality in runoff from stockpiles of salvaged concrete and bituminous paving: Minnesota Department of Transportation Final Report MNR-96/31. http://mnroad.dot.state.mn.us/research/MnROAD_Project/MnRoadReports/MnRoadOnlineReports/199631.pdf

> [*This study cited in USGS 2002 report. This Minnesota study was fundamentally flawed since it kept leachate samples for up to a week at room temperature before testing, known to result in the conversion of calcium hydroxide to calcium carbonate (carbonation). See discussions of the Lioy (2002) and Poon (2006) studies elsewhere in this complaint.*]
>
> The Stockpile Runoff Project addresses environmental concerns expressed by legislators and citizens of Minnesota about the quality of water in runoff from salvaged pavement stockpiles by determining the presence and characteristics of leachates. ... Three experimental stockpiles were located near the crest of the hill south of the **Shakopee Truck Station**. One pile consisted of coarse concrete material passing the 19.00 mm sieve but retained on the 4/75 mm sieve; a second consisted of fine concrete material passing the 4.75 mm sieve; and the third consisted of salvaged bituminous material ... Samples and data were collected between August 6. 1993 and October 4, 1994.
>
> ...
>
> Except for the first two weeks of monitoring, when the stockpile monitoring system received same day or next day service following a precipitation event, service occurred on a regular weekly basis for the remainder of the 14 month monitoring period. Servicing the system on a weekly basis meant that a flow event could occur soon after the [*previous*} servicing and the resulting water samples would remain in the 12 degree Celsius atmosphere o the equipment shelter until the next servicing, a week later. Only when the sample was returned to the Mn/DOT laboratory at Ft. Snelling, was the water sample temperature lowered with ice and/or refrigeration. The samples remained under refrigeration for 1 to 5 days before the Mn/DOT bench analyses ...
>
> [*The **pH was above 12** a few weeks after monitoring for the fine concrete stockpile, as seen from graph.*]

[285] Snyder, Mark B. (1995) Use of crushed concrete products in Minnesota pavement foundations: St. Paul, Minn., Minnesota Department of Transportation, Report No. MN/RC 96-12. http://mnroad.dot.state.mn.us/research/mnroad_project/mnroadreports/mnroadonlinereports/96-12.pdf

> Environmental concerns have focused on the **relatively high pH of the effluent produced by pavement drainage systems that remove water from untreated recycled concrete aggregate foundation layers**. ... While the effluent from RCA [*recycled concrete aggregate*] is initially extremely alkaline ... it seems likely that environmental concerns are probably restricted to a very small region in the vicinity of the drain outlets.
>
> ...
>
> Lakeville, Minnesota Test Beds ... Seven test beds were constructed in the fall of 1989 ... Three of the test beds were constructed using recycled concrete materials ... The testing was terminated in 1992 ... the pH of the recycled concrete beds showed an initial high peak within the first year [***as high as 12***] ... recycled concrete fines are the principal source of increased pH ...
>
> ...
>
> **Shakopee, Minnesota Test Stockpiles** ... The Minnesota Department of Transportation constructed three aggregate stockpiles at their truck station near Shakopee in the summer of 1993 – one of open-graded, coarse RCA , one of RCA fines (100% passing #4 sieve) [*sand consists of particles predominantly between 4.75 mm and 75 mm - passes through a No. 4 sieve, , but is mostly retained on a No. 200 sieve*] and one of dense-graded, recycled asphalt concrete. ... **Chemical analysis of the runoff data for the August-November 1993 period ... The fine RCA pH values decreased from slightly higher values (in the 11 to 12 range) to about 9.5 as well.**
>
> ...
>
> Laboratory Studies. Minnesota Department of Transportation (1987) ... The earliest experiments consisted of soaking samples of RCA in a 5-gallon bucket with a sand filter and fabric layer placed over a drain in the bottom of the bucket. The fabric layer often plugged within hours and pH values **as high as 11.5** were observed. ... Tests conducted using aggregate blends including as little as 25% RCA still produced high soak water pH values (**12.2 – 12.5**) ...
>
> ...
>
> Minnesota Department of Transportation (1989) ... Several 500-g samples of various gradings (e.g., 1" – 1.5", ¾" – 1", etc.) were prepared for each aggregate source. Each sample was soaked in distilled water for one week, then allowed to dry before being soaked and dried for two more one-week cycles. ... the finest grading (#4 - #200) [*particles between 4.75 mm and 75 mm*] yielding the highest initial [*pH*] values (**in excess of 11**) ...
>
> ...
>
> Ohio Department of Transportation ... (1993) ... Laboratory studies were performed on samples from the two RCA bases ... Neither source of RCA produced precipitate when simply soaked in distilled water, although the pH of the soak water generally increased to **more than 11** within 24 hours.

[286] Central Federal Lands Highway Division (2005) Appendix A, Roadway Surfacing Options Catalog. Recycling and Reclamation Alternatives. US DOT, Federal Highway Administration. http://www.cflhd.gov/techDevelopment/completed_projects/pavement/context-roadway-surfacing/

> Leachate: The leachate from RCA has a number of potential concerns, including highly alkaline runoff, a potential to clog drainage systems (especially those consisting of geotextiles), and potential to cause corrosion of nearby metal pipes. The **pH of the leachate is generally in the 11 to 12 range**.

287 Turner Fairbank Highway Research Center. Reclaimed Concrete Material, Material Description. US DOT. http://www.tfhrc.gov/hnr20/recycle/waste/rcc1.htm

> Reclaimed concrete material (RCM) is sometimes referred to as recycled concrete pavement (RCP) ... The pH of RCM-water mixtures often **exceeds 11**.

288 Iowa Dept. of Transportation (1999) Laboratory Study of the Leachate from Crushed Portland Cement Concrete Base Material. Final Report For MLR-96-4. http://www.operationsresearch.dot.state.ia.us/reports/reports_pdf/mlr/reports/mlr9604.pdf

> Since the 1980's, the Iowa Department of Transportation has increased its use of recycled Portland Cement Concrete (PCC) as drainable base material below some new pavements. Water flowing out of the longitudinal drains on projects having recycled PCC drainable bases was found to have a high pH value. ... **The drainable base material having its fines separated out and placed as a 2" bottom layer, below the remaining coarse material, generally gave pH values around 11.2 while other designs tested gave pH values around 11.5.** ... Drainable base materials were obtained from a 1995 project on US 151 in Linn County. The material had been stockpiled for about 1 year at the time the sample was collected.
>
> ...
>
> Upon the initial combining of distilled water with the recycled crushed PCC [*recycled Portland Cement Concrete, from 1.5 to 2 inch dimensions*] drainable base material, **the water pH soon rose to the range of 12.5. Over the first 10 weeks of testing the pH gradually came down to around 11.5**. It leveled off and stayed around that value for the next 20 weeks.

289 Personal communication (December 18, 2006) Mark J. Dunn, P.E., Operations Research Engineer, Research and Technology Bureau, Iowa Department of Transportation, regarding source, age, and storage conditions of concrete used in above study.

