



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

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

DATE: October 25, 2006

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TO: Bill Roderick, Acting EPA Inspector General
EPA Office of the 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**

This memorandum supplements my August 22, 2006 complaint that EPA fraudulently reported pH tests results showing the corrosive alkalinity of dust from the collapse of the World Trade Center (WTC).

Part A addresses the overall alkalinity of WTC dust, both large and small particles. EPA, OSHA and NYC illegally withheld pH data, and then falsified the associated health hazards for the pH data that it did release to the public. The EPA and OSHA criteria for corrosivity to human tissues are discussed. The sources and identities of alkaline constituents of WTC dust are provided. WTC dust on the Pile at Ground Zero would have been much more alkaline, based on the high temperatures from the ongoing fires converting materials to oxides and hydroxides. All publicly available pH testing has been restricted to the relatively low temperature dust generated during the initial collapse of the WTC, outside the perimeter of Ground Zero.

Part B addresses the fraudulent reporting (actually changing the numbers) for the pH of the smallest, most dangerous particles in WTC dust. New documentation is included to augment my original August 22 complaint to the EPA IG.

This complaint does not address EPA's fraudulent misrepresentations of the health significance of other toxic substances contained in WTC dust. Note that my July 4, 2003 submission to the EPA IG included the complaint that EPA had withheld alkalinity data from the public and rescue/recovery workers. This complaint was ignored and not even mentioned in the IG's August 21, 2003 report on EPA's role after the WTC collapse.

www.nycosh.org/environment_wtc/Jenkins-7-4-03-documentary-d.pdf
<http://www.nyenvirolaw.org/PDF/Jenkins-7-4-03-documentary-d2.pdf>

* The conclusions and opinions are those of the author and do not necessarily reflect those of the U.S. EPA.

PART A: Failure to Warn and Falsification of Health Implications for Corrosive Alkalinity

EPA, OSHA, and NYC hazardous incident personnel were equipped, trained, and required to conduct pH tests on September 11, 2001 and after

EPA, OSHA, and NYC On Scene Coordinators (OSC's) responded to assess the release or potential release of hazardous substances on September 11, 2001 and in the days and months after. They were trained, legally required, and equipped to conduct pH and other preliminary tests. Corrosive hazards, indicated in part by pH tests, are but one of a list of hazardous properties which must be assessed at the beginning before allowing other personnel to respond to an incident. Corrosive materials can be acid or alkaline (caustic). Dust and ashes from the WTC disaster were highly alkaline (high pH).

The fact that ashes from fires are caustic and alkaline is well known, beginning in early human history with the use of wood ashes for alkali potash. EPA, OSHA, and NYC personnel would have been aware of this fact, especially since they demonstrated their understanding of the hazardous nature of combustion products when they measured the plume from the WTC for acidity, a much more complicated procedure. The acidity of smoke from fires is also well known.

EPA denies having any pH data for WTC dusts

EPA denied ever testing the pH of WTC dusts, which is not credible. In a February 9, 2002 interview, EPA's Bonnie Bellow claimed that EPA did not need pH testing:

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.

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>

EPA and OSHA hazardous substance release incident regulations require corrosive material testing

The following are the OSHA and EPA regulations and standards which require OSC's (whether federal, state, city) to assess the corrosive alkaline or acid properties and other hazards during an emergency response to the release or potential release of hazardous substances:

OSHA Regulations (Standards - 29 CFR) Hazardous waste operations and emergency response. - 1910.120
...
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.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765

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.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1572

EPA and OSHA require on-scene response personnel to be trained to test for pH, and have pre-prepared kits and vehicles to include pH testing equipment

NYC and trained EPA On Scene Coordinators (OSC's) were in fact at Ground Zero the morning of September 11, 2001.

[Internal EPA document abstracted into the following document at page 371]

Cate Jenkins (7/4/03) 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>

Both EPA and OSHA require OSC's to be trained to test for corrosive materials (pH) at any potential or actual hazardous materials release incident. EPA and OSHA also require that pre-packed kits and vehicles be ready to deploy to any of these incidents. These are required to include a range of protective equipment and basic chemical sampling apparatus, including pH testing equipment (simple paper test strips and/or pH meters). The following are the requirements for training OSC's to conduct pH tests, and the lists of testing equipment that includes pH testing meters/strips that must be part of emergency deployment kits:

OSHA Regulations (Standards - 29 CFR), Standard Number: 1910.120 App E
Training Curriculum Guidelines ...

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.**

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9770

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.

<http://www.epa.gov/oamreg01/region6/PR-R6-06-10130/qualification.pdf>

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

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** ...

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=3061

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY OFFICE OF ENFORCEMENT ... **MULTI-MEDIA INVESTIGATION EQUIPMENT CHECKLIST**

...

Flashlights Tyvek 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

...

<http://www.epa.gov/Compliance/resources/publications/civil/programs/mmmall.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 ...

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

EPA, OSHA and NYC claims they did not have pH test data are not credible

On the basis of the above, it is not credible for either EPA, OSHA or NYC to deny having pH test data on WTC dusts from the first time they were on site at the disaster, September 11, 2001.

They were required to conduct pH tests, and trained and equipped to do so. pH was one of the easiest and most important tests for the dust and debris. EPA, OSHA and NYC were testing the air for pH (acid gases), a much more complicated procedure. They would also have been testing pH, at a minimum, by wetting WTC dust and applying pH paper test strips. Those results would have been alarming and instigated more extensive testing.

Furthermore, later EPA funded research included carefully controlled laboratory pH testing of WTC dusts, resulting in 8 publications. These studies are discussed in detail later in this complaint: USGS, 2002 (in conjunction and with and co-staff from EPA); NYC DOHMH/ATSDR, 2002; EPA, 2002 (mouse inhalation study); Chen and Thurston, 2002; McGee, *et al.*, 2003; Liroy *et al.*, 2002; Landrigan, *et al.*, 2004; and Yiin, *et al.*, 2004. If it were so important for EPA to test pH later in a costly laboratory setting, how can EPA claim that it was unimportant to test during the early days when first responders/recovery workers, residents, office workers, sanitation workers, and immigrant workers cleaning out buildings were actually being exposed?

No press releases issued by EPA, OSHA, or NYC, nor any worker or resident informational or fact sheets issued by the same, provided any warnings about the corrosive alkaline dusts. These official communications did not even admit that alkaline corrosive dusts were an issue or under investigation, whether in the first days/months after the disaster by field tests, or in the many carefully controlled laboratory investigations that followed. No pH testing results were ever provided by these entities in response to FOIA/FOIL requests, even after September 27, 2001 when it was known for certain they were in possession of such data.

This is not the first time that EPA and NYC have been documented as illegally concealing essential health information from the public. See my July 15, 2004 complaint to the EPA Inspector General which documented that EPA and NYC, working in concert, altered air asbestos test data, actually changing high test levels to zero in some cases, to lower levels, or deleting results altogether.

Jenkins, C. (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
http://www.911ea.org/EPA_Concealment_07.15.04_Jenkins1.pdf
<http://www.nyenvirolaw.org/PDF/EPA%20concealment-071504-Jenkins.pdf>

EPA suppresses USGS alkalinity pH data from September 17, 2001; USGS back-dates report to claim it notified public in a timely manner

The US Geological Survey (USGS) also suppressed pH testing data from samples it took on September 17, 2001. On request from EPA and with the participation of EPA staff, the USGS took dust samples from lower Manhattan on September 17, 2001 and found highly alkaline pH levels. USGS provided the information to EPA, OSHA, FEMA, etc. by some unknown date (participating EPA staff would have known instantaneously), and then posted the results on an internal government website by at least September 27, 2001.

This USGS data was not released to the public or first responders until a January 13, 2002 news article, followed by a more extensive news article on February 9, 2002. Then, in 2004, the USGS falsified their publication date for the report, claiming it was November 15, 2001. The following is an excerpt from the final USGS report:

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).

...
 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 ...

USGS (February 5, 2002 is the actual web posting date, the 11/15/01 date on report added in 2004 is falsified. See later analysis.)
 Environmental Studies of the World Trade Center area after the September 11, 2001 attack.
<http://pubs.usgs.gov/ofr/2001/ofr-01-0429/>

USGS obscures fact that it identifies calcium hydroxide Ca(OH)₂ at up to 20% in WTC dust

The USGS found up to 20% calcium hydroxide (Ca(OH)₂) in WTC dusts using X-ray diffraction methods. But the USGS disguised the fact by only calling it "portlandite." Ca(OH)₂ is expected to be a major contributor to the alkalinity of WTC dusts. For 33% of the samples within 5 blocks of the WTC, the USGS was able to identify from less than 5% up to 20% Ca(OH)₂. This 33% figure is unrealistically low, since there were many samples with highly alkaline pH levels where the USGS was unable to detect any Ca(OH)₂. For example, USGS sample numbers WTC01--02, 09, 15, 22, and 27 had pH levels over 10, but no identifiable Ca(OH)₂ in the same sample.

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 (Fe₂O₃ - 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 – CaCO₃

Quartz – SiO₂

Gypsum – CaSO₄ · 2H₂O

Anhydrite – CaSO₄

Muscovite-1M1 – KAl₂(Si₃Al)O₁₀(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			

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/>

"Portlandite" is a very obscure name for $\text{Ca}(\text{OH})_2$, a name apparently developed by X-ray crystallographers to describe the particular crystalline form of $\text{Ca}(\text{OH})_2$ 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.

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

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>

Web Mineral. Portlandite
<http://ruff.geo.arizona.edu/doclib/hom/portlandite.pdf>

The USGS gave the 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. It also gave the chemical formula for the simpler chemical mineralogical species it found, like hematite, gypsum, quartz, calcite, anhydrate, etc. It even gave the chemical formula for a complex mineral it claimed to have found, namely "muscovite," which is mica. But portlandite was mysteriously lacking any chemical identification.

In one obscure sentence, the USGS obliquely referred to "muscovite, carbonates, and other hydroxyl-bearing minerals." This is another apparently deliberate obfuscation. Portlandite, or $\text{Ca}(\text{OH})_2$, would not be described by any mineralogist or chemist as a "hydroxyl-bearing mineral." When hydroxyl groups are part of a complex crystalline mineral lattice in a typical complex mineral, they have completely different chemical characteristics than a highly ionic hydroxide anion in a simple base like $\text{Ca}(\text{OH})_2$.

The result of this omission of the identity of portlandite as $\text{Ca}(\text{OH})_2$ by USGS resulted in the contribution to the overall failure to warn and protect rescue and recovery workers, sanitation workers, immigrant laborers cleaning nearby buildings, and residents doing their own cleanups. Not being aware of the chemical identity of "portlandite" also meant that health professionals working on their behalf could not demand targeted OSHA monitoring for this important OSHA regulated alkaline caustic substance.

