LEAD CONTAMINATION OF SOILS IN NEW YORK CITY AND LONG ISLAND: AN INVESTIGATION OF LEVELS AND SOURCES

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Introduction

Soil contamination from toxic heavy metals, especially lead (Pb), has become an issue of prime concern in many regions. This is particularly true in urban settings where decades or centuries of residential, transportation, industrial, and commercial activities and the use of lead-based paint have released huge volumes of these contaminants into the local environment. This study suggests that background lead levels in Long Island soils decrease from west to east. These values in Nassau and Suffolk County soils (18 samples) are below levels requiring remediation, whereas those from within New York City (4 samples) are higher, with two samples exceeding the 400 μg Pb/g soil U. S. Environmental Protection Agency (EPA) threshold for remediation. In a more detailed study on Roosevelt Island, seven of sixteen samples (44%) examined contained more than 400 μg Pb/g soil.

Background

Lead poses significant health hazards to adults, including hypertension, and especially to children, including impaired growth and mental development. Dr. Howard Hu (1993), metals epidemiologist at Harvard University, noted that although a five or six point drop in IQ would seem to be relatively minor, such a change would triple the number of individuals with IQs of less than 80, which could severely tax health and social services. Also, a smaller proportion of people would have IQs greater than 120, costing society in terms of creativity as well. Many health effects at levels below the blood standard for lead (10 μg/dl) also occur (Hu,1993).

Lead poisoning from contaminated soils ranks second only to that from leaded paint, and poses a greater threat than lead in drinking water (Utermark,1993). Since the early 1970s, lead has been banned separately from use in some paints, gasoline, and plumbing. The EPA is now targeting lead in soils. Bare exterior soil can expose children to lead due to their normal hand-to-mouth activity (Goldman, 1995). A recent General Accounting Office report (Hembra, 1992) says that "many child-care centers and schools do little to check for lead hazards in paint, water and soil--even though they pose a greater risk to children than asbestos", a hazard which delayed classes in New York City for two weeks in the fall of 1993 so that inspectors could check buildings.

Purpose

This study systematically surveys lead concentrations in New York City and Long Island soils to determine whether they exceed thresholds designated as safe, to compare current levels with values reported elsewhere, and to identify possible contamination sources. The challenge is to produce an accurate picture of lead contamination in the study area which could serve as a valid foundation upon which to base future planning and legislative initiatives. This project will provide a rational basis for community and governmental action on environmental issues concerning lead exposure and will provide the framework needed to enable citizens to critically evaluate conflicting claims on environmental lead issues.

Sampling protocol

In the initial stages of the project, the goal was to establish a sampling net that would yield a clear picture of the areal distribution of lead in the soils of Long Island, with the intention of identifying background lead levels. Sampling sites were chosen based on a grid superimposed on Long Island as a whole. Public areas away from heavy traffic and industry, e.g., parks, were chosen. At approximately 25 kilometer intervals along the east-west axis of Long Island, where appropriate parks were available, samples were taken from the north shore area, south shore area, and near the midline. Data from these sites have delineated the general pattern of lead levels in the region, facilitating the selection of additional sites for more detailed study. Sampled park soils in Nassau and Suffolk counties contained lead concentrations of less than 130 μg/g. In Brooklyn, the values were higher, ranging from 180 to 570 μg Pb/g soil. Lead concentrations generally decrease from west to east.

Sixteen samples were collected from Roosevelt Island, which is in the East River, in order to determine the variation in soil lead content in a small, residential area where traffic is restricted and where overhead structures are present. All of the samples came from areas accessible to children. Nine samples were below the EPA's maximum acceptable value for bare soils in areas frequented by children (400 μg Pb/g soil). Six of the seven remaining samples contained more than 400 but less than 5000 μg/g. In this range, EPA guidelines recommend risk reduction activity which is dependent on the lead concentration and the likelihood of children's exposure. As these areas were mostly grass-covered, no additional remediation is indicated. Lead content of the remaining sample from Roosevelt Island, taken from underneath the Queensborough Bridge, was nearly 10,000 μg/g. This value would be high enough to require soil abatement if the soil were bare (Goldman, 1995).

A survey of lead in soils from Brooklyn schoolyards was begun in fall 1995 to determine whether schoolyards could be a significant source of lead for children in the area. These data should be available in spring 1996.

Samples consist of soil taken from 13 cm by 13 cm areas to a depth of one and one-half cm (equivalent to the one-half inch prescribed by the EPA; Goldman, 1995), using a plastic trowel or scoop. Where possible, samples were collected near large trees and shrubs, where soil disturbance was likely to be minimal. Visible vegetation and large particles such as pebbles were excluded from the samples. The soils were placed in plastic Whirlpak bags and were frozen as soon as possible after sampling to prevent growth of microorganisms and to inhibit changes in chemical composition. They were kept frozen until analysis.

Analytical Methods

Sample preparation begins with drying in a 60° C oven. Samples are then weighed to 0.01 mg and statistically split to 5 g. Lead concentration in splits is determined by a two-step digestion in which initially the split is evaporated to dryness with HNO_3-30% H_2O_2 and then the residue is treated with $CaNO_3$ and NH_4Cl, followed by reflux in dilute HNO_3-HCl. Acid extracts are filtered, brought to 100 mL, and stored in polyethylene bottles prior to analysis. Acid extracts are analyzed using flame atomic absorption spectrophotometry (AAS) at Brooklyn College.

Lead concentrations determined by AAS will be subjected to one-way ANOVA and other statistical techniques to establish the significance of quantitative analytical results using JMP3.1, statistical visualization software for the Macintosh from SAS Institute Inc. and MGAP, the mathematical geostatistical analysis program, both in the Brooklyn College Geology Department's computer facilities.

In addition, ^{210}Pb amounts will be determined for selected samples to estimate atmospheric lead retention. Facilities at Yale University will be used for these analyses.

Conclusions

Work completed to date suggests that background soil lead concentrations in Nassau and Suffolk Counties are low and, therefore, are unlikely to pose a health risk to residents. Brooklyn values are higher and may pose a health risk to children where soils are bare. Lead concentrations generally decrease from west to east.

Roosevelt Island samples contain a wide range of lead concentrations, from acceptable values in many areas to amounts suggesting localized point sources for lead. These data are currently being evaluated and sources are being researched.

Brooklyn schoolyard data are being gathered at the present time. Results should be available later in spring 1996.

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