> We only allow our recycled pavement to be used on roadway projects, therefore it was a highway pavement. Recycled concrete from other sources is not allowed since we have no control over the materials used in the concrete. The original pavement was constructed in 1961 and was crushed for recycling in 1995 (with stockpile samples taken in 1996), therefore the pavement age was 34 years. The material was crushed and stockpiled on the project site by the contractor. Our stockpiles are rarely, if ever, protected from rain.

290 Timothy G. Townsend (1998) Characteristics of Leachate from Construction and Demolition Waste Landfills. State University System of Florida, Florida Center For Solid and Hazardous Waste Management. http://www.hinkleycenter.com/publications/townsend_98-4.pdf

> Four leaching lysimeters were used over a 72-day period in lysimeter study 1. Components included wood, ferrous metal, drywall, concrete, asphalt roof shingles, insulation, and cardboard as a mixed C&D waste stream. ... Column study 2 was operated using unsaturated conditions on individual C&D waste components. The results of column study 2 confirmed some of the results of study 1. The concrete-only lysimeter exhibited a **consistent pH above 11**. ...
>
> ...
>
> For the batch studies, gypsum drywall and concrete materials were used to examine leaching characteristics of C&D waste using the Synthetic Precipitation Leaching Procedure (SPLP) batch test. Three different size-reduced materials of each component were tested to identify the effect of particle size on contaminant leaching.
>
> ...
>
> The concrete-only **lysimeter resulted in a consistent pH above 11**. ... Gypsum drywall and concrete were tested with the SPLP test. Three different size reduced materials of each component were used to identify a particle size effect on leaching behavior. The resulting batch leachate was filtered and analyzed for a number of conventional parameters including pH, alkalinity, total dissolved solids and ions. While pH resulting from all drywall materials was in the neutral, **the concrete pH was near range of 11 to 12**, as was observed in the concrete-only lysimeter in study 2.

291 T. G. Townsend, Y.-C. Jang, W. Weber (2000) Continued Research into the Characteristics of Leachate from Construction and Demolition Waste Landfills. State University System of Florida, Florida Center for Solid and Hazardous Waste Management. http://www.hinkleycenter.com/publications/CDLeach.pdf

> 3.2.5 Methodology for Synthetic Leaching Procedure Test of C&D materials To examine contaminant leachability of each C&D component, a synthetic precipitation leaching procedure (SPLP) **batch test** was performed (US EPA SW 846- 1312). The SPLP test simulates contaminant leaching using mildly acidic rainwater. A 100-gram sample was placed in a 2-liter polyethylene container. Two liters of SPLP leaching solution were then added to the container. The container was placed in a rotary extractor and rotated for **18 hours** ± 2 hours at 30 rpm. After tumbling, the mixture was filtered using a pressurized filtration apparatus with a 0.7-μm glass fiber filter. The test method is the same as other standardized batch leaching tests such as the Toxicity Characteristic Leaching Procedure (TCLP; EPA SW-846 Method 1311, USEPA 1994) with the exception of the leaching fluid. T
>
> ...
>
> **The concrete batch resulted in pH above 11**. The high pH was likely caused by the release of hydroxyl ions from the dissolution of the alkali hydroxides (KOH, NaOH) and calcium hydroxide [Ca(OH)2]. ... Results of Conventional Water Quality Parameters from Batch Tests.
> Concrete [pH] 11.68

292 Christian J. Engelsen, Hans A. van der Sloot, Gordana Petkovic, Grethe Wibetoe, Erik Stoltenberg-Hansson and Walter Lund (2005) Constituent release predictions for recycled aggregates at field site in Norway. Gjenbruksprosjektet. www.gjenbruksprosjektet.net/filemanager/download/1628/Constituent%20release%20predictions%20on%20field%20site%20in%20Norway_Engelsen_et_al.pdf

[*For crushed concrete from a highway that had been in service from 1980 to 2004*]: ... field site data from the **first 14-month exposure period**. During this period the leachate pH decreased from **12.8 to 9.5 in the uncovered crushed concrete field and from 12.8 to 11.5 in the crushed concrete fields in the road base covered with asphalt**.

293 Chi-Sun Poon, X.C. Qiao, Dixon Chan (2006) The cause and influence of self-cementing properties of fine recycled concrete aggregates on the properties of unbound sub-base. Waste Management 26 (2006) 1166–1172. http://www.elsevier.com/locate/wasman www.sciencedirect.com

> Recycled concrete aggregates, with nominal sizes ranging from 40 to <5mm, were used. They were sourced from a commercially operated construction and demolition waste recycling facility in Hong Kong.
> ...
> For the pH value measurement, 5 g of the FRCA and 100ml of distilled water were simultaneously added into a 200-ml glass Flask with a screw lid and were automatically mixed on a shaking table. The pH values of the solution were measured at 10, 20, 40, 60, 120, 180 and 4320min after the mixing process had begun.
> ...
> the pH value (Fig. 2) of the solution prepared with the 0.3–0.6mm fraction of RCA was the highest compared to the pH values of the samples prepared with <0.15 or 0.15–0.3mm fractions. ... [*pH values were 11.4 from 20 minutes to 180 minutes after water addition, then plummeted to 10.06 after 3 days. Larger sized particles (0.15 to 0.3 mm and 0.3 to 0.6 mm) had pH 11 or 10.8 initially, also dropping to around 10 after 3 days.*]

294 USGS (2002) Cold War Legacy Not A Post-Dismantlement Environmental Concern. USGS Fact Sheet 085–02. http://mo.water.usgs.gov/fact_sheets/wtrqual/WittFS085-02/report.pdf

> [*See USGS document for a photograph of the implosion demolition of a large steel reinforced concrete missile silo.*]
> To harden these for potential nuclear attack, launch facilities were fabricated of concrete and 2-inch reinforcement bar and installed below land surface. Launch tubes were constructed to a depth of 80 feet with a 4-foot thick concrete base ... The control room and all metal surfaces were coated with a waterproof coating containing polychlorinated biphenyls (PCBs) to prevent corrosion. ... Dismantlement of the launch facilities began on December 8, 1993, with implosion of the first launch control room and the upper part of the launch tube. Debris from the implosion was pushed into the remaining unaffected lower part of the tube and covered with concrete.
> ...
> Long-Term Monitoring Network An extensive environmental survey as well as an interim groundwater sampling effort was conducted within the missile deployment area by the U.S. Geological Survey ... Analysis was conducted on whole-water (unfiltered) to assure PCB compounds attached to sediment would be available for detection. Measurements of specific conductance, pH, and temperature were recorded during the sampling procedure ... [*Interestingly, USGS did not provide results of the pH monitoring, but the USGS stated that PCB and petroleum contaminants did not exceed limits.*]

295 USGS (February 2000) Recycled Aggregates—Profitable Resource Conservation. USGS Fact Sheet FS–181–99. http://pubs.usgs.gov/fs/fs-0181-99/fs-0181-99so.pdf

[*See also several earlier references cited by this USGS publication on recycled concrete from building demolitions and pavement replacement.*]

> Recycled Aggregates Originate from Construction and Demolition Debris
> Much of the infrastructure that has been constructed since the 1950's, particularly roads, has become, or is becoming obsolete and in need of replacement or repair. As Americans go about tearing up roads and tearing down buildings, they generate large quantities of demolition wastes, yielding over 200 million t (metric tons) of recycled aggregates annually. Demolished infrastructure can be either disposed in landfills or recycled. The decision is usually made by the demolition contractor, taking into consideration regional economics, contract terms, and legal mandates.
> ...
> Aging U.S. infrastructure, decreasing availability of landfill space, and environmental concerns work together to increase concrete recycling. There are two approaches to recycling concrete. One alternative is to haul the concrete debris to a permanent recycling facility, usually close by to minimize transportation costs, for crushing and screening.
> ...
> State agencies have been slow to accept recycled aggregates from concrete for high-quality uses such as road surfacing. Specifications, based on considerable research and favorable in-service experience, have allowed its use mostly as road base material. ... Recyclers often have the opportunity to charge a fee for accepting concrete debris, especially along the Atlantic corridor where landfill space is running short and charges for depositing materials into landfills are high.