USGS scientists finally release results through press on January 13, 2002 and February 9, 2002

It was not until January 13, 2002 and February 9, 2002 that the USGS released the pH results from their September 17, 2001 tests through the press. The following are quotations from these two news stories:

Swayze and Todd Hoefen, another USGS geophysicist, flew to New York on Sept. 17. ... Taking the ferry across the Hudson from New Jersey, they collected samples of dust in Zip-lock freezer bags from window ledges, flower pots, car windshields — anyplace it was collecting. They hoofed it out two miles — or to the river's edge — in each direction of the compass from the collapsed towers and gathered three dozen samples.

...
Worried that a rainstorm the night of Sept. 14 might have altered the dust, Swayze and Hoefen found dry samples — dust from an apartment on the 30th floor about three blocks from the World Trade Center and a gymnasium in the World Financial Center across from the smoldering ruins.

Finding and analyzing the dry dust was crucial, the scientists said, because it presented an accurate picture of what risks workers and residents would face if they encountered dust that hadn't been rained upon or splashed with wash water.

...

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 X-ray 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. 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. From 7 to zero is an indication of acid. From 7 to 14, the top of the scale, is alkaline. Levels near either end of the pH scale can harm health.

Plumlee was mixing one part of dust to 20 parts of water. ... "We were startled at the pH level we were finding," he added. "We knew that the cement dust was caustic, **but we were getting pH readings of 12 and higher.** It was obvious that precautions had to be taken to protect the workers and people returning to their homes from the dust." Significant efforts are being made at ground zero to keep the work area wet, to suppress the dust, but this has minimal effect on the hazards of pockets of dust just below the surface.

...

They took their findings to toxicologists and emergency coordinators from the EPA and physicians from the U.S. Public Health Service and the Centers for Disease Control. These medical authorities agreed that the Geological Survey's findings, especially the high pH levels, must be available to those setting rules for worker safety and those considering whether and when to permit people to return to their homes and offices, the scientists said. ... The USGS team broke all records and had their findings reviewed and on a "government-only" Web site within a week.

"It was important to get the information out to those who needed it," Clark said. "What we wanted to indicate to emergency response workers and those making decisions about people returning to their homes and offices was that in addition to the high pH, there were heavy metals, especially chromium and aluminum, in the dust which could be released by water."

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

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.

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>

USGS withheld pH data from public until January and February 2002, then falsifies publication date, back-dating it to November 15, 2001

No health and safety professionals known to me acting on behalf of rescue and recovery workers, residents and others exposed to WTC dust were made aware of the USGS pH results until the January 13, 2002 and February 9, 2002 press articles quoted above. This lack of timely notification on pH and chemical testing is in marked contrast to USGS's prompt release of thermal testing of the hot spots from the fires at Ground Zero to first responders:

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.**

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/>

The USGS then falsified the date when their report on pH and other chemical testing was published so as to make it appear they notified first responders and the rest of the public in a timely manner. This can be proven by the use of the Internet Archive "WayBackMachine" at web.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 April 5, 2004 and July 4, 2004, and that it was back-dated to November 15, 2001.

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

Neither the November 25, 2001 nor the November 29, 2001 alleged publication dates match the alleged November 15, 2001 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 February 5, 2002. 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 February 5, 2002 should be accepted as the credible date when the USGS actually made their report available to the public by publication on the internet. This February 5, 2002 date dovetails with the press articles on January 13 and February 9, 2002 in the St. Louis Post-Dispatch. If the USGS had actually posted the report on the internet before February 5, 2002, then the USGS scientists quoted in the press articles would have stated it. These scientists forced the release of the USGS WTC data through their statements to press. Note that the USGS did not announce this report with a press release of its own, as appears to be their typical practice.

See the following web.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 November 17, 2001, 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

USGS pH test of 1:20 water leachates underestimated the alkalinity of WTC dust

The USGS pH test methods did not reveal the maximum alkalinity levels or the true corrosive properties to human tissues for a range of reasons. First, the USGS diluted the dust samples with 20 parts water. This is not a standard dilution ratio for testing pH of solid soil like materials,

which should use a 1:1 ratio of sample to water. Using a 20:1 ratio will lead to erroneously low pH levels.

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.

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/>

EPA's established pH method is part of the EPA SW 846 series, Method 9045D, which uses a dilution ratio of about 1 to 1 dust to water.

Furthermore, the chemist responsible for the actual pH testing was quoted in the February 13, 2002 press article as stating: "We were startled at the pH level we were finding ... we were getting pH readings of 12 and higher." But when the final USGS report came out, the highest pH level reported was 11.8. This indicates that the USGS had found higher pH levels using more standard EPA testing methodology using the 1:1 ratio, but chose not to include these alarming results in their report.

Even if USGS had reported the pH results using the 1:1 ration, the EPA Method 9045D states that it may give erroneously low pH results for solid substances:

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.

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>

As discussed later, water-based pH testing is an inappropriate measure of corrosivity for sparing soluble alkaline substances like $\text{Ca}(\text{OH})_2$. Corrosivity standards under EPA, OSHA, and the Federal Hazardous Substances Act (FHSA) require animal testing because of either solubility or water decomposition problems. Even if pH testing was an appropriate, the only dusts tested by USGS were deposited during the initial collapse of the WTC outside the perimeter of Ground Zero. These dusts were not representative of the dusts from the Pile at Ground Zero. The high temperatures from the ongoing fires would have converted some of the CaCO_3 to the more highly alkaline compounds, CaO and $\text{Ca}(\text{OH})_2$.

OSHA deleted tests for calcium, indicators of Ca(OH)₂, CaO and CaCO₃

As discussed at the beginning of this complaint, EPA, NYC, and OSHA have denied performing any on-site pH tests at the epicenter of Ground Zero and have not made any of this pH data public, even though they were required to by OSHA standards at 29 CFR 1910.120, trained to make such tests, and pre-equipped to do so. It is not credible that they did not have pH test results and other preliminary field test data beginning on September 11, 2001.

This section documents the fact that OSHA selectively deleted a complimentary set of pH-related data from its metals tables of air monitoring. OSHA deleted test data for the category of all calcium compounds, which would indicate the presence (and need for further testing) for the OSHA-regulated alkaline substances calcium oxide (CaO), calcium hydroxide (Ca(OH)₂) and calcium carbonate (CaCO₃). OSHA test methods would simultaneously reveal the alkaline related metals calcium, sodium, and potassium, along with other metals such as copper, iron, cobalt, etc.

The following is OSHA's summary of the tests it performed for metals, dusts, and acid gases. There is a link to the metal data tables at the top of the web page address given below:

Total Dust (PNOR) 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/m³). The highest exposure was found on one operator who was exposed at approximately 4X PEL. **[note there is no mention of respirable dust, only total dust]**

...

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/m³. Workers were sorting debris.

Oxides of Nitrogen/Sulfur [which would result in acidic corrosive conditions when contacted with wet human tissues] 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.

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>

OSHA cannot escape responsibility for deleting the calcium category from its data tables by claiming they were only interested in "heavy metals." They reported data for metals that are not as "heavy" as calcium. Calcium has a molecular weight of 40. But magnesium only has a molecular weight of 24. Magnesium oxide is not as caustic and alkaline as CaO, Ca(OH)₂ and CaCO₃, and thus of less concern and significance, but OSHA included it. Also debunking the "heavy metal" argument is the fact that OSHA tested for beryllium which has a molecular weight of only 9, a much less "heavy metal." (OSHA found no beryllium, so did not include it in the tables, but they at least discussed the fact that they had tested for it. No such discussion for calcium, sodium, and potassium was included.

OSHA methods simultaneously reveal calcium/sodium/potassium compounds along with other metals, and reiterate hazard concern and OSHA PEL's as part of methods themselves

OSHA would have used either of two of their laboratory test methods for metals in air or dusts, atomic absorption (AA) or inductively coupled argon plasma (ICAP). Both OSHA test methods list a large range of metals that will be quantified simultaneously. These metals include but are not limited to calcium, sodium, and potassium.

METAL & METALLOID PARTICULATES IN WORKPLACE ATMOSPHERES (ATOMIC ABSORPTION), Method no.: ID-121

...

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/m³ ...
K	Potassium hydroxide	2 mg/m³ ...
	Magnesium oxide fume	Total particulate [15 mg/m ³] ...
Na	Sodium hydroxide	2 mg/m³

<http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html>

METAL AND METALLOID PARTICULATES IN WORKPLACE ATMOSPHERES (ICP [*inductively coupled argon plasma*] ANALYSIS), Method no.: ID-125G

...

Table 1 Air Contaminants - OSHA Permissible Exposure Limits* ...

Ca	Calcium oxide	5 mg/m³
K	Potassium hydroxide	2 ...
Na
	Sodium hydroxide	2

<http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html>

Government/private studies found calcium/sodium/potassium in dust/air outside of Ground Zero

OSHA cannot claim that it did not find any calcium, sodium, or potassium compounds, and thus was not reporting them for this reason. Calcium, sodium and potassium compounds have always been 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. These researchers were using the same laboratory methods as OSHA, and probably sending them to the same outside contract laboratories as OSHA. The following are studies which reported calcium as well as other metals associated with toxic or hazardous properties:

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. Liroy, 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/2002/110p703-714liroy/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 Trade Center Collapse Piles: Anaerobic incineration? Advances in Chemistry. ACS symposium series, vol. 919, pp. 152-163
<http://cat.inist.fr/?aModele=afficheN&cpsid=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. Gorcynski, M. Kendall, L. C. Chen, C. P. Weisel, B. Buckley, I. Yang, and P. J. Liroy (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.epaos.org/doc_list.asp?site_id=WTC

November 19, 2001 - WTC dust inside buildings found highly alkaline

In an EPA-funded study, the alkalinity of dust inside buildings near Ground Zero was still highly alkaline on November 19, 2001. This dust contained significant fractions of small respirable size particles.

The dust and smoke generated during the collapse immediately penetrated and contaminated the interior of apartments and office buildings in southern Manhattan. Dust surface loadings, up to (and at times greater than) 3 cm thick, were deposited on indoor surfaces, from visual assessment. The patterns and extent of deposition throughout the rooms sampled indicated that the dust was deposited during the collapse of the building. To provide a basis for evaluating the potential health risk for returning residents and indoor workers, 16 indoor WTC dust/smoke samples were collected by staff of New York University (NYU) and the Environmental and Occupational Health Sciences Institute (EOHSI) on November 19, 2001, from two uncleaned buildings.

Address	Floor	Location	Color	pH
Liberty Street	8	LR & BR	gray/tan	11
	5	Library	N/A	N/A
		Hall	gray/tan	11
		Baseboard	N/A	N/A
	4	Floor	gray/tan	11
		Hall & LR	gray/tan	11
		High Chair	tan	11
		BR	N/A	N/A
	2	Front Room	tan	11
		Front Room	N/A	N/A
Entryway		gray/tan	11	
Trinity Place	7	Walkway	gray/tan	8
	10	Office	gray/tan	10
		Office Window	N/A	N/A
North Moore Street	—	Air Filter	gray/white	5-6
South End Avenue	—	HEPA Prefilter	gray	5

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. Liou (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>

The alkalinity may well have significantly diminished during this 2-month time interval from September 11 to November 19, 2001 by reacting with atmospheric moisture and carbon dioxide, in carbonization neutralization process. Regardless of whether the measured alkalinity was as high as that of the originally deposited dusts, these results have major implications for the exposures experienced by residents doing their own do-it-yourself cleanups, and most importantly for the thousands of mostly immigrant workers who found employment cleaning the interiors of buildings in lower Manhattan after 9/11.

