Lead Contamination in Jasper, Indiana

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Introduction

The health hazards associated with working with lead have been recognized since the second century B.C. This knowledge, however, did not protect the slaves working in the mines in ancient Rome. In the 18th and 19th centuries, the increased widespread use of lead resulted in lead poisoning becoming a cause of ill health and death. Today the United States produces approximately a million tons of lead annually, which is about ten pounds per inhabitant. The majority of the lead is used in battery manufacture and for leaded gasoline production. The two largest sources of atmospheric lead emissions in the United States (2) in 1975 were from gasoline combustion, 127,800 tons (90.4%), and waste oil disposal, 5000 tons (3.5%). The contamination of roadside ecosystems from the combustion of leaded gasoline has been extensively studied and reviewed by William H. Smith (6) of Yale University. The size of this roadside ecosystem has been estimated to be 118,000 square miles. Lead in the upper 5 cm of the soil profile may be elevated 30 times non-roadside soil within a few meters of the street or highway. The soil lead is largely bound by organic matter or present as relatively insoluble lead sulfate.

In the late summer of 1980 it came to our attention that an inordinate amount of lead and other heavy metal contamination had been found in Jasper, Indiana (4). We were asked to determine the extent of contamination and the probable cause. The results of our preliminary investigation of the pH and lead content of water samples taken from the area caused a great deal of concern. This concern prompted a more extensive investigation of the lead content of sediment and soil samples and a survey of the extent of the contamination.

Description of the Study Area

The study area is located at the south edge of Jasper in Dubois County, Indiana. The area contains a mixture of industries and residential housing. Of particular concern was a low "swampy" area located east of Old U. S. 231 highway. The low area is adjacent to the back yards of several homes that are located along the highway. On the west side of Old U. S. 231, across from these homes, is an engine and transmission repair company which had a discharge that ran into a small ditch, went under the highway, and through a ditch which was at one end of a residential yard. A garden was located within about ten feet of this ditch. The local residents said that on occasion this ditch overflowed onto their garden. The ditch led to the "swampy" area described above. The low swampy area is wooded except for fairly large patches where there was no living vegetation. The low area drained into a creek and this creek flowed to the Patoka River.

The ditch and the low "swampy" area had a strong oily odor. On the trunks of the trees was a well defined oil ring. This ring was several feet above ground level, indicating that sometime during a high water situation there was a substantial amount of oil contamination. Some of the weeds were coated with oil and were dying. Some of the lower limbs of the trees were heavily coated with oil as the water receded. The sticks and stumps lying near the water's edge were also visually

coated with oil. There was an oily sheen on the water in some areas. The water in the swampy area had no visual sign of containing life.

Sample Preparation and Analytical Method

Water Sample Preparation: If the water samples were relatively free of suspended matter, they were run directly on a Perkin Elmer 401 Atomic Absorption Spectrophotometer. Samples that contained a substantial amount of sediment were filtered and then analyzed.

Soil and Sediment Sample Preparation: All glassware was extensively washed with hydrochloric acid and then rinsed several times with deionized water. The soil or sediment samples were placed on an acid-washed watch glass and oven-dried to a constant weight at about 105° C. A weighed portion of the dried sample was placed in a 250 ml. beaker and 100 ml. of concentrated HCl was added. The mixture was heated until about 20 to 25 ml. of solution remained. Twenty-five milliliters of water was added to the mixture and heated (not boiled) for 15 minutes. The solution was poured off into a separate beaker and the soil extracted twice more with water. The combined extract was then boiled to dryness. The residue was treated with 10 ml. of concentrated HCl and 10 to 20 drops of concentrated HNO_3. If any particulate matter remained, the solution was filtered. The resulting solution was diluted to 25 ml. and analyzed by atomic absorption spectroscopy. It was sometimes necessary to dilute the sample even more to fit into the working range of the calibration curve. Reagent and equipment blanks were run.

Results

An initial survey of the swampy area in Jasper, Indiana indicated that a rather severe pollution problem existed. Oil contamination was visually obvious. The pH of the ditch leading to the swamp as well as the water in the swamp was very high (pH 12-13). The initial laboratory analysis revealed lead levels in the water ranging from 15-69 p.p.m. or mg/liter. Barltrop has evidence that ingestion of as little as 1 mg/day by a 2-year-old child during a 6-month period will cause lead poisoning (1). Dr. Kehoe several years ago showed that normal adults ingest about 0.2 to 0.3 mg of lead/day, largely from foods and beverages, and estimated that ingestion of about 10 times that amount (2 or 3 mg/day) for a prolonged period of months would result in chronic toxicity (3). The finding of high levels of lead in the water prompted us to investigate soil and sediment samples.