296 Seattle Daily Journal of Commerce (May 19, 2000) After the implosion: Where did all the concrete go? http://www.djc.com/special/concrete00/4.html

> Environmental experts and government officials agree the danger of limited exposure to the floating cloud that ensued after the blast - to those viewing from an adequate distance - was insignificant. It was determined beforehand that the demolition plan met health standards at all government levels.
> ...
> "Most of the particles fell down to earth ... they contained nothing you'd consider carcinogenic, " said Jim Nolan, a spokesman for Puget Sound Clean Air. He said "dusting off downtown" with a variety of sweepers immediately following the implosion mitigated potential health threats from inhaling particulate matter.
> ...
> "We measured atmospheric mercury levels continuously before, during and after the Kingdome blast. We observed elevated levels of mercury in both the gas phase and particulate phase. The concentrations we measured are not likely a health concern, due to their relatively low values and short exposure time. However, it must have been quite a bit of mercury to generate the concentrations we observed," said Eric Prestbo, Ph.D., a Frontier spokesman.

Seattle Post Intelligencer (March 26, 2000) http://seattlepi.nwsource.com/kingdome/photo.asp?SubID=33&PhotoID=635

> This is a sample of dust from the Kingdome implosion, magnified 360 times. [*photograph provided*] The P-I collected it off of the rear window of a Seattle police car parked under the Alaskan Way Viaduct. Robert Fisher, chief scientist for Lab/Cor, analyzed the dust under an electron microscope. His preliminary findings were that the dust contained bits of wood, concrete, sand or silica, and some fiberglass. "It's pretty much what you always get when you blow up a building," he said. Fisher and his colleagues set up air monitors a block from the Dome, but say they don't expect to find anything hazardous in the dust.

[297] Seattle Daily Journal of Commerce (May 19, 2000) After the implosion: Where did all the concrete go? *op. cit.*

[298] Seattle Post-Intelligence (March 22, 2000) Boom with a view, *op. cit.*
[*See link to map of restricted area r study cited above.*]

[299] The (liberal) Girl Next Door (October 18, 2005) The Demolition of a Party. http://liberalgirlnextdoor.blogspot.com/2005/10/demolition-of-party.html

> In the spring of 2000 there was a controlled demolition of the Kingdome in Seattle so the city could make way for a new stadium worthy of our Mariners. I'm not big on destruction, yet even I was drawn to the freeway overpass with a view of the impending collapse. It was truly amazing to watch something so carefully constructed brought down to the ground in a matter of seconds. As the dust cloud rose into the sky I thought of the people who had worked so hard to build the Dome and wondered if they too watched it reduced to a pile of rubble. ... On that spring day in 2000, once the dust settled, anyone within five miles of the Kingdome had some cleanup to do. There was a fine layer of gritty concrete dust on everything. It was a bummer, but it was easily cleaned up with a wet cloth.

[300] Controlled-Demolitions, Inc. - Video of Kingdome imploding. Right click for full screen version: http://controlled-demolition.com/images/client/kingdome.mpg

[301] Seattle Times. From Dome to Dust. Implosion photo gallery. http://seattletimes.nwsource.com/kingdome/

[302] Coffee Czar. Taking Down the King Dome... http://www.coffeeczar.com/kingdome/

[303] Seattle Post-Intelligencer (March 22, 2000) Boom with a view There will be more than one way to watch the Kingdome rumble into rubble. http://seattlepi.nwsource.com/kingdome/dome22.shtml

> Blast crews and health experts say people should avoid the immediate downtown area, in part because the implosion will generate large amounts of dust. "People with asthma or pre-existing breathing problems should stay away," said Jim Nolan, a compliance officer with the Puget Sound Clean Air Agency. "Even people who are healthy should stay back because it will cause you to gag," he said.

CNN (March 26, 2000) Seattle Says Dusty Goodbye to Kingdome. http://transcripts.cnn.com/TRANSCRIPTS/0003/26/bn.01.html

> Residents have been warned of the dangers of dust in the area. People with respiratory problems have been told to stay inside and people have been told to hose off their cars once the dust settles, because wiping the cars off could damage the finish.

[304] Christine Todd Whitman, EPA Administrator (September 13, 2001) On-camera statement, transcribed from CBS Sundance channel production "Dust to Dust: The Health Effects of 9/11"

> We've had concern, we're going to continue to monitor. But right now, as I will tell you, everything we're getting back from the sampling that we're doing, is below background levels. There is not a reason for the general public to be concerned. It's not going to be a particular hazard unless you have breathing difficulties, heart condition, then you shouldn't be out here walking around and trying to get exercise. So that's not appropriate, obviously.

[305] Andrew C. Revkin (September 14, 2001) Monitors Say Health Risk From Smoke Is Very Small. New York Times. www.NYT.com

> [*New York Times*] The persistent pall of smoke wafting from the remains of the World Trade Center poses a very small, and steadily diminishing, risk to the public, environmental officials and doctors said yesterday. ... There could be a slight health threat, they said, to city residents with weakened immune systems, heart disease or asthma ...

[306] AsiaPacificProductions – http://approd.com/credits.html

> [Link to short documentary video on Kobe Earthquake. Click on the photograph first, then on the link that appears at the bottom of the enlarged photograph. Then (right click for full screen version after the video begins.]

[307] Japan. National Committee for the International Decade of Natural Disaster Relief (IDNDR) (1995) Pictures of disasters in the Great Hanshin - Awaji earthquake. [*See Section 23 for demolition debris piles and transfer to barges.*] http://www.crid.or.cr/digitalizacion/pdf/eng/doc8339/doc8339.htm

[308] Gotoh, T. (1999). Presumption of alkaline pollution due to concrete dust by dissolving buildings since Hanshin earthquake disaster. (In Japanese.) 32nd Annu. Meeting Rep. for Safety Eng. Corona Sha, Tokyo.