Again, these alkalinity levels as measured by pH are not in any way representative of the dusts from the Pile at Ground Zero to which rescue and recovery workers were exposed. This is because the ongoing fires may have converted less alkaline materials such as CaCO_3 to more highly alkaline compounds like CaO and Ca(OH)_2 .

November – December 2001, joint ATSDR/NYC study tests pH, makes fraudulent claims about health relevance

During November and December 2001, the US Centers for Disease Control's (CDC) Agency for Toxic Substances and Disease Registry (ATSDR), funded by EPA through its Superfund authority, in conjunction with the NYC Department of Health and Mental Hygiene (DOHMH) tested dust inside and outside buildings near Ground Zero. Some of the tests included pH.

ATSDR/NYC reported the results of the joint study in a 4-page press release on February 8, 2002. The press release did not even mention the pH or alkalinity of WTC dust. They frustrated health care professionals attempting to assist citizens exposed to WTC dust by not releasing the report itself, which was 137 pages long.

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.

The tests examined samples of both air and dust. The air samples from inside the buildings showed no elevated levels of asbestos.

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

The full study (referred to as "ATSDR/NYC") was not released to the public until October 4, 2002:

NYC Department of Health & Mental Hygiene (October 4, 2002) ATSDR and New York City release final report on residential air and dust sampling in lower Manhattan following WTC collapse
http://www.nyc.gov/html/doh/html/press_archive02/pr831004.shtml

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>

ATSDR/NYC first obscured the fact that portlandite was the same thing as $\text{Ca}(\text{OH})_2$. Then, they falsified the information in American Conference of Governmental Industrial Hygienist (ACGIH) documents. They claimed that there had never been any adverse health effects on

ATSDR/NYC obscured finding $\text{Ca}(\text{OH})_2$ at up to 8% in dust and air by calling it "portlandite"

In the full study ATSDR/NYC reported "portlandite" in air and in settled dusts at levels up to 8%. They did not define the term portlandite in the executive summary, and waited until page 21 to define it once in a parenthesis, after they had used it before without defining it 26 times previously. This was the exact same strategy used by USGS. ATSDR/NYC, like the USGS (discussed earlier) made it appear that portlandite was some innocuous naturally occurring complex rock-like natural mineral. It is not.

Portlandite is calcium hydroxide ($\text{Ca}(\text{OH})_2$), a highly caustic alkaline base that is the reactive constituent of uncured concrete as well as being in cured, dried concrete in significant concentrations. The following is an excerpt of the ATSDR/NYC study addressing portlandite and the alkaline corrosivity issue:

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.*]

...

Calcite (calcium carbonate) and portlandite (calcium hydroxide) are also components of concrete. They occurred with similar frequency in the dust samples and were often collocated 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.**

...

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*]

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.
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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>

ATSDR/NYC falsified ACGIH hazard determinations and lung clearances, $\text{Ca}(\text{OH})_2$, CaCO_3 , CaSO_4

ATSDR/NYC directly falsified the hazard assessments for $\text{Ca}(\text{OH})_2$, CaCO_3 and CaSO_4 made by the American Conference of Governmental Industrial Hygienists (ACGIH), a prestigious organization pre-dating OSHA, and always on the forefront of protecting workers with recommendations for more stringent exposure limits than imposed by OSHA.

ATSDR/NYC claimed ACGIH stated that $\text{Ca}(\text{OH})_2$, CaCO_3 and CaSO_4 were soluble in body fluids and easily cleared from the lungs. All 3 of these substances are essentially non-soluble or only slightly soluble. The ACGIH describes the water solubilities as follows: $\text{Ca}(\text{OH})_2$ – 0.185%; CaCO_3 – "practically insoluble in water"; CaSO_4 – 0.2%. The ACGIH then documents many human and animal studies showing irreversible lung changes for all these substances,

which cannot in any way be claimed to be "minerals ... soluble in body fluid ... easily cleared from the respiratory tract and lungs when inhaled."

ATSDR/NYC also falsely claimed that the ACGIH found no health hazards from Ca(OH)_2 , CaCO_3 and CaSO_4 . This is a lie. The ACGIH has set Threshold Limit Values (TLV's) for all 3 of these substances, 2 of which are more stringent than OSHA's. The following table documents the fact that neither ACGIH nor OSHA considers these substances harmless and without health consequences:

	OSHA PEL (and) 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
Calcium Oxide (CaO) Unslaked lime, quicklime CaO converts to Ca(OH)_2 on contact with moist tissues, toxicologically equivalent to Ca(OH)_2 .	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

Calcium Oxide ... NIOSH REL [Recommended Exposure Limit]: 2 mg/m³ TWA
Current OSHA PEL [Permissible Exposure Limit]: 5 mg/m³ TWA
1989 OSHA PEL: Same as current PEL
1993-1994 ACGIH TLV [Threshold Limit Value]: 2 mg/m³ TWA

No data on acute inhalation toxicity are available on which to base an IDLH [*Immediate Danger to Life and Health*] for calcium oxide. 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 x the OSHA PEL of 5 mg/m³ ... **The revised IDLH for calcium oxide is 25 mg/m³ based on acute inhalation toxicity data in humans (ACGIH 1991).**

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

Other governmental agencies also regulate CaO and Ca(OH)₂ as corrosive substances. For example, the European Union classifies CaO as a corrosive substance. Canada classifies Portland cement as a corrosive substance, where CaO and Ca(OH)₂ are the primary alkaline corrosive ingredients. There are numerous studies showing exposures to CaO and/or Ca(OH)₂ from Portland cement resulting in permanent respiratory system damage, third degree burns, etc., too numerous to review here.

Citation of outdated 1975 5th Edition because recent 2000 9th Edition of The Diseases of Occupations did not support ATSDR/NYC's desired conclusion of "no hazards" from Ca(OH)₂, CaCO₃ and CaSO₄"

ATSDR/NYC also deliberately and knowingly cited two outdated references that supported their false claim there had never been any adverse health effects from heavy exposures during the mining and processing of Ca(OH)₂, CaCO₃ and CaSO₄. The ATSDR is part of the Centers for Disease Control and has access to one of the largest, most up-to-date libraries in the world. The ATSDR/NYC lists 63 authors and contributors to the preparation of the report (see page 51 of the ATSDR/NYC report), proving ample staffing for a more up to date review of the scientific literature. The failure to utilize more recent documentation of the hazards associated with WTC dust amounts to criminal malpractice.

The first outdated reference used by ATSDR/NYC is the 1975 5th edition of Hunter's *The Diseases of Occupations*:

[ATSDR/NYC study, op. cit.]
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).**

...
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.

Indeed, Hunter's *The Diseases of Occupations* is one of the most recognized authoritative texts on industrial medicine. 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 the year 2000, greeted by the Journal of the American Medical Association (JAMA) in glowing terms (JAMA 2000; 284:1985-1986).

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>

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

The old 5th edition is now obsolete, containing many errors because our knowledge of the causation and effect of toxic workplace substances has expanded dramatically over the last 30 years. But ATSDR/NYC did not stop at just adopting the outdated findings from Hunter's 5th edition. They also went to the extent of fraudulently misrepresenting what it actually said.

One directly fraudulent misrepresentation is the claim that the 5th edition of Hunter said that 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), because Ca(OH)₂ is an exceedingly rare mineral in nature, and never mined commercially. It 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 CaCO₃. Synthetic modern concrete would be the only source of any Ca(OH)₂ in WTC dusts.

In lime mortars, the actual lime species present is **hydrated or slaked lime (or portlandite) and is formed simply by the hydration reaction $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$** 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**

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>

Web Mineral. Portlandite

<http://ruff.geo.arizona.edu/doclib/hom/portlandite.pdf>

Mineralogy Database. Portlandite

<http://webmineral.com/data/Portlandite.shtml>

If the 5th edition of Hunter was to be relied upon for any current health assessments, consider what this 1975 edition stated about blood lead levels (*op. cit.*, p. 270). 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 current scientific findings where blood lead levels less than or equal to 2 µg/dL have been associated with both myocardial infarction and stroke mortality (Menke, *et al.*, 2006). 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.

Andy Menke, Paul Muntner, Vecihi Batuman, Ellen K. Silbergeld and Eliseo Guallar (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>

The 1975 5th edition of Hunter's also stated that hexachlorocyclohexane, lindane, and DDT had not caused any adverse effects in worker exposures (*op. cit.*, p. 487), and that methylene chloride and trichloroethylene are suitable substitutes for benzene (*op. cit.*, p. 483).

Citation of outdated 1956 British report to justify no hazards from Ca(OH)₂, CaCO₃ and CaSO₄

ATSDR/NYC also cited an 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, CaCO₃ and CaSO₄:

[ATSDR/NYC study, op. cit.]

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).**

...

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 (SMRE) Research Report No. 72, 1956.**

This 50-year old reference is no longer readily available to the public, and has at best historical significance. One can guess what it actually states about Ca(OH)₂, CaCO₃ and CaSO₄, because even the hazards of asbestos were not well recognized at this time period.

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.

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.**

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>

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/2001111024046/http://www.ci.nyc.ny.us/html/doh/html/alerts/wtc3.html>

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.

...

Kirk Johnson (February 8, 2002) With Uncertainty Filling the Air, 9/11 Health Risks Are Debated. NY Times] www.nyt.com

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."

DAVID SEIFM (February 28, 2006) WTC Dust May Still Be a Risk. NY Post www.nypost.com

ATSDR/NYC creates new corrosivity criteria subverting EPA and OSHA regulatory levels

ATSDR/NYC also created their own criteria for a corrosive alkaline material. This new standard contradicts and misrepresents the legally binding corrosivity standards of EPA, OSHA, and the Federal Hazardous Substances Act (FHSA). ATSDR/NYC obscured the fact that they had created new criteria for corrosivity by hiding it in the protocol for their study. However, they cited it in their main study itself without any explanation that it was the result of their own proposal, or stating that it contradicted existing EPA, OSHA and FHSA standards.

[From ATSDR/NYC protocol]

[p. 43] **There are very few standards for the regulation of the pH of a substance.** The national Secondary Drinking water standards set the pH range at 6.5 - 8.5. EPA has established guidelines for the testing of the acute dermal irritation and the acute eye irritation properties of substances. Those guidelines state that it is not necessary to test substances with a pH of less than 2.0 or greater than 11.5 as they are known to be corrosive. A corrosive is a highly reactive substance that causes irreversible damage to living tissue after less than 4 hours of exposure. Using this information as a basis, **the following guide is proposed**

pH	Acid/base	Properties
0 - 2.0	Strongly acidic	Corrosive
>2.0 - 6.5	Weakly acidic	Irritant
>6.5 - 8.5	Neutral	
>8.5 - 11.5	Weakly basic	Irritant
>11.5	Strongly basic	Corrosive

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 also intentionally misrepresented standards for corrosive substances by claiming "[t]here are very few standards for the regulation of the pH of a substance" and then citing only an EPA drinking water standard, which is irrelevant). There are clear and applicable EPA regulations at 40 CFR § 370, which are identical to the OSHA Hazard Communication standards for corrosivity at 29 CFR § 1910.1200. These standards are not dependent on the pH, and instead require animal testing, particularly because of the problem with the inability to test pH for relatively insoluble solids. See the next major section for a discussion of these standards under OSHA, EPA and the FHSA.

