POLYCHLORINATED BIPHENYL (PCB) INVESTIGATIONS

A Case Study

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INTRODUCTION

In September, 1977, fish samples were collected from the Sheboygan River, by the Wisconsin Department of Natural Resources (DNR) for contaminant analysis. The sampling site located at Kiwanis Park in the City of Sheboygan is one of 29 stations which comprise Wisconsin's newly established National Water Quality Monitoring Network. The Sheboygan River is located in the Lake Michigan drainage basin.

Laboratory tests of these fish samples, and from fish samples taken in March, 1978, showed high levels of polychlorinated biphenyls (PCBs). Because these levels were well in excess of the U.S. Food and Drug Administration tolerance levels, the DNR conducted an extensive search for sources of PCBs in the Sheboygan River.

The DNR visited Diecast Division of Tecumseh Products Company located in Sheboygan Falls in April, 1978, and learned that the company used hydraulic fluids containing PCBs until about 1972. In May, 1978, the DNR collected sediments from the Sheboygan River and also collected samples of fill material from a dike on the bank of the Sheboygan River immediately behind the Diecast Plant. Samples of soils and fill material were also taken from the company property within the plant fence. Laboratory tests of the samples indicated that PCBs were present. The highest concentrations of PCBs were found in granular oil absorbent material (120,000 ppm) which had been deposited on the dike and at other locations on the Company property.

Based on the DNR findings, Diecast Division and the City of Sheboygan Falls were ordered to cease disposal of PCB contaminated materials in the river area (even though they ceased use of the hydraulic fluids in 1972) and to provide proper storage, transportation, and disposal of any materials containing PCBs. Diecast Division of Tecumseh Products Company retained

Donohue & Associates, Inc., to determine the extent of PCB contamination on and near their property and to provide engineering representation at various meetings with the DNR.

DESCRIPTION OF PROJECT AREA

The Diecast Division of Tecumseh Products Company operates an aluminum diecasting plant in the City of Sheboygan Falls, Wisconsin. The plant lies immediately west of the Sheboygan Falls wastewater treatment facility and is in the floodplain near the confluence of the Sheboygan and Onion Rivers.

The project area was divided into three individual sections for reference purposes and because, initially, the extent of PCB contamination was not known. Immediately behind the diecasting plant is a fenced yard area (approximately 40,000 ft^2). This area is fairly level with a grass vegetative cover. South of the fenced yard area is a dike(approximately 400 ft long). The dike is not uniform in shape or in height, indicating that it probably was constructed with surplus fill material from the area without the benefit of engineered plans. The dike was overgrown with grasses and small sapling trees. The third area delineated for reference purposes was between the dike and the river. This area is overgrown with grasses, saplings, and mature trees. Riprap had also been placed along several portions of the river bank.

USE OF PCBs

The PCB involved is an organic chemical compound comprised of two joined benzene molecules which form a biphenyl molecule with usually two, three or four chlorine atoms. The compound used in diecasting machines is a brown, oily substance; a liquid of the viscosity of hydraulic oil. A PCB compound is an extremely stable material requiring a temperature of over 2500°F to break it down; at the same time exhibiting excellent lubricating characteristics and noncompressibility.

The PCB material was found to have excellent qualities as a hydraulic oil for use in machines or equipment utilizing hydraulic systems. Also, because of its resistance to high temperature, it was found to be ideal for the diecasting

industry. Diecasting machines' hydraulic systems operate under very high pressures, up to 1200 psi. If a hydraulic line broke under this pressure, the oil from the system sprayed about in great quantities. The molten aluminum in the holding furnace next to the diecast machine is generally kept at a temperature of 1225 to 1250°F. This created quite a fire hazard before the introduction of the PCB hydraulic fluids. In fact, many diecasting shops were destroyed from this cause prior to the introduction of the PCB hydraulic fluid.

SOURCE OF PCB CONTAMINATION

During the period that Diecast Division of Tecumseh Products Company used PCB hydraulic fluids in the diecast machinery, hydraulic leaks occurred from time to time and when a leak did occur, it generally resulted in a large spill of the hydraulic fluid. In the clean-up procedure, as much fluid as possible was scooped up. Some hydraulic fluid inadvertently went down a drain in the area of the machinery, and the final clean-up was performed by spreading an absorbent material (Speedi-Dri) over the wetted area to soak up the remaining hydraulic fluid. The collected fluid was placed in drums and stored, some fluid went into the storm drains and finally the absorbent material soaked with the hydraulic fluid was used for fill in an area south of the present building. Diecast Division of Tecumseh Products Company ceased using the PCB hydraulic fluids after January 1, 1972 because a less expensive replacement became available.

