Introduction

The collapse of the World Trade Center on September 11, 2001 produced a dust cloud of immense proportions which settled all over lower Manhattan and inside lower Manhattan buildings. Fluorescent light bulbs, computer screens and other devices known to contain mercury were pulverized and became a part of the dust cloud.

This investigation was undertaken in order to observe the presence of mercury in World Trade Center dust, and to assess mercury vapor concentrations arising from this dust.

Literature Review

Information regarding usages, health effects, environmental fate, and applicable regulations (public advisories and exposure levels) was obtained from an exhaustive review of:

I. Toxicological Profile for Mercury. Prepared by Research Triangle Institute under contract number: 205-93-0606 for US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, 1993.

II. United States Environmental Protection Agency's Mercury Study Report to Congress. EPA-452/R-93-003, 1997.

III. Canadian Soil Quality, Guidelines for Contaminated Sites. Human Health Effects of Inorganic Mercury Final Report. March 1996, prepared by Health Canada.

IV. Guidelines prepared by Department of Health for the States of New Jersey, New York, and Illinois.

V. United States Environmental Protection Agency National Air Quality and Emissions Trends Report 1998.

VI. Epidemiologic Notes and Reports. Elemental Mercury Poisoning in a Household – Ohio 1989. Center for Disease Control and Prevention. Morbidity and Mortality Weekly Report, June 29, 1990 / 39 (25); 424-425.

VII. Elemental Hg Poisoning – North Carolina, 1988. Morbidity and Mortality Weekly Report, November 17, 1989 / 38 (45); 770-72, 777.

VIII. Mercury Poisoning Among Residents of a Building Formerly Used for Industrial Purposes - New Jersey 1995. Morbidity and Mortality Weekly Report, May 24, 1996 / 45 (20); 422-4.

IX. Current Trends Acute and Chronic Poisoning from Residential Exposures to Elemental Mercury – Michigan 1989-1990. Morbidity and Mortality Weekly Report, June 14, 1991 / 40 (23); 393-395.

X. Mercury Exposure in a Residential Community – Florida 1994. Morbidity and Mortality Weekly Report, June 10, 1995 / 44(23); 436-437, 443.

Mercury in the Environment & Human Exposure

Mercury occurs naturally in the environment (ubiquitous) [I] and exists in several forms. It has wide usages in the health, agriculture, and electrical industries [I]. It is also used in ethnic and religious practices [I]. Mercury concentrations in the environment (air, soil and water) have generally increased since the industrial revolution [I, II]. Mercury has been observed to enter and accumulate in food chains (fish, etc.) as methylmercury and represents the primary source of human oral exposure [I, II]. Other sources of human exposure are dental amalgams, and mercury contaminated dust and air in the vicinity of industrial and hazardous waste sites [I, II]. Modern technology such as fluorescent light bulbs, computer screens, thermometers, sphygmomanometers, electrical switches, thermostats, and batteries, etc. also represent other sources of potential human exposure [I, II, IV]. Incineration of medical and municipal waste as well as fossil fuel burning is also responsible for mercury release into the ambient environment [I,II]. Fluorescent light bulb breakage was estimated to add 1.5 tons/year of mercury to the environment from 1990-1993 [I,II,IV]. Natural degassing of mineral mercury also adds to the total mercury in the environment [I,II]. The majority of the mercury released into the environment from both natural and anthropogenic sources is in vapor form. Anthropogenic sources have been identified as:

-Processing facilities (Industrial/Chloralkali plants)

-Incinerators (medical and municipal)

-Hazardous waste sites, etc [I,II,III,IV].

Therefore, mercury concentrations in the environment are expected to be greater under the settings as identified above. Existing data reviewed point to non-existent mercury

concentrations in non-industrial urban environments [I,II,III,IV]. The United States Environmental Protection Agency estimated airborne mercury concentrations at .00102mg/m^3 (coarse) and .00104 mg/m^3 (fine), in urban environments. The Environmental Protection Agency also noted that higher concentrations would be encountered in industrial environments. Higher concentrations of mercury .01-.015mg/m^3 were noticed near point emission sources (industrial) as defined earlier. Concentrations of mercury in air measured above the water surface of the mercury contaminated Wabigoon River in Ontario ranged from .0000063mg/m^3 to .000016 mg/m^3.

Mercury Exposure in Indoor Environments

The following have been associated with mercury exposure in residential settings:

- Broken thermometers and sphygmomanometers
- Accidental discovery of stored mercury by children
- Application of mercury containing latex based paint
- Developing industrial sites/buildings for residential needs
- Fluorescent bulb breakage
- Religious and ritualistic practices (I,II,IV & IX).

The Agency for Toxic Substances and Disease Registry released a National Alert titled "A Warning about Continuing Patterns of Metallic Mercury Exposure" [IX]. In this document, the Agency for Toxic Substances and Disease Registry identifies inhalation as the primary route of exposure for human population. It was also noted that "even at low levels, metallic mercury can cause harm before symptoms arise."

1) The Environmental Protection Agency in 1988 (Elemental Mercury Poisoning in North Carolina, 1988) identified mercury concentrations of 1 μg/m^3 (.001 mg/m^3) as an obtainable goal for decontamination in cases of residential mercury contamination [VII].
2) In an incident involving mercury contamination in 1989 in an Ohio household, acceptable concentrations of mercury in residential settings was defined at less than or equal to 0.5 μg/m^3 (.0005 mg/m^3) [VI].
3) In a 1991 study, Beusterien and co workers studied homes which had been painted with mercury containing latex based paint. Airborne mercury concentrations were observed to vary from .0003 mg/m^3 to >.0005 mg/m^3. This group, after an extensive study, concluded that potentially hazardous mercury exposure could occur in homes with airborne mercury concentrations greater than .0005 mg/m^3 [I].
4) In 1995, in a case involving an old factory building in Hoboken, NJ which had been developed into residential units, mercury contamination was discovered. The highest airborne mercury concentration in breathing zone was .005 mg/m^3. Mercury decontamination was undertaken and the Agency for Toxic Substances and Disease Registry recommended "indoor mercury air levels be maintained at less than 0.3 μg/m^3 (.0003 mg/m^3) to protect public health VIII.

Our literature review suggests that potentially harmful exposure to mercury can occur when:

I. A source of mercury is identified in a residential setting,

II. Ventilation in a residential setting is compromised,

III. Mercury source is present in air pathways such as windows, AC and air ducts,

IV. Mercury source is constantly agitated (temp/mechanical disturbance).

Literature review also points towards an observable downward trend (from .001 mg/m3 in 1988 to .0003 mg/m^3 in 1995) as far as acceptable mercury vapor concentrations in residential indoor environments are concerned