ATSDR/NYC also falsely declared substances with pH levels between 8.5 and 11.5 to be "weakly basic." ATSDR has absolutely no data to support their claim that this pH level is only "weakly basic" and only an "irritant" that would not cause tissue damage. There are many highly corrosive substances with pH levels between 8.5 and 11.5 when they are totally dissolved in a water solution, but have severe corrosive properties when in direct contact with human tissues, because they exert their alkaline effects directly in the solid state and/or as an organic water-insoluble substance.

ATSDR/NYC did not use optimal pH test methods and failed to inform that method used fails to reveal high pH for solids

The ATSDR/NYC study included pH test information, but only from 2 locations. Their pH results were not credible based on the fact that they contained Ca(OH)₂ at concentrations of 6% and 3%. They also falsely claimed there was not enough dust for testing more than 2 samples.

[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.]

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>

[ATSDR/NYC protocol]

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]

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>

The ATSDR/NYC reported pH test results of 8.6 for a sample containing 6% Ca(OH)₂, and 9.8 for a sample containing 3% Ca(OH)₂. The following table gives the pH levels and the concentrations of detected substances. 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 (Na₂OH, K₂OH), or sodium or potassium carbonate (Na₂CO₃, K₂CO₃). 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 first measured the Ca(OH)₂ concentrations by X-ray diffraction, then deliberately waited for several months before testing for the pH, allowing atmospheric carbonization reactions to convert the Ca(OH)₂ to CaCO₃ before pH testing.

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

Furthermore, the pH test method used by ATSDR/NYC is known to give abnormally low pH results for solids like WTC dust. ATSDR/NYC failed to inform the public that the Method 9045C/D states clearly in the method itself that it may give erroneously low pH readings for solid substances. In other words, the method may not register high pH readings for alkaline materials like WTC dust:

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.

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>

There also was an obligation to test more samples for pH. The ATSDR/NYC decision to use only 10-25 grams dust for a pH test was a deviation to begin with from EPA's Office of Solid Waste Method 9045C (now supplanted by Method 9045D), which requires a full 20 grams of material. ATSDR/NYC could have modified the method further to use a smaller sample.

In evaluating WTC dust for pH, government funded and approved studies have used smaller samples. The McGee *et al.* 2003 study 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 PM_{2.5} 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:

The PM_{2.5} 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).

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>

In the USGS study a maximum of 2.5 grams WTC was all that was required:

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).

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/>

In an indoor location with low dust levels, thin layers of settled dust indoors could have been tested with pH paper. As discussed earlier, this is a recognized method for all EPA and OSHA emergency response actions, and field kits are required to carry pH paper. Dusts could have been misted with water, followed by the application of pH test strips. Any elevation of the pH should have been reported to the public with any necessary cautionary words as to the accuracy of testing with pH paper.

OSHA, EPA, and FHSA corrosive criteria do not rely on pH

Why pH testing is not used in federal standards to measure corrosivity

The criteria for corrosive alkaline or acid substances under EPA, OSHA, and the Federal Hazardous Substances Act (FHSA) do not rely on pH for several reasons. One reason is that many corrosive substances do not dissolve or incompletely dissolve in water, so the pH cannot even be measured in the first place. Exposures may be directly to a solid material or an organic substance that does not need to dissolve in water to exert corrosive effects. Alternatively, if a substance is only partially dissolved in water, then the only thing being measured by a pH test is the partial leachate of the substance.

For example, one of the most corrosive alkaline constituents of WTC dust would be calcium hydroxide ($\text{Ca}(\text{OH})_2$). It would only dissolve in only to a maximum of 0.185% for a saturated solution. But that sparingly soluble solution would have a pH around 12.5. That means its true, total alkalinity potential can never be measured by a pH test. $\text{Ca}(\text{OH})_2$ particles could be inhaled into the lungs and create a pH environment of 12.5 around the solid particles for a prolonged period of time, while it gradually leaches and dissolves. On the other hand, if the same amount of a completely dissolved substance with the same pH – 12.49 were in contact with lung tissue, it would soon be diluted, having a much shorter time to excerpt its corrosive effects.

This is why pH testing is irrelevant to predicting the true corrosivity on human tissues. Thus, the need for animal testing for corrosivity from alkaline or acidic compounds is well demonstrated. All federal regulations recognize this fact and require animal testing by law.

EPA, however, has gone one step further and issued guidance stating that no other proof of corrosivity is necessary if the pH is either above 11.5 (highly alkaline) or below 2 (highly acidic). This means that any animal testing to the contrary is not considered credible.

The following are excerpts from the EPA, OSHA, and FHSA criteria for corrosivity. They all rely on animal testing, not pH.

EPA criteria for corrosive substances as an "immediate (acute) health hazard"

EPA includes corrosive substances under its definition of an "immediate (acute) health hazard." EPA's regulations then define corrosive substances as being the same as those meeting the OSHA Hazard Communication Standard under §1910.1200 of Title 29:

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;

Title 40 of the CFR: Protection of Environment - PART 370

<http://www.epa.gov/epahome/cfr40.htm>

The EPA has testing criteria for corrosive alkaline or acid substances, based on actual animal testing. The EPA testing criteria state that it is presumed that a substance with a pH level at or above 11.5 is corrosive, but that below that, it must be tested on animals to make the

determination. In other words, even if animal testing does not show corrosivity at pH levels of 11.5 or higher, EPA will still define it as corrosive. At levels below 11.5, EPA requires actual animal testing, and will not accept pH tests:

(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.

...

(d) Principle of the test method. The substance to be tested is applied in a single dose to one of the eyes in each of several experimental animals; the untreated eye is used to provide control information. The degree of irritation/corrosion is evaluated and scored at specified intervals and is fully described to provide a complete evaluation of the effects.

...

(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.** ...

[Note that substances in the middle of this pH range must be tested, because pH may not predict real physical responses if the substance has limited solubility. See earlier discussions of the limitation of pH in predicting corrosive responses.]

EPA Office of Prevention, Pesticides and Toxic Substances (June 1996) 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

[Analogous test guidelines for dermal irritancy and corrosion]
EPA Office of Prevention, Pesticides and Toxic Substances (June 1996) Health Effects Test Guidelines OPPTS 870.1200 Acute Dermal Toxic
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Drafts/870-1200.pdf

Note that the EPA pH standard for an aqueous waste of pH 12.5 or higher under the Resource Conservation and Recovery Act (RCRA) at 40 CFR § 261.22 is not in any way applicable. EPA has issued guidance on this matter, saying that this level does not protect against eye or respiratory system damage, since it assumes that the substance is already being contained at a secured waste management facility out of public contact. EPA further states that this particular standard does not apply to non-liquids such as the dust from the WTC.

[For an explanation why this standard of 12.5 is not applicable to direct contact or non-aqueous]
EPA Office of Solid Waste (November 15, 1996) Hazardous Waste Characteristics Scoping Study, pp. 41, 49
<http://www.epa.gov/epaoswer/hazwaste/id/char/scoping.txt>

Title 40 of the CFR: Protection of Environment - PART 261.22
<http://www.epa.gov/epahome/cfr40.htm>

OSHA standard for corrosivity

As stated earlier, the OSHA Hazard Communication definition of corrosive also does not rely on a specific pH level, but instead whether the substance can damage tissues, as determined by an animal testing:

"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.

OSHA. Hazard Communication. - 1910.1200
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099

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 ...

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>

OSHA has addressed the issue of when the pH of a substance cannot be measured, because it is a solid. OSHA gives the example of titanium tetrachloride, a solid material which decomposes in water, but nonetheless, is extremely corrosive to tissues in its solid form:

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.**

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

OSHA has also interpreted corrosive air hazards (whether alkaline or acid) as being "immediately dangerous to life or health" (IDLH) even if the corrosive effects are delayed. Note that NIOSH has classified CaO as IDLH at concentrations of 25 mg/m³ in air. The air would not in any way test as having a pH of 11.5 at this concentration found by NIOSH to be an IDLH. But it would be corrosive to the lung of humans or test animals.

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."

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

Corrosive standard under Federal Hazardous Substances Act

Corrosive is defined by the Federal Hazardous Substance Act (FHSA) as any material in contact with living tissue causes destruction of tissue by chemical action, regardless of the pH. The FHSA requires animal testing:

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

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

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.

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%20corrosive%22%20site%3Acpsc.gov%22>

§ 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 ...

Title 16 CFR Ch. II, § 1500.42
<http://www.access.gpo.gov/nara/cfr/cfr-table-search.html>

Sources of corrosive alkaline materials in WTC dust

There are several sources of alkaline corrosive chemicals in WTC dust derived from building materials. These include concrete, drywall, glass, and the combustion products of cellulosic materials. Fires and extended elevated temperatures are known to convert concrete, glass, wood ashes and other combustion products to more alkaline oxides and hydroxides. Thus, WTC dust from the actual Pile would have been much more alkaline than the dusts deposited outside the perimeter of Ground Zero from the initial collapse. No publicly available studies are available to characterize either the pH or the alkaline chemical species responsible for the caustic alkaline dusts from the actual Pile at Ground Zero.

This section provides documentation of the sources of alkaline materials, their conversion to higher alkalinity by heat, the temperatures at the epicenter, the concentrations of bases such as calcium hydroxide ($\text{Ca}(\text{OH})_2$) found in WTC dust, as well as pH levels found in WTC dust.

Concrete as a source of CaO , Na_2O , K_2O , $\text{Ca}(\text{OH})_2$, Na_2OH , K_2OH and CaCO_3

The intense heat from the explosion and continuing fires at the epicenter at Ground Zero above 1500°C . undoubtedly converted some of cured complex crystalline cement materials back to their original reactive materials, calcium, sodium, and potassium oxides and hydroxides (CaO , Na_2O , K_2O , $\text{Ca}(\text{OH})_2$, Na_2OH , K_2OH).

However, temperatures as high as 1500°C . were not necessary for the re-generation of CaO $\text{Ca}(\text{OH})_2$ from the highly pulverized concrete from the WTC collapse. This is because both free $\text{Ca}(\text{OH})_2$ as well as free CaCO_3 are present in normal cured concrete. Furthermore, government studies of both airborne and settled WTC dusts showed high concentrations of free uncombined $\text{Ca}(\text{OH})_2$ (up to 20%) and free uncombined CaCO_3 (up to 33%) in WTC dust, discussed later.