Soil Analysis for Lead: The lead content of the upper layer of soils of unmineralized and uncontaminated areas is generally given as 10-20 p.p.m., dry weight basis (6). A sample taken from the top 5 cm. of soil along a Maryland highway that carried a traffic volume of 48,000 vehicles per day was found to contain 540 p.p.m. lead. We took a soil sample on high ground (not subject to flooding) and about 50 feet east of old highway 231, and it was found to contain 27-35 p.p.m. lead. The lead concentration varied with depth as shown in Table I. The soil in the garden ranged from 86-164 p.p.m. lead, which is from three to six times the concen-

TABLE I. *Lead Concentration In Soils With Depth*

Sample	Pb in ppm			
	0 - 1.5	1.5 - 3	3 - 4.5	4.5 - 6 in.
Near House	35	27		
Garden	98	86	130	164
Edge of Swamp	2820	742		

tration found in our background sample. The vertical distribution of lead concentrations in the soil samples taken from the garden indicated that the garden had been plowed. Soil samples taken near the swamp were very highly contaminated with lead. Lead levels as high as 2820 p.p.m. were found.

The lead contamination of the soil extends over at least 7.9 acres. The soil samples taken around the periphery of the swampy area contained lead at levels of 35-1094 p.p.m.

Sediment Analysis for Lead: Sediment taken from the ditch leading to the swamp contained 71 p.p.m. lead. Sediment taken from the ditch leading from the swamp contained 72 p.p.m. lead. Sediments taken from standing pools of water in the swamp had lead levels ranging from 2210 to 6643 p.p.m. Samples taken from underneath the railroad bridge that crosses the creek into which the swamp drains contained from 111-152 p.p.m. lead. It appears that in locations of fast-moving water, the sediments contained less lead than in standing pools or in areas of slow-moving water.

Figure 1 is a sketch of the area under investigation and contains a summary of the lead levels found in the water, soil, and sediment samples.

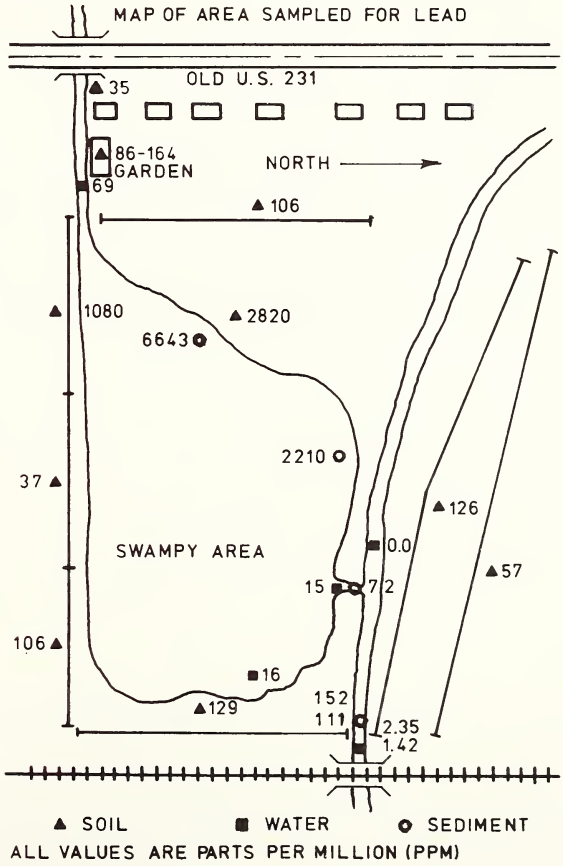

FIGURE 1.

Summary

The swampy area east of old U.S. Highway 231 and located at the south edge of Jasper, Indiana, has been found to be highly contaminated with lead. The water was also found to be very caustic and oil contamination was visually observed. One grab sample taken from the ditch leading to the swamp contained approximately 20% oil. The "water" sample burned when an ignited wooden match was placed into it. The lead contamination was observed in soil samples taken over an area of approximately 7.9 acres. There is every reason to believe that the soil and sediment contamination may extend well beyond the study area. It is the understanding of the authors that dredging operations are planned for the Patoka River. Since the Patoka River is the receiving stream for this drainage area, sediment samples should be collected and analyzed for lead before dredging operations commence. It would also be prudent to carefully assess the impact that a dredging operation would have, if any, on drinking water supplies located downstream.

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