[309] Takao Gotoh, Takashi Nishimura, Minoru Nakata, Yuzuru Nakaguchi, and Keizo Hiraki (2002) Air Pollution by Concrete Dust from the Great Hanshin Earthquake. J. Environ. Qual. 31:718–723. http://jeq.scijournals.org/cgi/reprint/31/3/718

> Air pollution in the areas affected by the Great Hanshin Earthquake (Hyogo, Japan) of 17 Jan. 1995 was quite serious. We performed three investigations of dust. In the first investigation, we measured the total suspended particulate (TSP) concentration in the greatly damaged areas, located around the Sannomiya Station where a few hundred thousand people walked by during the daytime of 3 February. The maximum concentration at five points reached 150 μg/m^3. In the second investigation, eight samples, which were classified into three groups (concrete, mortar, and soil dusts) as sources, were analyzed elementally by X-ray fluorescence. The elements found in concrete dust (Ca and S) were similar to those found in mortar dust. These differed from those found in soil dust (Ti, Fe, and Zr). The elements found in soil dust were important from the viewpoint of heavy metal contamination. In the third investigation, **the alkalinity of concrete dust was observed by dissolution. This solution was equivalent to pH 11 to 12** and electrical conductivity 20 to 30 μS/m.
>
> ...
>
> Twenty-five percent of those who replied to the British Medical Research Council (BMRC)-type questionnaire complained about worsening health after the earthquake, and 67% of them complained about respiratory problems. ... But the relation between the weakening of the environment after earthquake and the weakening of health was not clear until now. This work emphasizes the fourth investigation of concrete dust due to the destruction and demolition of buildings detailed from the viewpoint of alkaline pollution in the devastated area.
>
> ...
>
> pH and Conductivity of Collected Dust
>
> We measured the pH and electric conductivity (EC) values of the dust at five points around five demolition work sites, two of which were located around JR Sannomiya Station, two around JR Rokkomichi Station (Nada-Ku), and one located 1 km southwest of Sannomiya station on 16 Feb. 1995. The following results were obtained. **All the measured pH values of the dust collected at the five points exceeded 11.5** and all the measured EC values exceeded 20 μS/m. From these results, it was suspected that these areas were polluted by alkaline concrete dust resulting from the demolition of deserted buildings. In order to find the relation between the concrete dust and alkalinity, we measured the pH and EC values of aqueous solutions, prepared by dissolving about 10 mg of each the three concrete dust samples (A, B, and C) shown in Table 2 into 10 mL of distilled water.
>
> ...
>
> We measured the TSP concentration in the devastated areas with a laser dust monitor and analyzed the component elements of such dust. The following results were obtained. First, in the area around Sannomiya Station shown in Fig. 3, where the demolition of the deserted buildings was conducted simultaneously and in a relatively small area, the maximum value of TSP concentration reached 150 μg/m^3. The average value at five points exceeded 100 μg/m^3. The few hundreds of thousands of people who walked through the area were exposed to high concentrations of dust during the demolition work.

[310] Japan. National Committee for the IDNDR (1995), *op. cit.*

[311] Johns Hopkins School of Public Health, Faculty and Staff. Web page for Dr. Geyh: http://faculty.jhsph.edu/?F=Alison&L=Geyh

[312] Christopher M. Beck, Alison Geyh, Arjun Srinivasan, Patrick N. Breysse, Peyton A. Eggleston, and Timothy J. Buckley (2003) The Impact of a Building Implosion on Airborne Particulate Matter in an Urban Community. J. Air & Waste Manage. Assoc. 53:1256–1264.
http://www.awma.org/journal/pdfs/2003/10/beck.pdf

> Building implosions are an increasingly common occurrence in cities across the United States. In 2000 alone, one major building demolition contractor imploded 23 high-rise public housing apartment buildings. [*citing a personal communication with Controlled Demolition, Inc., Phoenix, MD.*]
>
> ...
>
> [*inset in article*] Implosion Fact Sheet – Large Building Implosion and Air Quality ... The dust cloud extended 1 ½ blocks from the implosion site. To Do: Stay away from the implosion. Watch it on TV especially if you are very young, elderly, have immune problems, or a lung disease like asthma. Stay indoors. If you live near the implosion, **keep your doors and windows closed before and for 1 hour after the implosion.** Implosion dust can get indoors. Use a damp cloth or mop to clean dust from surfaces. Don't vacuum the dust. Vacuuming stirs the dust back up into the air. Rinse sidewalks and door stoops with a hose. The dust settles on outdoor surface near or downwind from the implosion. Remove shoes or use a doormat. This will keep the dust from being carried inside.
>
> ...
>
> X-ray fluorescence analysis indicated that the elemental composition was dominated by crustal elements: calcium (57%), silicon (23%), aluminum (7.6%), and iron (6.1%).
>
> ...

Distance from implosion (m)	100	160	300	475	825	1130	780	...
Peak concentration (μg/m$_3$)	54,000	605	36	5686	1578	589	42	...
Duration of peak (min)	40	14	No effect	38	7	12	No effect	

> ...
>
> The composition of the plume was investigated with respect to mold spores and elemental composition. ... The elemental composition of the implosion plume was evaluated based on an integrated PM10 sample. Of the 545 μg/m3 measured, seven crustal elements accounted for 96 and 26% of the elemental and total mass concentrations, respectively. The total mass contribution rises to 39%, assuming that the seven elements were present as their common oxides (Al_2O_3, K_2O, CaO, TiO_2, Mn_2O_7, and Fe_2O_3).
>
> The current study tells part of the story about the impact of a building implosion on the air quality in an urban community by providing time- and space-resolved PM10 assessment. As shown by [Lioy, *et al.* (2002), *op. cit.*] from settled dust samples after the collapse of the World Trade Center,

> PM in the inspirable size range 10–100 µm is also generated from a building collapse, posing an exposure and health threat not characterized in the current study.

[313] Srinivasan A, Beck C, Buckley T, Geyh A, Bova G, Porter C, Mertz W, Perl T. (2002) The Ability of Hospital Ventilation Systems to Filter Aspergillus and Other Fungi Following a Building Implosion. Infect Control Hosp Epi 23, 520-525.
http://www.journals.uchicago.edu/ICHE/journal/issues/v23n9/4110/4110.web.pdf

[314] Johns Hopkins School of Public Health (January 31, 2001) Building Implosions Not a Spectator Sport.
http://www.jhsph.edu/publichealthnews/press_releases/PR_2001/Buckley_implosions_2001.html

> Numerous high-rise HUD residential buildings are being demolished by implosion in cities across the United States because of a new Department of Housing and Urban Development (HUD) initiative that encourages the building of mixed-income housing instead of high-rise tenements.
> ...
> The wind blew the dust cloud to the southeast, so that neighborhoods to the north or west of the site were unaffected. Measurements made inside neighborhood houses showed indoor air to be unaffected by the implosion, suggesting that **staying indoors offers protection from the high outdoor concentrations.**
> ...
> Watch building implosions on TV rather than in person, especially if you are very young, elderly, have a weakened immune system, or have lung or heart disease.
>
> If you are determined to **watch the implosion in person, do so from at least two blocks away** and from a position that is upwind.
>
> If you live near and downwind of the implosion, **stay indoors with your doors and windows closed for at least an hour** after the building has fallen. If you are among one or more of the vulnerable groups described above, leave the area if possible and stay away for at least one hour after the implosion.
>
> Some of the dust from the implosion will get indoors and settle on surfaces. **Use a damp cloth or mop to clean these surfaces.** Vacuuming is not as effective since it sometimes merely stirs up the dust.
>
> Support for this study was provided by the U.S. Environmental Protection Agency (EPA) and the National Institute for Environmental Health Sciences.