It does not take much $\text{Ca}(\text{OH})_2$ or CaO (which converts to $\text{Ca}(\text{OH})_2$ on contact with moisture) to create a highly caustic alkaline water solution. This is because a saturated solution of only 0.185% in water will result in a pH of 12.5. If a dust from the WTC contains a concentration of

only 0.185 % Ca(OH)₂, it could result in a pH level of 12.5, assuming that no other soluble substances interfered with the dissolution of the Ca(OH)₂ into water.

The following are excerpts from a USGS monograph describing the temperatures (750 – 1000° C.) for converting limestone (primarily CaCO₃) to CaO in a cement manufacturing kiln to an intermediate product called cement "clinker." Note that Na₂O and K₂O are also present due to impurities in the raw materials. Na₂O and K₂O are very strong bases.

Oxide Formula [in cement clinker at 750 – 1000° C. prior to formation of the aluminum-silicate complexes at higher temperatures]	Percentage by mass [in pre-cement "clinker"]
CaO [calcium oxide]	63.4
SiO ₂	20.9
Al ₂ O ₃	5.7
Fe ₂ O ₃	2.9
MgO	1.9
K₂O + Na₂O [potassium oxide and sodium oxide]	0.6
Other (incl. SO ₃ -)	3.6
H ₂ O	1

...
Alkalis, particularly sodium (Na₂O) ... 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 Na₂O + 0.658 K₂O) [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, SiO₂, Al₂O₃, Fe₂O₃), 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 (CaCO₃), and calcination simply strips the carbon dioxide from this mineral (or any other carbonate minerals present): **CaCO₃ + heat → CaO + CO₂ ↑**.

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>

Importantly for considerations of the alkalinity of WTC dust, steel reinforced concrete is designed to retain its alkalinity by preventing the conversion of Ca(OH)₂ in the pores of the concrete to CaCO₃. This is because a high alkalinity is needed to protect the embedded steel from oxidizing. Thus, most of the concrete that was pulverized to a fine, respirable dust was in this highly alkaline state, containing free Ca(OH)₂. The following are descriptions of the need to protect concrete from carbonation in order to protect the embedded steel:

Of particular concern today is the alkali silica reaction in the concrete and the corrosion of the reinforcing steel, both of which are affected by the alkalinity of Portland cement concrete. Portland cement is made by burning constituents which include lime in a kiln and grinding the result to a fine powder. This produces a highly alkaline material which reacts with water and hardens. When it is added to coarse and fine aggregate and mixed with water, the cement combines with the aggregate and hardens to form concrete. The hardening process (hydration reaction) is complex and continues over many months if not years, depending on the amount of water in the mix. There must be excess water for workability and a pore network therefore develops as it dries out. **Excess calcium hydroxide and other alkaline hydroxides are present in the pores and a solution of pH 12.0 to 14.0 develops** (pH 7.0 is neutral; values below indicate acidity, and alkalinity above). **It is this pore network and the solutions it contains that are critical to the durability of the concrete.**

...
 Although the alkalinity within the concrete pore structure can lead to ASR, **the high pH value also provides a protective coating of oxides and hydroxides on the surface of the steel reinforcement. Without this layer, which is known as a 'passive' film, the steel would be exposed to the air and moisture in the pores, leading to rapid corrosion.** It is the main chemical reason why reinforced concrete is a durable construction material. The layer is durable and self repairing, and it can last for hundreds of years if the alkalinity is maintained. However, the passive layer itself can be attacked by chlorides in salt and the alkalinity of the concrete can be reduced by reaction with atmospheric carbon dioxide, a process known as 'carbonation'.

DETERIORATION THROUGH CARBONATION

Carbon dioxide, which is present in the air in proportions of around 0.3 per cent by volume, dissolves in water to form a mildly acidic solution. Unlike other acids that may chemically attack and etch the surface of the concrete, this acid forms within the pores of the concrete itself where the carbon dioxide dissolves in any moisture present. **Here it reacts with the alkaline calcium hydroxide forming insoluble calcium carbonate. The pH value then drops from more than 12.5 to about 8.5.** The carbonation process moves as a front through the concrete, with a pH drop across the front. **When it reaches the reinforcing steel, the passive layer decays when the pH value drops below 10.5.** The steel is then exposed to moisture and oxygen and is susceptible to corrosion.

Broomfield, John (1996) The Repair of Reinforced Concrete. The Building Conservation Directory
<http://www.buildingconservation.com/articles/concrete/concrete.htm>

In an earlier column we discussed the amazing alkalinity of portland cement concrete and some of its effects. Its **high alkalinity is primarily provided by the "bases" present in all concrete (potassium hydroxide, sodium hydroxide, and calcium hydroxide)** that form when water is added to portland cement.

...
The solid compounds that form when concrete hydrates are primarily calcium hydroxide, calcium silicate hydrates, calcium aluminate hydrates, and calcium sulfoaluminate hydrates (mainly ettringite). Each of these compounds contains water that is chemically combined when the hydrates are formed. When a concrete surface is exposed to the air, all of these solid compounds can react chemically with carbonic acid. Carbonic acid is a solution that is formed when atmospheric carbon dioxide dissolves in water (rainwater is essentially carbonic acid). When the calcium compounds react with the carbonic acid, the calcium of each of them forms calcium carbonate, the combined water is released as "free water," and the rest of the compounds become silica and alumina gels. The exception is the sulfoaluminates, which decompose to form calcium sulfate dihydrate (gypsum) and calcium carboaluminate hydrates.

These carbonation reactions cause the high pH of the concrete (12.4 and higher) to dramatically drop to about 8.5 to 9. This can occur so fast that in minutes the paste at the surface is very thin, but completely carbonated. The water released by the chemical reactions continues both the formation of carbonic acid and the carbonation process. When carbonation begins, it is almost self-sustaining because of that release of water. But it soon becomes limited because of the increasing difficulty for carbon dioxide to penetrate into the depth of the concrete.

...
There are several other negative carbonation reactions. ... **Also, if the carbonation front reaches embedded steel, the steel can corrode. Good concrete design and construction requires steel to be located deeply enough that the carbonation front will not reach it during a structure's expected lifetime.**

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>

Concrete does not need to be that thick to prevent carbonation from neutralizing $\text{Ca}(\text{OH})_2$. The American Concrete Institute (ACI) recommends only a minimum cover of 1.5 inches to prevent carbonation during the expected lifetime of a concrete structure, even for external structures such as bridges exposed to high moisture. This means that the carbonation depth in concrete is limited to the surface. Thus it can be inferred that the steel reinforced concrete in the WTC would not have carbonized in bulk, retaining its original alkalinity.

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.

National Ready Mixed Concrete Association. CIP 25, Corrosion of Steel in Concrete
http://www.nrmca.org/converted_pdfs/original%20cips/25.pdf

Drywall as a source of CaO, Ca(OH)₂, K₂O and K₂OH

In some instances, drywall is also made with calcium oxide (CaO) in addition to the main ingredient calcium sulfate (CaSO₄ or plaster of Paris). During the drywall manufacturing process, the CaO is converted to calcium carbonate (CaCO₃) by hydration and carbonization reactions described earlier in the cement section.

The extended high temperatures from the WTC fires would have converted some of the CaCO₃ back to the original CaO from drywall as well. The following (from a Material Safety Data Sheet) shows both the concentration ranges of calcium carbonate in a particular drywall product line as well as the hazardous decomposition back to CaO at only 825° C:

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)**.
Lafarge North America, MSDS for all drywall products
<http://www.lafargenorthamerica.com/wps/wcm/resources/file/ebb46e4ca8cd4c5/Drywall%20MSDS%205.pdf>

Potassium sulfate (K₂SO₄) is intentionally added to drywall mixtures as a crystallization modifier. Numerous Material Safety Data Sheets (MSDS's) from drywall manufacturers list its content as up to 5%. The reference below addresses the functionality of its use in drywall:

The chart lists the gypsum crystal modifiers as fine ground gypsum, **potassium sulfate**, aluminum sulfate, boric acid and organic retarder.

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>

K₂SO₄ will decompose at elevated temperatures to corrosive fumes, including potassium oxide (K₂O). The following MSDS's (and many others) warn of this problem:

CALGON POWDER,
Potassium Sulfate >95% [greater than 95%]
... **Hazardous Decomposition: Oxides of Sulfur and Potassium.**

OFI TESTING EQUIPMENT, INC. Material Safety Data Sheet
<http://www.ofite.com/msds/205-26.pdf>

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**

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/9Y2FPMYDKJRC7J43KMHVwehfNel/M/uS7RPw

Window glass and fiberglass as sources of Na₂O, Na₂OH, K₂O, K₂OH, CaO and Ca(OH)₂

Window glass contains up to 30% sodium oxide (Na₂O), a highly caustic substance which is converted to its respective hydroxide (NaOH, or lye) on contact with moisture. Glass also contains potassium oxide (K₂O) and calcium oxide (CaO). WTC dust contained both pulverized glass shards as well as fiberglass. Na₂O, K₂O, and CaO can be released from glass particularly at elevated temperatures, contributing to the alkalinity of WTC dust.

The processes whereby Na₂O are released from glass are extensively studied by the municipal waste incinerator industry, the nuclear waste industry which encapsulates radionucleotides in glass, photographic plate preservationists/restorers, glass manufacturing industries, etc. First, at elevated temperatures, Na₂O will directly vaporize out of the glass. Second, elevated temperatures, or even extended contact in moist environments, will lead to a process called "devitrification," whereby silicon oxide crystals separate out of the glass, leaving behind a glassy substance with even higher concentrations of Na₂O. This remaining Na₂O enriched glass is more soluble in water (or contact with moist tissues), leaching Na₂O and NaOH.

There are two studies that established that glass particles did melt at Ground Zero, creating rounded spheres. The first study by the USGS 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 second study, also excerpted below, found rounded glass spheres carried by the plume from the WTC far north of the epicenter.

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 ₂ O	MgO	Al ₂ O ₃	SiO ₂	SO ₃	K ₂ O	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

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/>

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.

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>

References to the vaporization of Na₂O from glass, devitrification of glass, and leaching of Na₂O out of glass are given below:

The principal addition to window glass is sodium oxide or soda (Na₂O). ... 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

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/>

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: $\text{Na}_2\text{O} (\text{melt}) + \text{H}_2\text{O} \rightarrow 2 \text{NaOH} (\text{g})$. This type of volatilisation may be the major source of dust emissions in soda-lime glass furnaces.

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>

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 . [*Na₂O is sodium oxide, K₂O is potassium oxide.*]

...

[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.

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>

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.

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>

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

Burning wood or any other cellulose materials (paper, fiberboard) will lead to ashes which are alkaline with a pH around 10.6. This is a well known fact and the basis of the early manufacture of the first alkali, "potash." Potash is a combination of potassium carbonate (K_2CO_3) and sodium carbonate (Na_2CO_3). Calcium carbonate (CaCO_3) is also present in cellulosic ashes, and would be present in a free uncombined form, more readily convertible to $\text{CaO}/\text{Ca}(\text{OH})_2$.