[315] Lioy, *et al.* (2002), *op. cit.*

[316] USGS (February 5, 2002) [2/5/02 is the actual web posting date, the 11/27/01 or 11/15/01 date on report added in 2004 is falsified. See www.archive.org analysis in attached 10/25/06 complaint to the EPA IG.] Environmental Studies of the World Trade Center area after the September 11, 2001 attack.
http://pubs.usgs.gov/of/2001/ofr-01-0429/

[317] Takao Gotoh, Takashi Nishimura, Minoru Nakata, Yuzuru Nakaguchi, and Keizo Hiraki (2002) Air Pollution by Concrete Dust from the Great Hanshin Earthquake. J. Environ. Qual. 31:718–723. http://jeq.scijournals.org/cgi/reprint/31/3/718 [See earlier citation for excerpts].

[318] Christopher M. Beck, Alison Geyh, Arjun Srinivasan, Patrick N. Breysse, Peyton A. Eggleston, and Timothy J. Buckley (2003) The Impact of a Building Implosion on Airborne Particulate Matter in an Urban Community. *op. cit.*

[319] From the above cited study by Beck, Geyh *et al.*, if 39% total mass is due to oxides of crustal elements, and of these crustal elements 57% is due to calcium, then by the study's own assumption, 22% of the total mass would be due to calcium oxide (without the refining calculation of converting to the respective molecular weights). The highest level of particulates was 54,000 ug/m3, or 54 mg/m^3, at a distance of 100 meters. This would correspond to a concentration of up to 12 mg/m^3 of calcium oxide. Compare this to the OSHA limit of 5 mg/m^3, or the NIOSH recommended limit of 2 mg/m^3.

[320] EPA Office of the Inspector General (November 4, 2004) Special Report. Review of Conflict of Interest Allegations Pertaining to the Peer Review of EPA's Draft Report, "Exposure and Human Health Evaluation of Airborne Pollution from the World Trade Center Disaster." Report No. 2005-S-00003.
http://www.epa.gov/oigearth/reports/2005/20041104-2005-S-00003.pdf

[*The 7/16/03 complaint from Cate Jenkins is attached as Appendix A to the 11/4/04 IG report which responds to Jenkins' 7/16/03 complaint.*]

> We found that Dr. Geyh's statements reflected the factual results of her research study. Additionally, during the peer review, she noted the limitations of existing test data and the need for more data about the potential long-term health risks associated with exposures at the WTC site. As such, her statements did not demonstrate that she had " taken sides" with respect to the issues being peer reviewed. We concluded that any potential biases arising from these statements were not so material as to warrant her exclusion from the panel. **However, the fact that such opinions were expressed provided a basis for the perception that there may have been a bias, and supports the need for EPA or its Contractor to improve their efforts to ensure that peer review panels as a whole are balanced.**

[321] Geyh AS, Chillrud S, Williams DL, Herbstman J, Symons JM, Rees K, Ross J, Kim SR, Lim HJ, Turpin B, Breysse P. (March 2005) Assessing truck driver exposure at the World Trade Center disaster site: personal and area monitoring for particulate matter and volatile organic compounds during October 2001 and April 2002. J Occup Environ Hyg. 2(3):179-93.

> Cleanup workers were potentially exposed to airborne contaminants, including particulate matter, volatile organic compounds, and asbestos, at elevated concentrations. This article presents the results of the exposure assessment of one important group of WTC workers, truck drivers, as well as area monitoring that was conducted directly on site during October 2001 and April 2002. In cooperation with a local labor union, 54 drivers (October) and 15 drivers (April) were recruited on site to wear two monitors during their 12-hour work shifts. In addition, drivers were administered a questionnaire asking for information ranging from "first day at the site" to respirator use. Area monitoring was conducted at four perimeter locations during October and three perimeter locations during April. During both months, monitoring was also conducted at one location in the middle of the rubble. Contaminants monitored for included total dust (TD), PM10, PM2.5, and volatile organic compounds.
>
> ...
>
> During October, the personal exposure of 54 truck drivers involved in hauling debris away from the rubble pile was assessed for asbestos and **either** TD [*total dust*], EC/*OP CIT.* [*elemental and organic carbon*], or VOCs [*"a limited suite of volatile organic compounds"*].
>
> ...
>
> In April, the personal exposure of the last 15 remaining truck drivers at the site was assessed for the same contaminants.
>
> ...
>
> The frequency of monitoring during October 2001 depended on availability of the truck drivers and accessibility to the monitoring locations, personal safety, and equipment security. ... During April, drivers refused to wear the personal monitoring equipment. We understood their refusal to wear the monitors to be the result of emotional and physical exhaustion related to working at the site. To approximate driver exposure, monitors were placed in the truck cab with sampling cartridges hung at head height from the rear view mirror or from a hook near the driver's head.

322 Breysse PN, Williams DL, Herbstman JB, Symons JM, Chillrud SN, Ross J, Henshaw S, Rees K, Watson M, Geyh AS. (August 2005) Asbestos exposures to truck drivers during World Trade Center cleanup operations. J Occup Environ Hyg. 2(8):400-5.

> This article presents results of asbestos air sampling conducted to assess the exposure to truck drivers working at the World Trade Center site. Sampling consisted of a combination of area and personal monitoring of 49 truck drivers and included optical and electron microscopic analyses. Three sampling periods were conducted: October 1- 7, 2001, October 17-26, 2001, and April 13-23, 2002. Area sample locations were selected to estimate airborne concentrations around the perimeter of the site, on top of the pile, and in the pit. ... Personal sampling results suggest that asbestos fiber exposures to truck drivers at the site were low. ... Area sample results were generally less than the personal results (except for the sample collected on top of the rubble pile) and decreased over the course of the cleanup. Our results show low airborne asbestos concentrations and a predominance of short fibers. Given these low concentrations, evidence of short fibers, and the short duration of the exposure (less than 10 months to complete the cleanup), it is likely that truck drivers working at the site are not at an increased risk for asbestos-related disease.

323 Julie B. Herbstman, Robert Frank, Margo Schwab, D'Ann L. Williams, Jonathan M. Samet, Patrick N. Breysse, Alison S. Geyh (2005) Respiratory effects of inhalation exposure among workers during the clean-up effort at the World Trade Center disaster site. Environmental Research 99: 85–92. www.sciencedirect.com

> While the development of new wheeze suggested the presence of airway obstruction, the near-normal distribution of age-adjusted FEV1/FVC ratios suggested that the degree of obstruction was mild. The prevalence rates of upper airway symptoms (nasal congestion, sore throat, hoarse throat) exceeded those of lower respiratory symptoms, however, it was not determined whether symptoms pre-dated arrival at the WTC site.
>
> ...
>
> We contacted all truck drivers, carpenters, and dock workers on site during the study period. Because we were restricted from accessing some areas of the site where some of the heavy equipment operators or laborers worked, we are unable to determine the percentage of these workers who were contacted for participation. One hundred eighty-three workers agreed to participate in this study. Approximately 10 workers, whose union affiliation was not recorded, declined to participate. One hundred percent of carpenters and dock workers agreed to participation. Nearly all truck drivers on site were successfully recruited. A participation rate for heavy equipment operators and laborers cannot be calculated. Ninety-six percent (96%) of all recruited participants agreed to perform spirometry.
>
> ...
>
> This work was supported in part by supplemental funds from the US National Institute of Environmental Health Sciences (NIEHS) to the NIEHS Environmental Health Science Center (P3 ESO3819) [*which in turn was funded by EPA*] and by the Johns Hopkins Bloomberg School of Public Health.

324 Johnson SB, Langlieb AM, Teret SP, Gross R, Schwab M, Massa J, Ashwell L, Geyh AS. (2005) Rethinking first response: effects of the clean up and recovery effort on workers at the world trade center disaster site. J Occup Environ Med. 47(4):386-91.

> A mailed survey was sent to truck drivers, heavy equipment operators, laborers, and carpenters. It assessed work-related exposures and somatic and mental health symptoms. In one open-ended question, respondents shared any aspect of their experiences they wished; these 332 narrative responses were analyzed using qualitative techniques. RESULTS: Respondents reported suffering debilitating consequences of their work, including depression, drug use, and posttraumatic stress disorder. They felt poorly prepared to work in a disaster, lacked protective equipment and training, and felt overwhelmed by the devastation they faced.

325 Robin Herbert, Jacqueline Moline, Gwen Skloot, Kristina Metzger, Sherry Baron, Benjamin Luft, Steven Markowitz, Iris Udasin, Denise Harrison, Diane Stein, Andrew Todd, Paul Enright, Jeanne Mager Stellman, Philip J. Landrigan, and Stephen M. Levin (2006) The World Trade Center Disaster and the Health of Workers: Five-Year Assessment of a Unique Medical Screening Program. Environmental Health Perspectives, 114(12); 1853 – 1858.. http://www.ehponline.org/members/2006/9592/9592.pdf

326 Dennis Stefani, Dennis Wardman, and Timothy Lambert (2005) The Implosion of the Calgary General Hospital: Ambient Air Quality Issues. J. Air & Waste Manage. Assoc. 55:52–59. http://www.calgaryhealthregion.ca/hecomm/envhealth/RAM/Publications/Implosion_of_Calgary_General.pdf

> This paper discusses the implosion of a large inner-city hospital in Calgary, Alberta, Canada, on October 4, 1998. Stationary and mobile air monitoring conducted after the implosion indicated there were several **short-term air quality issues**, including significant temporal increases in total suspended particles, particulate matter (PM) with aerodynamic diameter less than or equal to 10 µm (PM10), PM with aerodynamic diameter less than or equal to 2.5 µm (PM2.5), asbestos, and airborne and settled lead. In addition, the implosion created a dust cloud that traveled much further than expected, out to 20 km. ... Public advisories to mitigate personal exposure and **indoor migration of the implosion dust clou**d constituents **should extend to 10 or 20 km around an implosion site**. ... Before the implosion, all friable and some nonfriable asbestos was removed from the structures. Lead (Pb) present in the paint because of the age of the building was assumed to have an insignificant impact on air quality or deposition.
>
> ...
>
> The air quality data were compared with ambient air quality guidelines that were in place the year of the implosion (1998), and the analysis was updated with some current health risk information for acute exposures to PM2.5. ...
>
> ...
>
> Based on stationary monitoring results, the hypothesis that there would be insignificant levels of airborne and deposited Pb and airborne asbestos within 1 km is rejected. PCM asbestos concentrations exceeded airborne criteria at a number of downwind locations ... The 24-hr average post-implosion airborne lead concentrations were elevated compared with normal background levels but were not above the 24-hr guideline. Wipe test results for Pb in settled dust ranged from “below detection limits” to a high of 1347 µg/ft^2 at location #6 ...
>
> ...
>
> Settled dust samples collected following the WTC collapse were alkaline in nature because of the dominant influence of aerosolized building material constituents such as concrete and gypsum. [*McGee, et al. 2003*] ... Significant quantities of gypsum and calcium carbonate were found in WTC PM2.5 surface dust. [*McGee, et al. 2003, typographical error in study citing Chen as lead author*] Thus, the BVC [*Calgary hospital*] implosion may have generated significant quantities of building material aerosols in TSP, PM10, and PM2.5 fractions.
>
> ...
>
> Mice lungs instilled with 100 µg of World Trade Center (WTC) PM2.5 surface dust demonstrated lung inflammation and airway hyper-responsiveness with methacholine challenge, which was estimated to be equivalent to a human inhalation concentration of 450 µg/m^3. [*citing EPA Gavett, et al. 2003 study*] ... In addition, the inflammatory response in mouse lung may have been underestimated [*in the EPA Gavett study*] because **the WTC dust used in testing may be considered weathered or aged**, although the timing between sample collection and experimentation is unclear. Freshly fractured rock has been shown to be more inflammatory than weathered rock because of the presence of larger amounts free radicals on fresh rock cleavage planes.
>
> ...
>
> Although **the risk to health was deemed to be minima**l because of short exposure times, it is still prudent to minimize public exposure to asbestos, which is a known human carcinogen, and to Pb, which is toxic at very low levels. ... **The finding of elevated levels of airborne PM as far as 20 km is significant.** Only people within a 1-km radius were advised to remain indoors during and after the implosion or to leave the area. These findings suggest that the 1-km advisory zone was too small.

[327] Samuel Dorevitch, Hakan Demirtas, Victoria W. Perksy, Serap Erdal, Lorraine Conroy, Todd Schoonover, and Peter A. Scheff (2006) Demolition of High-Rise Public Housing Increases Particulate Matter Air Pollution in Communities of High-Risk Asthmatics. J. Air & Waste Manage. Assoc. 56:1022–1032.
http://www.awma.org/journal/pdfs/2006/7/dorevitch.pdf

> At three public housing developments in Chicago, IL, PM with an aerodynamic diameter >10 µm (PM10) and >2.5 µm were measured before and during high-rise demolition. During structural demolition, short-term peaks in real-time PM10 (30-sec averaging time) occasionally exceeded 500 µg/m^3. ... IMPLICATIONS - **Demolition of public housing high-rise structures using heavy equipment** causes large increases in local concentrations of particulate matter, **which, unlike demolition by implosion, may be sustained over weeks**.
>
> ...
>
> DISCUSSION
>
> Our Findings in the Context of Previous Research ... Two studies of demolition by implosion noted extremely high instantaneous TSP concentrations: in one study, a maximum 1-min average was 54,000 µg/m^3, [*Beck, Geyh, et al. 2003*] and in the other, a 10-sec average was >99,999 µg/m^3. [*Stephani, et al. 2005*] In both of those studies, peak concentrations dramatically decreased within minutes to hours after implosion, although at some monitoring sites they remained elevated compared with baseline measures. **Because structural demolition by mechanical disruption occurs over weeks rather than minutes, the elevated concentrations of particulates are sustained over a much longer time frame than when implosion is used.**
>
> ...
>
> Dust samples collected outdoors after the destruction of the World Trade Center were mainly (by mass) >53 µm in diameter, [*Lioy, et al. 2002, EPA-funded WTC study*] considerably larger than we noted. However, we sampled ambient air, whereas the World Trade Center samples were of settled dust, which one would expect to contain larger particles. ... **The fact that the particulates were composed of predominantly calcium carbonate is to be expected, because it is a major component of building materials. This has also been noted in samples from the World Trade Center site.** [*citing Lioy, et al. 2002, EPA-funded study*]
>
> ...
>
> **Relatively high concentrations of cockroach and mouse allergens have been documented in inner city homes and could become aerosolized by demolition.**
>
> ...
>
> The large size (~17 µm aerodynamic diameter) of demolition particulates may mitigate these effects to some degree. Particles of this size are unlikely to infiltrate indoors or to be inhaled into the lower respiratory tract, although they could cause upper airway symptoms.