At elevated temperatures such as existed for months at the WTC, these carbonates can be converted to potassium oxide (K_2O), sodium oxide (Na_2O), and calcium oxide (CaO). This would increase the alkalinity of the to WTC dust substantially. The Merck Index, 8th Ed. states that Na_2CO_3 starts decomposing to Na_2O at temperatures as low as 400° C. A controlled experiment on wood showed decomposition of both Na_2CO_3 (and the presumed decomposition of K_2CO_3) above 900° C. See references below:

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

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>

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 ...**

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

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 CaCO₃**, and that **beyond 900° C is due to the decomposition of K₂CO₃** 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 CaCO₃**. This was confirmed in separate experiments where temperatures at the minima for pure CaCO₃ and for a CaCO₃/K₂CO₃ 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.**

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>

Material Safety Data Sheet ... **Potassium Carbonate** ...

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.**

Fisher Scientific (2000)

<https://fscimage.fishersci.com/msds/02576.htm>

Material Safety Data Sheet ... **Sodium Carbonate** ...

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.

FMC Wyoming Corporation (2004)
http://msds.fmc.com/msds/10000010373-MSDS_US-E.pdf

Temperatures at Ground Zero from fires

The WTC fires that lasted until at least December created high enough temperatures to generate and re-generate the more highly caustic alkaline oxides/hydroxides from carbonates in WTC dust. Thus, the pH level tests of the dusts dispersed from the original collapse outside the perimeter of Ground Zero are non-representative. The pH levels would have been much higher on the "Pile" of hot ashes and dusts at the epicenter of the WTC collapse, where rescue and recovery workers were exposed.

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, and that the melting point of steel was 1500° C. The USGS reported fly-over remote sensing of continuing fires at the WTC on September 16 showed temperatures in hot spots as high as 704° C., meaning the temperatures could be extrapolated to be even higher in earlier days and below the surface.

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).

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]

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 ($0.26 > D_p > 0.09 \mu\text{m}$) 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.**

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>

Available studies of pH and $\text{Ca}(\text{OH})_2$ and CaCO_3 levels in WTC dusts

There are only 5 available studies (with emphasis on "available") that characterize the alkalinity of WTC dust. These studies also attempted to identify the specific chemical compounds responsible for this alkalinity.

There were only two studies that were capable of identifying calcium hydroxide ($\text{Ca}(\text{OH})_2$), the most predominant highly alkaline constituent of WTC dust (although NaOH and KOH would also have been present in smaller concentrations). These include the joint study by the CDC's Agency for Toxic Substances and Disease Registry (ATSDR)/New York City's Department of Health and Mental Hygiene (DOHMH) and the USGS. Both these studies used X-ray diffraction. The most extensive and best quality X-ray diffraction analyses of WTC dust, both in fractionated air samples as well as settled dust, comes from the ATSDR/NYC study. The ATSDR/NYC study characterized 243 separate samples of airborne and settled dust by X-ray diffraction, both near Ground Zero as well as comparison samples in Upper Manhattan. Although the interpretations of the health implications of the X-ray diffraction data in the ATSDR/NYC study were clearly falsified, the actual X-ray diffraction analyses appear valid and reliable.

[ATSDR/NYC study]

Calcite (calcium carbonate) and portlandite (calcium hydroxide) are also components of concrete. They occurred with similar frequency in the dust samples and were often collocated 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.**

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>

[USGS study]

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 [$\text{Ca}(\text{OH})_2$]**, 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 ($\text{Ca}(\text{OH})_2$) 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

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/>

John K. McGee, Lung Chi Chen, Mitchell D. Cohen, *et al.* (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>

Paul J. Liroy, 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/2002/110p703-714liroy/EHP110p703PDF.PDF>

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. Liroy (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>

Unfortunately, because of exposures to moisture (direct water contact or atmospheric) and atmospheric carbon dioxide, it would be impossible to now test for specific constituents of WTC dust from the epicenter. As documented earlier, CaO and Ca(OH)₂ are converted by atmospheric moisture and carbon dioxide to CaCO₃ by hydration and carbonization reactions over time. This results in a substantial neutralization and lowering of the pH. Even bagged ready-mix concrete decomposes from CaO/Ca(OH)₂ to CaCO₃ after a few months during normal storage, with a maximum shelf-life of about 1 year.

pH levels for WTC-dust and related materials

The following are some pH levels found in WTC dust and also pH levels associated with cement, other building material constituents, and common household products. As discussed earlier, the corrosivity criteria under either OSHA, FHSA, and EPA are not dependent on the pH, because significantly insoluble substances like CaO and Ca(OH)₂ can cause more damage because they exert their effects over long periods of time while they slowly dissolve in constant contact with tissues.

As discussed earlier, none of the pH tests listed below are from the Pile at Ground Zero, where dusts were exposed to elevated temperatures that would have converted CaCO₃ to CaO and Ca(OH)₂. The dusts at the epicenter at Ground Zero would have been much more caustic and alkaline.

WTC dust, inside buildings near Ground Zero, November 19, 2001, highest Not representative of WTC dust at epicenter subjected to high temperatures L-M. Yiin, A. Vette, V., et al. (2004) <i>op. cit.</i> http://www.awma.org/journal/ShowAbstract.asp?Year=&PaperID=1214		pH = 11
WTC dust, September 17, indoors adjacent to Ground Zero, highest Not representative of WTC dust at epicenter subjected to high temperatures Under-represented pH by using 1:20 water dilution USGS (2001) <i>op. cit.</i> http://pubs.usgs.gov/of/2001/ofr-01-0429/		pH = 11.8
WTC dust, September 16 or 17, 1 block east of Ground Zero (Courtlandt St.) Not representative of WTC dust at epicenter subjected to high temperatures Sample had uncharred paper and "low temperature combustion materials." Sample also had time to neutralize by reaction with atmospheric moisture and carbon dioxide. P. J. Liroy, C. P. Weisel, J. R. Millette, <i>et al.</i> (July 2002) <i>op. cit.</i> http://ehpnet1.niehs.nih.gov/members/2002/110p703-714liroy/EHP110p703PDF.PDF		pH = 11.5
WTC dust, fine particulates (PM2.5) September 12 – 13, outside of Ground Zero Not representative of WTC dust at epicenter subjected to high temperatures J. K. McGee, L. Chi Chen, M. D. Cohen, <i>et al.</i> (2003) <i>op. cit.</i> http://www.ehponline.org/members/2003/5930/5930.pdf		pH = 10.00
uncured reactive Portland cement --	slightly soluble, 0.1 to 1%	pH = 12-13
http://www.titanamerica.com/products/msds/pdf/titan_Portland_cement.pdf www.lafargenorthamerica.com/wps/wcm/resources/file/eb8a9045eb37551/Portland%20Cement%20MSDS%205.pdf		
Minimal alkalinity specification, cured Portland concrete for corrosion prevention of steel-reinforced concrete http://www.buildingconservation.com/articles/concrete/concrete.htm		pH ≥ 10.5
calcium carbonate (CaCO ₃) component of cured concrete http://www.graymont.com/msds/MSDS_PCC.pdf	0.0014% saturated solution	pH = 9.4
calcium oxide (CaO) unslaked lime, quicklime (solubility based on the lower molecular weight of CaO, not Ca(OH) ₂) http://www.graymont.com/msds/MSDS_High_Calcium_Quicklime.pdf http://www.ashgrove.com/pdf/msds/CALCOXID.pdf	0.125% saturated solution after converting to Ca(OH) ₂ in water	pH = 12.49

calcium hydroxide (Ca(OH) ₂) portlandite, slaked lime, hydrated lime http://en.wikipedia.org/wiki/Calcium_hydroxide http://cavemanchemistry.com/oldcave/projects/lime/	0.185% saturated solution	pH = 12.49
potassium carbonate (K ₂ CO ₃) https://fscimage.fishersci.com/msds/02576.htm		pH = 11.6
sodium carbonate (Na ₂ CO ₃) http://msds.fmc.com/msds/100000010373-MSDS_US-E.pdf	1% solution	pH = 11.4
sodium hydroxide (lye, caustic soda) http://www.injectorall.com/MSDSD3.htm http://www.prism.princeton.edu/PRISM_cleanroom/MSDS/naoh_sodium_hydroxide.pdf	0.5% water solution,	pH = 13
Liquid Plumr® drain cleaner (0.5 – 2% sodium hydroxide, 5 – 10% sodium hypochlorite) http://www.thecloroxcompany.com/products/msds/liquidplumr/liquid-plumr.pdf		pH = 13.2
Fantastik® Heavy Duty Oven Cleaner (1 – 5% sodium hydroxide) http://msds.ogden.disa.mil/msds/owa/web_msds.display?imsdsnr=190879		pH = 12.3
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

PART B: Fraudulent Reporting of pH for Smallest, Most Dangerous WTC Particles

My August 22, 2006 complaint to the EPA IG only addressed the fraudulent reporting of the pH of the smallest particles of WTC dust, those with a diameter less than 2.5 microns (µm). This part of my current complaint provides expanded documentation of this deliberate fraud.

The implosion of the WTC created an unusually large amount of small sized dust particles, with a significant fraction being smaller than 2.5 microns (µm). These smaller particles are called "PM2.5" (particulate matter with average diameters less than 2.5 microns). A micron is one ten thousandth of a centimeter (0.0001 cm). 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 in fact alkaline is a very important one.

OVERVIEW: Fraudulent change of pH data for smallest PM2.5 particles

The following table quotes the contradictory statements about the alkalinity of the smallest PM2.5 particles found in the identical WTC dust samples tested by the exact same laboratory at the exact same time, etc.

CONFLICTING STATEMENTS IN EPA-FUNDED RESEARCH: pH OF SMALLEST PM2.5 PARTICLES	
Neutral or low alkalinity claims	High alkalinity claims
<p><u>2/11/02 Senate testimony</u></p> <p>[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 ...</p> <p><u>2/20/02 email from EPA-funded Dr. Chen at NYU</u></p> <p>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.</p> <p><u>12/02 Lancet medical journal study</u></p> <p>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</p> <p><u>5/04 Landrigan et al. in Environmental Health Perspectives study</u></p> <p>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 (Liroy 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. [<i>Basis for claiming that small particles were non-alkaline came from the McGee 2003 which states the exact opposite. See the column on the other side of this table.</i>]</p>	<p><u>12/02 final study on WTC particulate effects in rat nasal cavities</u></p> <p>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 ...</p> <p><u>6/03 McGee et al. in Environmental Health Perspectives</u></p> <p>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 ...</p> <p>The pH of lyophilized WTC PM2.5 reconstituted in unbuffered saline [<i>pre-neutralized WTC dust</i>] 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. ...</p> <p>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.</p>

Setting the stage: EPA hires "independent" scientists to reassure public

Within hours, at least by September 12, 2001, the National Institute of Environmental Health Sciences (NIEHS) requested that NYU's Environmental Health and Children's Centers to "apply their scientific expertise to investigate the potential risks" of the World Trade Center collapse. NIEHS is part of the National Institutes of Health, DHHS. However, it was EPA Superfund money that was being funneled through NIEHS for this effort.

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

See the following excerpts for descriptions of the NYU community outreach role under EPA (aka NIEHS) funding after 9/11:

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>

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

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.



Dr. Thurston describing results of NYU's air monitoring efforts at World Trade Center community forum.

...
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>

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. The following are some of the relevant print journalism articles quoting Dr. Thurston. Those available start with the seminal New York Times story on October 11, 2001 and the British Medical Journal piece of October 27, 2001. There were also many in-person presentations and speeches by Dr. Thurston, particularly at Stuyvesant High School.

New York Times, October 11, 2001
Contaminants Below Levels for Long-Term Concerns

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.

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

British Medical Journal, October 27, 2001

News extra: **Early research says dust at World Trade Center site not dangerous**

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.**

British Medical Journal (October 27, 2001) 323:956

<http://bmj.com/cgi/content/full/323/7319/956/a>

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.

"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.

NY Daily News, 11/21/01, Public Distrusts Gov't Air Tests By JOE WILLIAMS, Daily News Staff Writer

www.nydailynews.com

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."

Rebuilding Wall Street, The Restoration of America's Financial Marketplace. Dow Jones Newsletters January 3, 2002, Tests Say Air Is Safe, But Some People Feel Ill Near Ground Zero By Mark Maremont and Jared Sandberg of The Wall Street Journal

Expired webpage is now available on web.archive.org at:

http://web.archive.org/web/20030321211224/http://www.djnewsires.com/pdfs/rws_010302.pdf

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.

Boston Globe (2/12/02) Concerns intensify on ground zero dust By Fred Kaplan

www.boston.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.

WTC's Air of Uncertainty Experts weigh health risks of twin towers fires & dust (Sunday, February 10, 2002) By Paul H.B. Shin and Russ Buettner, Daily News Staff Writers

www.nydailynews.com

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.**

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>

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.**

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>

Downtown Express (October 14 - 20, 2003) Volume 16 • Issue 2003.
LETTERS TO THE EDITOR: Helping out on air

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.

Dr. George D. Thurston, Associate professor of environmental medicine, N.Y.U. School of Medicine
http://downtownexpress.com/de_25/lettertotheeditor.html

After the August 21, 2003 EPA Inspector General's report was issued finding that EPA gave citizens misleading and premature assurances as to the safety of the air after the WTC collapse, Dr. Thurston changed his stance. He now echoed the conclusions of the EPA IG, that EPA had inadequate data to give such assurances. I confronted Dr. Thurston for his revisionist stance in a series of emails:

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 withing 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*]

February 11, 2002 Senate testimony by Dr. Thurston claims small particle WTC dust is non-alkaline and will not penetrate lung

On February 11, 2002, Dr. George Thurston provided the following testimony before the Senate Committee on Environment and Public Works:

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.

Thurston, G. D. (2/11/02) 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 http://www.senate.gov/~epw/107th/Thurston_021102.htm

Thurston explicitly 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 publication of the St. Louis Post-Dispatch article exposing the fact that WTC dust was highly alkaline. See the earlier section on the USGS testing of WTC dust for pH. Because the smallest particles are those which can be inhaled and reach deep within the lungs, Dr. Thurston's testimony effectively defused the major health concern issue relating to the alkalinity of WTC dust, namely inhalation hazards.

As a result, public health professionals had no basis to warn rescue and recovery workers, office workers in the financial district, laborers (mainly immigrants) cleaning out buildings, or residents who had been told to conduct do-it-yourself cleanups without respirators by EPA and NYC about the immediate danger of respiratory system damage from the corrosive alkalinity of the dust. Government officials had already been working hard and effectively to defuse public concerns about the long term hazards from other toxic constituents like asbestos. There was no other pH alkalinity data to refute Dr. Thurston and EPA. It would have required prompt sample collection after 9/11, separating the dust into the small size ranges and pH testing. This required a dedicated laboratory and staff set up and trained long before 9/11. EPA and NYU controlled the data.

EPA was source of data for February 11, 2002 testimony that smallest PM2.5 particles were neutral

None of Dr. Thurston's colleagues at NYU actually performed the pH measurements of the smallest PM2.5 particles, although NYU was responsible for collecting the dust and separating it in the laboratory into the PM 2.5 size range. The pH tests of the dusts apparently were performed at EPA's National Health and Environmental Effects Research Laboratory (NHEERL) in Research Triangle Park. See the May 2002 abstract below wherein EPA scientists state that all the chemical and other testing of the PM2.5 particulates was performed in the EPA laboratory.

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.

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

NYU reaffirms claim that small PM2.5 particles neutral in February 2002 email interchange

On February 13, 2002, I initiated an email interchange with Dr. Thurston because I doubted his February 11, 2002 Senate testimony claiming the smaller WTC dust particles were not alkaline. I proffered the alternative hypothesis that the larger surface area to mass of the smaller particles could well explain any discrepancy between their lower pH (lower alkalinity) results. During sample storage prior to testing, moisture in the atmosphere could collect on the smaller particles, react and neutralize them. Dr. Geoff Plumlee, the U.S. Geological Service (USGS) scientist responsible for pH testing of WTC dust for the USGS (they tested the pH of both large and small WTC particles combined), also became involved in the email interchange. He also was concerned about the aging of the smaller WTC particles and their neutralization prior to any opportunity for testing. Dr. Thurston referred my inquiry to Dr. Lung Chi Chen at NYU, and copied in Dr. Morton Lippman.

This interchange is important in establishing that both Dr. Thurston, Dr. Chen and Dr. Lippman were extremely aware of the issue being presented to them, namely the selective neutralization of the smaller particles prior to any opportunity for pH analysis. But they were all completely silent on the fact that the EPA laboratory had actually observed the phenomena I proposed. The EPA NHEERL laboratory had artificially neutralized the smaller particles, but not the larger ones, and tested the pH after this neutralization "lyophilization" procedure which involved a 2-day water soak. As seen in later discussions, EPA also tested the pH prior to this lyophilization procedure and found the smallest PM2.5 particles were in fact highly alkaline. The following are excerpts from this email interchange:

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 desiccant 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 moisture 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, \pm 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.

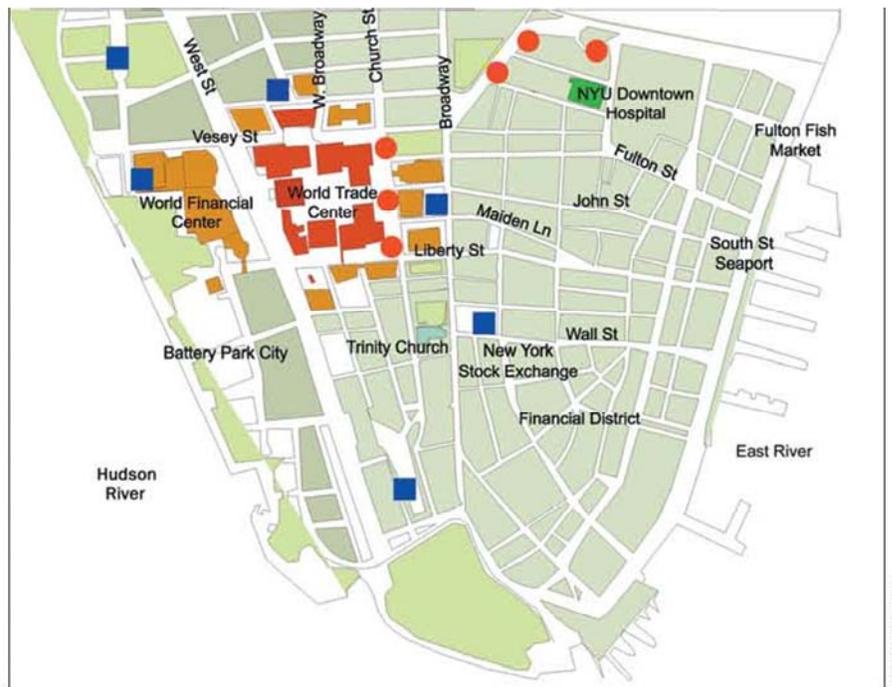
Thank you very much,
Cate Jenkins

December 2002 "Lancet" medical journal claims small particle WTC dust is non-alkaline, cites importance to rescue and recovery workers

In the December 2002 issue of the "Lancet" medical journal, Dr. Chen and Dr. Thurston published their claim that the small PM_{2.5} particles of WTC dust were non-alkaline. This publication explained the health significance of the non-alkalinity claim for the smaller particles. If they were non-alkaline they would not damage the deep regions of the lungs.

In the Lancet article itself, Dr. Chen and Dr. Thurston said that their findings were particularly important to rescue and recovery workers, since the dust came from nearer Ground Zero and simulated exposures to this dust being resuspended by rescue and recovery operations:

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.

...



Lung Chi Chen and George Thurston are associate professors of environmental medicine at the NYU School of Medicine. Lung Chi Chen is an expert in inhalation toxicology. George Thurston is the Director of Community Outreach at the Department of Environmental Medicine and is an expert in epidemiological analysis of the health effects of air pollution.

Department of Environmental Medicine, NYU School of Medicine, Tuxedo, NY, USA (L C Chen PhD, G Thurston ScD)
(e-mail: chenL@env.med.nyu.edu)

...

Our work is supported by NIEHS [*funded by EPA*] Center of Excellence (ES00260) and US EPA PM Health Research Center (R827351).

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>

The NIEHS adopted the conclusions in Dr. Chen and Dr. Thurston's publication in the Lancet whole-heartedly. NIEHS continues to post the complete Lancet article on its website, and describes its conclusions glowingly as follows:

NIEHS, Division of Extramural Research and Training
Environmental Health News, Highlights in Environmental Health Sciences Research, 2002 Highlights
World Trade Center Cough: Lessons Learned

Background: In the aftermath of the World Trade Center attack and collapse, thousands of people were exposed to high concentrations of gaseous and particulate matter air pollution. This pollution resulted from the release into the atmosphere of millions of tons of pulverized and incinerated building materials, furniture, equipment, and unburned jet fuel. Many residents and emergency responders reported a persistent "World Trade Center cough" despite the pronouncements of safety by a variety of government agencies. This team provides a possible explanation for this disparity.

Advance: One property of the dust that is probably most responsible for its irritancy is its caustic nature. The pH of the bulk of the dust was greater than 10, which is irritating to the mucous membranes found in the nose and throat. **The pH decreased as the size of the particles decrease to around neutral pH at 2.5 microns and smaller. The caustic large dust particles caused temporary nose, throat, and upper airway symptoms; however, they were effectively caught by the body's defenses. Conversely the fine dust that did reach the lungs was lower in concentration and much less caustic.** Therefore, although severe acute symptoms were reported, the overall dust exposures probably will not have cumulative health implications for the general population in lower Manhattan.

Implication: The important public health lesson to be learned from this disaster is that government agencies should make wider assessments of exposure to different sizes of particles before making pronouncements as to the safety of situations. Although in this situation the agencies were apparently correct regarding the long-term safety of the exposures, premature assurances in light of a large number of people with a persistent cough may have tended to undermine rather than increase public confidence.