[328] Lioy, *et al.* (2002), *op. cit.*

[329] The Chicago demolition study stated that the WTC study measured settled dust, but failed to mention that high pH levels were found in this settled dust. The Calgary study stated that WTC studies found that WTC dust was alkaline, but carefully avoided stating that the dust in their study might also have been alkaline.

330 Takao Gotoh, Takashi Nishimura, Minoru Nakata, Yuzuru Nakaguchi, and Keizo Hiraki (2002) Air Pollution by Concrete Dust from the Great Hanshin Earthquake. J. Environ. Qual. 31:718–723. http://jeq.scijournals.org/cgi/reprint/31/3/718 [*See earlier citation for excerpts*].

331 Gotoh, T. (1999). Presumption of alkaline pollution due to concrete dust by dissolving buildings since Hanshin earthquake disaster. (In Japanese.) 32nd Annu. Meeting Rep. for Safety Eng. Corona Sha, Tokyo.

332 National Library of Medicine search engine interface page for "PubMed": http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed

333 Bos, Peter M.J. MSc; Busschers, Marloes MSc; Arts, Josje H.E. PhD (2002) Evaluation of the Sensory Irritation Test (Alarie test) for the Assessment of Respiratory Tract Irritation. Journal of Occupational & Environmental Medicine. 44(10):968-976.
http://www.joem.org/pt/re/joem/abstract.00043764-200210000-00017.htm;jsessionid=F7TMsbLQnvY1gy1Lgg1J8WnplCy1Q5YjkGmnLcyGv0GX9jFp1Vyx!-1119014599!-949856145!8091!-1

> The available literature on respiratory tract irritation, seen as a local inflammatory response and/or tissue damage, after single and repeated (few-day) exposure was evaluated and compared with data on sensory irritation. No relation was found between the sensory irritation potential (as measured by the Alarie test) and local tissue damage (histopathological changes) in the respiratory tract after single or repeated exposure. It was concluded that the Alarie test is inappropriate to evaluate respiratory tract irritation.
> ...
> The term "irritation" as commonly used in occupational hygiene and toxicology is not unequivocal. It may refer to two different basic processes. On the one hand, irritation refers to an inflammatory response due to local contact with the noxa (chemical, physical) and involves local redness, edema, pruritis, or pain, and, eventually, altered function. This type of irritation is being assessed in the standardized skin and eye irritation/ corrosion tests.[9,10] On the other hand, the second meaning is related to the interaction of substances with free nerve endings, when inhaled via the nose, causing local sensation with associated local reflexes and in some cases systemic reflexes; these effects are often referred to as sensory irritation. Sensory irritants stimulate the trigeminal nerve endings in the cornea and nasal mucosa evoking a burning or stinging sensation. In some cases, this may be accompanied by pulmonary irritation due to the stimulation of the vagus nerve of the lower respiratory tract.[11–14] The local reflexes resulting from sensory irritation, eg, lacrimation or decreased breathing rate, are considered to be of a protective nature, that is, to limit contact and thus prevent local damage to (lower) respiratory tissue and possible systemic effects.
> ...
> Results ...
> Histopathological Nasal Passage Lesions after Repeated Exposure ...
> For these 14 substances, the concentration at which histopathological changes were induced was not related to their sensory irritation potential. The minimal concentration at which substances with a relatively low RD_{50} [*concentration that produced a sensory response measured by reduced respiration rate in animals*] (<10 ppm) induced lesions varied to a large extent: 0.3*RD_{50} (toluene diisocyanate), 1*RD50 (allyl alcohol, allyl glycidyl ether), 3*RD_{50} (formaldehyde), or even higher than 3*RD_{50} (allylamine). In addition, substances with a relatively high RD_{50} (150 to 174 ppm) induced lesions already at 0.3*RD_{50} (dichlorobenzene, acetic acid, diisopropylamine). ... The available data indicate that the minimal exposure concentration necessary to induce histopathological changes is not related to the RD_{50} ... the substances with a relatively high RD_{50} (acetic acid, dichlorobenzene, and diisopropylamine) induced lesions at concentrations of 0.3*RD_{50}, and not all of the strong sensory irritants (RD_{50} <10 ppm) appeared to be strong respiratory tract irritants. ...
> ...
> Some substances induced injuries that rapidly stabilized, others caused injuries that became more severe with increasing exposure duration. There was no correlation between concentrations inducing histopathological changes in the respiratory tract and the RD_{50}. ...

334 OSHA. CONFINED SPACE HAZARDS. http://www.osha.gov/SLTC/smallbusiness/sec12.html

> Irritant (Corrosive) Atmospheres ... Prolonged exposure at irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This may result in a general weakening of the defense reflexes from changes in sensitivity. The danger in this situation is that the worker is usually not aware of any increase in his/her exposure to toxic substances.

335 OSHA. Occupational Exposure to Cadmium, Section: 6, Title: Section 6 - VI. Quantitative Risk Assessment
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=820&p_table=PREAMBLES

> The mechanism of clearance is directly related to the deposition within the respiratory tract, which is a function of the particle size. In the upper respiratory tract, clearance by the mucociliary escalator is operative, while in the lower part of the respiratory tract or in the alveoli, clearance can occur by dissolution and direct uptake by macrophages, which are also cleared by the mucociliary escalator. Biological half-time is influenced by the competence and efficiency of these clearance processes. Removal of particles from the lung by mucociliary action, rather than by dissolution and diffusion, may allow for a longer retention time. However, any cytotoxicity that slows ciliary movement or creates an overburden on macrophage capability would increase that retention time, thus allowing for more dissolution and formation of the free cadmium ion ...

336 Holma B, Lindegren M, Andersen JM. (1977) pH effects on ciliomotility and morphology of respiratory mucosa. Arch Environ Health. 1977 Sep-Oct;32(5):216-26.

> Tracheal cilia of cows exposed, in vitro, for 20 hours to different acidities and alkalinities of sulfuric acid and sodium hydroxide, respectively ... In alkaline reactions, ciliostasis [*inactivity of the cilia*]occurred at pH 9.6. Destroyed cilia were found above pH 10.15 ... The first symptoms, however, of adverse effects were intracellular edema and the simultaneous occurrence of cellular polyps in both acid and alkaline reactions at pH 6.7 and 9.5, respectively. ...
> ...