Citation: Chen LC, Thurston G. World Trade Center cough. Lancet. 2002 Dec; 360 Suppl:s37-8, NIEHS
<http://www.niehs.nih.gov/dert/profiles/hilites/2002/wtccough.htm>

December 2002 EPA study reverses, gives high alkalinity pH results

In December 2002, EPA published a report on its mouse inhalation study of WTC dust. This EPA report directly contradicted Dr. Thurston's February 11, 2002 testimony, as well as the December 2002 Lancet article written by Dr. Chen and Dr. Thurston. The EPA mouse inhalation report stated that the exact same smaller PM_{2.5} WTC particles from the exact same samples and tests were in fact highly alkaline. There is no way that the two claims can be reconciled. Either one group or the other was making a fraudulent claim. It was the same data being discussed.

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.

Remember, as discussed in great detail earlier, these samples were from dust from outside the perimeter of Ground Zero, not from the Pile where the continuing fires would have converted the CaCO₃ to the more highly alkaline compounds CaO and Ca(OH)₂. Thus, these tests, even though showing alkalinity, grossly underestimated the alkalinity of the dusts to which rescue and recovery workers were actually exposed.

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.

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

This EPA mouse inhalation study as a whole is meaningless and misleading as well. First, EPA used pre-neutralized "lyophilized" particles, so any observed respiratory effects did not represent the full range of toxic properties of WTC dust. Second, the inhalation study used a water spray nasal cavity injection method. This means the larger size droplets were unable to reach the deeper regions of the mouse lung.

June 2003 McGee *et al.* study also states alkaline pH levels for same dust

In June 2003 the results from the joint EPA and EPA-funded NYU research were published again, this time in the journal *Environmental Health Perspectives* (EHP). This publication covered the analytical method protocols that were part of the December 2002 EPA report on mouse particulate toxicity study in mice, discussed above.

As with the EPA December 2002 mouse particulate toxicity study, the 2003 EHP McGee *et al.* study also stated clearly and explicitly that the same dust from exact same locations sampled by NYU scientist on the same dates (September 12 and 13, 2001) were highly alkaline for the small PM2.5 particles. In other words, this 2003 McGee *et al.* study was also stating just the opposite of the 2002 Lancet medical journal article and the February 11, 2002 Senate testimony by Dr. George Thurston.

If it still seems unclear that the samples and tests were identical, a color map was provided of the sampling locations in the 2003 EHP McGee *et al.* study, excerpted below. (A few of the samples from the 2002 Lancet study were not included so as not to bias results with too many samples in the same area.) Compare this with the color map excerpted earlier from the December 2002 Lancet article.

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 deleted]

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	
WTCE	8.88	
WTCB	9.54	
WTCC	9.32	
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.

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>

One thing that is interesting is the fact that Dr. Chen, a participating scientist in this study, originally stated that the larger particles had a pH above 11. However, the published study itself said that the larger particles only had a pH as high as 10. The following is the email that I received from Dr. Chen on February 20, 2002. However, by the time the study was published in December 2002 by EPA, and again published as the McGee *et al.* study in the journal Environmental Health Perspectives in 2003, mysteriously the pH of the larger particles had dropped to 10. This produces another credibility problem with this EPA funded research, since other studies were finding pH levels above 11.

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.

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May 2004 Landrigan *et al.* study reverses again, now claiming the same small PM2.5 WTC dust samples were non-alkaline (neutral)

In 2004, the same scientists, joined by others, published another study in the journal Environmental Health Perspectives (EHP), which combined the results from the earlier EPA funded research with new data on the observed human health effects. In another reversal, very different statements were made about the pH of small PM2.5 WTC dust particles. Now they were neutral, non-alkaline again.

A new false claim was made in this 2004 study to bolster and explain why the smaller particles were not alkaline. This new false claim may be the most telling of all. This is the claim that the smaller WTC particles did not contain as much cement-like particles that were the assumed responsible agents for the alkaline high pH levels of WTC dust. The 2004 Landrigan *et al.* study provided absolutely no data whatsoever to support this spurious new claim, and furthermore is contradicted by other research.

2004 Landrigan et al. cites 2003 McGee et al. as source of data for non-alkalinity of PM2.5 WTC dust

The 2004 Landrigan *et al.* study cited 2003 McGee *et al.* and 2002 Lioy *et al.* as the basis for its claim that PM2.5 WTC dust was non-alkaline. But the McGee study said just the opposite about the small PM2.5 particles, and the Lioy study said nothing whatsoever about the small PM2.5 particles. Since there was no new data in 2004 Landrigan *et al.* upon which to make a claim of non-alkalinity, it had to be based on these earlier 2 studies. The following statement claiming non-alkalinity of PM2.5, as well as the new claim that the smaller particles had a different chemical composition compared to the larger particles, is from Landrigan *et al.* The extensive list of contributors to the study, along with their affiliations and funding sources, is also provided below.

Dust pH was highly alkaline (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.**

[Extended information on funding, reviewers, and authorship/contributors given below:]

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Health and Environmental Consequences of the World Trade Center Disaster. Environ Health Perspect (2004) 112:731–739.
<http://ehp.niehs.nih.gov/members/2004/6702/6702.pdf>

Data from both the 2003 McGee et al. and the ATSDR/NYC DOHMH study contradict new claim in 2004 Landrigan et al. that small PM2.5 particles had different chemical composition

As stated earlier, there was a newly created false claim in the 2004 Landrigan *et al.* study that the smaller WTC particles did not contain as much cement-like particles, presumed responsible agents for alkalinity of the larger particles. See above excerpt. The 2004 Landrigan *et al.* study provided absolutely no data whatsoever to support this new claim. Two separate studies, both with data, refute this claim in Landrigan *et al.* The first is the McGee *et al.* 2003 study, excerpted below. Note that Landrigan *et al.* was citing McGee *et al.* as its source for making all its claims on the pH of the smaller particles.

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.

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<http://www.ehponline.org/members/2003/5930/5930.pdf>

The second study with real data to refute Landrigan *et al.* is the September 2002 ATSDR/NYC DOHMH study which has extensive mineral composition data for the smaller size fractions, as well as larger sized particles in airborne dusts. An examination of the data tables in this ATSDR/NYC DOHMH study show that the PM4 and PM10 samples appear to contain greater concentrations of Ca(OH)₂ (portlandite) and CaCO₃ (calcite) than the larger size particle fractions (PM100).

The XRD [*X-ray diffraction*] analysis for crystalline minerals in settled surface dust is semiquantitative (estimated values, indicated by “J”). However, **quartz [SiO₂], calcite [CaCO₃], portlandite [Ca(OH)₂] and gypsum [CaSO₄] 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 [CaCO₃] 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/m³J–14 µg/m³J and portlandite at 14 µg/m³J–95 µg/m³J in inhalable dust. ...**

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>

Thus, there was no unintended error in the 2004 Landrigan *et al.* study regarding the alkalinity of the smaller particles. It required invention and effort to come up with the newly created false claim that the smaller particles had a different composition in order to support the false claim of non-alkalinity.

High profile human health consequences may have motivated falsifications in 2004 Landrigan study

It may have been important to reassert the false claims that the small PM_{2.5} particles were non-alkaline to counter any conclusions as to the causative agents for the health consequences documented in the 2004 Landrigan *et al.* study. The study would have been expected to, and did, receive significant media coverage. EPA preferred to hide behind the "toxic soup – unexpected health consequences, how could we have known" defense for not protecting workers and the public from WTC dust, when it knew from the very beginning that at a minimum, WTC dust met the EPA and OSHA criteria for a corrosive material that posed an immediate and present danger to health.

This 2004 Landrigan *et al.* study has been followed by several others showing adverse permanent health effects in not only rescue/recovery workers but also laborers cleaning buildings after 9/11, office workers, and residents. The most recent study comes from the Mt. Sinai School of Medicine:

ABSTRACT

Background. Approximately 40,000 rescue and recovery workers were exposed to caustic dust and toxic pollutants following the September 11, 2001 attacks on the World Trade Center (WTC). These workers included traditional first responders such as firefighters and police and a diverse population of construction, utility, and public sector workers.

Methods. To characterize WTC-related health effects the WTC Worker and Volunteer Medical Screening Program was established. This multi-center clinical program provides free standardized examinations to responders. Examinations include medical, mental health, and exposure assessment questionnaires, physical examination, spirometry, and chest X-ray.

Results. Sixty-nine percent of 9,442 responders examined between July 2002 and April 2004 reported new or worsened respiratory symptoms while performing WTC work. Symptoms persisted to the time of examination in 59%. Among those who had been asymptomatic before 9/11, 61% developed respiratory symptoms while performing WTC work. Twenty-eight percent had abnormal spirometry. FVC was low in 21% of our population. Obstruction was present in 5%. Among non-smokers, 27% had abnormal spirometry vs. 13% in the general U.S. population. Prevalence of low FVC among nonsmokers was five-fold greater than in the U.S. population (20% vs. 4%). Respiratory symptoms and spirometry abnormalities were significantly associated with early arrival at the site.

Conclusion. WTC responders had exposure-related increases in respiratory symptoms and PFT abnormalities that persisted up to 2.5 years after the attacks. Long-term medical monitoring is required to track persistence of these abnormalities and identify late effects, including possible malignancies. Lessons learned should guide future responses to civil disasters.

Robin Herbert, Jacqueline Moline, Gwen Skloot, Kristina Metzger, Sherry Baron, Benjamin Luft, Stephen Markowitz, Iris Udasin, Denise Harrison, Diane Stein, Andrew Todd, Paul Enright, Jeanne Mager Stellman, Philip J. Landrigan, and Stephen Levin (September 6, 2006)
The World Trade Center Disaster and the Health of Workers: Five-Year Assessment of a Unique Medical Screening Program. Environmental Health Perspectives, prepublication online at:
<http://www.ehponline.org/members/2006/9592/9592.pdf>

CONCLUSION

This complaint documents that a range of governmental entities responsible for protecting the citizenry engaged in a concerted cover-up of the corrosive alkalinity of WTC dusts.

After 9/11, EPA, OSHA, ATSDR, and NYC focused media attention on a range of specific toxic substances (asbestos, silica, lead, mercury, volatile organic compounds, dioxins, PCB's, etc.) as the only hazards of concern from the WTC collapse. They then claimed that although long-term exposure standards may not be met, short term exposures during an interim cleanup period could be tolerated. EPA, OSHA and NYC issued an "all clear" for the area, both for residents, office workers, and rescue and recovery workers through press releases, fact sheets, etc.

EPA, OSHA, ATSDR, and NYC were all uniformly silent in all public communications about pH data establishing that WTC dusts were alkaline enough to be corrosive. This was the one health standard that could not be cleared on the basis that there would only be short-term interim exposures. Not only were these entities silent about corrosivity hazards, they also falsified studies and health documentation to support their claims.



cc: Affected parties and responsible officials