> The mucous blanket covering the epithelium of the respiratory tract is a first defensive barrier against inhaled pollutants. Its resistance to acid or alkaline loadings affects not only the solubility and dissociation of inhaled substances and their ability to permeate the respiratory membranes, but also the removal of deposited materials, since the condition of the mucus differs in acid and alkaline solutions. Thus exposure to acid or alkaline substances has clinical and hygienic significance, and the study of the effects of different pH values on the mucus and mucosa is essential to an evaluation of the hazard presented by acid and alkaline types of air pollutants.

[337] Andrew P. Worth and Mark T.D. Cronin (2001) The use of pH measurements to predict the potential of chemicals to cause acute dermal and ocular toxicity. Toxicology 169: 119–131.

> According to the first decision rule, which is applied to all observations, seven observations with pH values > 10.5 are placed in node 3 and are predicted to be corrosive. The remaining 37 observations are placed in node 2 and subjected to a second decision rule. Application of the second rule leads to 13 observations with pH values < 3.9 being placed in node 4 and being predicted to be corrosive. The remaining 24 observations are placed in node 5 and are predicted to be non-corrosive. The numbers above each node show how many observations (chemicals) are sent to each node, and the histograms illustrate the relative proportions of corrosive and non-corrosive chemicals in each node. The CT [*classification tree*] for skin corrosion potential can be summarised in the form of PM 1 [*predictive model 1*].
>
> **If pH < 3.9 or if pH > 10.5, then predict as C** [*corrosive*]; otherwise, predict NC [*non corrosive*]. (PM 1)
>
> ...
>
> Indeed, a number of chemicals with intermediate pH values are corrosives (Fig. 2), skin irritants (Fig. 3) or eye irritants (Fig. 4), which indicates that some chemicals elicit their corrosive or irritant effects by mechanisms other than a pH-dependent mechanism. This is especially true of chemically-induced skin and eye irritation, which are known to be associated with an inflammatory response in which the chemically- induced release of 'primary' cytokines leads to the synthesis and release of 'secondary' cytokines that help to maintain the inflammatory response.

[338] C. Clary-Meinesz, J. Mouroux, J. Cosson, P. Huitorel, B. Blaive (1998) Influence of external pH on ciliary beat frequency in human bronchi and bronchioles. Eur Respir J. 11: 330–333. http://erj.ersjournals.com/cgi/reprint/11/2/330

> Using the image analysis system applied in the previous study, we compared variations in the ciliary beat frequencies (CBF) of bronchi and bronchioles sampled from human lung resections at various pH in vitro. Application of nonparametric tests (the variance of samples was not similar) indicated that CBF was not significantly modified when pH was varied between 7.5 and 10.5 for bronchi, and between 5.5 and 10.5 for bronchioles. Reversible and significantly lower CBF were observed below pH 7.0 for bronchi and below pH 5.0 for bronchioles. Extreme pH values such as 11.0 or 3.0 were lethal within a few minutes. Thus, **respiratory ciliary beating is able to tolerate external pH variations between 3.5 and 10.5 without permanent impairment.**
>
> ...
>
> In humans, **normal pH values in tracheal mucus range 6.9–9.0** [3]. Moreover, infection can be accompanied by pH values as low as pH 5.8 in mucus [4]. ... Here we examine CBF modifications induced by pH variations in the medium surrounding ciliated cells and compare results from bronchi and bronchioles. ... Measurements were made from 17 lungs resected for tumours. ... Lung tissues were examined for sampling within 1 h of resection.
>
> ...
>
> CBF of bronchial cells remained stable between pH 7.5 and 10.5 ($Z_{Hjl} < 3.5$). When the pH value was lowered below pH 7.0, CBF decreased significantly. CBF values at pH 7.5 differed significantly from CBF values at pH 7.0, but the level of significance was not high ($Z_{Hjl} = 4$, compared to 3.5). A pH value of 5.5 reduced the bronchial CBF by 50%, while ciliary activity was almost arrested at pH 3.5. **At pH 3.0 or 11.0 cells were irreversibly damaged: at pH 11.0, cells were progressively damaged, allowing some initial CBF measurements within the first 5 min,** whereas at pH 3.0 they showed deleterious effects too fast to allow any CBF measurement (fig. 1a).
>
> Bronchiolar ciliary beat behaviour was slightly different. Bronchiolar CBF did not differ significantly from initial values at pH 7.0 between pH 5.5 and 10.5 ($Z_{Hjl} <3.4$). In contrast to bronchial cilia there was no difference between CBF at pH 7.0 and pH 7.5. Below pH 3.5, CBF decreased by more than 50%. **As seen for bronchial cells, pH 3.0 and 11.0 were deleterious in the same way** (fig. 1b). ... In our experimental conditions, we showed that bronchial CBF does not significantly change in response to changes in the pH of the external medium between 7.5 and 10.5.

[339] INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY (1986) ENVIRONMENTAL HEALTH CRITERIA 54 - AMMONIA. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization. http://www.inchem.org/documents/ehc/ehc/ehc54.htm

> 1. Ammonia is irritant to the respiratory tract causing:
>
> (a) bronchial oedema, spasm, and hypersecretion resulting in chest tightness, wheeze, and cough, which may progress to severe dyspnoea; and
>
> (b) lower airway inflammation with exudative pulmonary oedema and impaired gaseous diffusion. Symptoms may be delayed 24 h or more. Resolution may be by **fibrosis producing a restrictive defect.**

[340] Brautbar N, Wu MP, Richter ED. (2003) Chronic ammonia inhalation and interstitial pulmonary fibrosis: a case report and review of the literature. Arch Environ Health. 2003 Sep;58(9):592-6. http://www.findarticles.com/p/articles/mi_m0907/is_9_58/ai_n7069078/print

[341] See earlier discussions and documentation of the data from the University of California at Davis, DELTA Group, showing 21 to 22% portland cement in the smallest respirable WTC dust particles.

[342] United Nations Economic Commission for Europe (2005) Globally Harmonized System of Classification and Labelling of Chemicals (GHS), First Revised Edition. 3.1.2.6 Specific considerations for inhalation toxicity at p. 112; Chapter 3.2 Skin Corrosion/Irritation, Chapter 3.3 Serious Eye Damage /Eye Irritation at p. 137; 3.2.1 Definitions at p. 123. http://www.unece.org/trans/danger/publi/ghs/ghs_rev01/01files_e.html

See also original 2003 version of the same document, where the only difference in the abstracted language below is that the definition of corrosion of the respiratory track is included in an Appendix. http://www.unece.org/trans/danger/publi/ghs/ghs_rev00/00files_e.html

> Corrosion of the respiratory tract is defined by destruction of the respiratory tract tissue after a single, limited period of exposure analogous to skin corrosion; this includes destruction of the mucosa. The corrosivity evaluation could be based on expert judgment using such evidence as: human and animal experience, existing (in vitro) data, pH values, information from similar substances or any other pertinent data.
> ...
> Skin Corrosion is the production of irreversible damage to the skin; namely, visible necrosis through the epidermis and into the dermis, following the application of a test substance for up to 4 hours. Corrosive reactions are typified by ulcers, bleeding, bloody scabs, and, by the end of the observation at 14 days, by discolouration due to blanching of the skin, complete areas of alopecia, and scars.
> ...
> Serious eye damage is the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the anterior surface of the eye, which is not fully reversible within 21 days of application.