IN-FIELD INVESTIGATIONS

Analyses of data from the DNR findings were inconclusive as to the extent of PCB contamination on the Diecast property. It appeared, from the DNR data, that contamination existed only where there was visual evidence of hydraulic fluids or the "Speedi-dri" compound. Therefore, we decided that the sampling program should attempt to focus in on the extent of PCB contamination in a phased approach.

Preliminary Geochemical Soil Sampling Program

The first phase of the investigation began with a preliminary geochemical soil sampling program. Initially, based on DNR data and information gathered from plant personnel, we felt that portions of the dike would account for the majority of contamination with some "hotspots" located between the building and the dike. Therefore, this preliminary geochemical soil sampling program was established for sampling on the dike, in and near the river, and in the vicinity of DNR sampling locations with high PCB concentrations to determine the potential for vertical migration.

A total of 48 samples were recovered at 17 locations along the dike. The locations of the sampling points were approximately 25 feet apart. The samples were taken continuously, in 18 inch sample lengths, from the top to the bottom of each sample hole (to a maximum depth of 6 feet). Logs for each sample hole were prepared.

Samples were obtained by forcing a soil sampler into the ground to the required depth. The sampling tools consisted of a split tube sampler screwed to a length of drill rods. A drive head was attached to the top of the rods. A post hole pounder was used to drive the sampler into the soil for a distance of 18 inches. When the sample was taken, the post hole pounder with a bump plate attached was used to bump the rods and sampler upwards and free them from the ground. The hole was augered clean before taking the next sample.

The split tube sampler was fitted with a thin liner of tenite butyrate tubing. Thus, when the head and shoe of the sampler were removed, the barrel of the sampler was opened in two halves exposing the liner which contained the sample. The liner was then capped at each end and labeled. The samples were identified and classified in the field and preserved for further reference or laboratory testing.

After each sample was obtained, the sampler was thoroughly cleaned to prevent any contamination by the preceding sample. A wire brush was used to remove any material adhering to the tools. The tools were then washed

with hexane and reassembled. Disposable gloves were worn when handling each sample, and all throw-away materials were properly disposed. The clean-up operation was performed at a location some distance from the sampling sites.

Of the samples analyzed for PCBs, concentrations ranged from 0 to 1700 ppm.

Several soil samples were also collected in the vicinity of where the DNR had sampled on the dike and also on the river bank near the waters edge. These samples were collected to determine the extent of vertical migration of PCBs in the soils where the DNR found surface concentrations between 50,000 and 100,000 ppm, and to determine if there was any contamination along the river.

The sample analysis to determine the vertical migration potential of PCBs indicated that significant migration was not occurring. Samples separated by 12 to 18 inches of soil decreased in concentration from 2,600 to 120,000 ppm near the surface to 20 to 30 ppm 12 to 18 inches beneath the surface.

Samples collected along the river ranged from 2 to 100 ppm.

Geochemical Soil Sampling Program

After the completion of the preliminary geochemical soil sampling program, a systematic geochemical soil sampling program was conducted at the Diecast Plant. The purpose of this phase of the sampling program was to determine more accurately the extent of possible PCB contamination in the dike located along the Sheboygan River, near the surface in the area between the dike and the plant and the dike and the river, and the vertical extent of contamination on the Diecast property.

Several sampling patterns were selected as the most efficient means of obtaining the required data. On the dike, a soil sample traverse with reference stakes spaced at 10 foot intervals was laid out along the centerline. Two sampling points were located 2½ feet from each reference stake on both sides of the dike for a total of 80 sampling points. Logs were prepared for

each sampling point. In the area between the dike and the plant, a square grid pattern was laid out with 130 sample points spaced equally at 20 foot intervals.

Samples were collected along the dike using a split tube sampler which was driven to the in-situ soils which ranged from a depth of 18 to 60 inches. Samples were numbered consecutively in the order taken. Samples from each side of the dike, at the various 10 foot interval reference stakes, were composited if no visible signs of contamination were present. Soil types were visually identified. After each sample was collected, the sampler was thoroughly cleaned to prevent contamination by the preceding sample, following the cleaning procedures outlined previously.

The concentration of samples analyzed for PCB ranged from 0 to 32,000 ppm.

In the area between the dike and the plant, near surface soil samples were collected at each sampling point. These samples were taken by hand from soil exposed with a spade. The soil samples were scraped from the sides of each test hole and collected in 4 oz. sample jars. If samples taken from two adjacent test holes showed no visible sign of contamination, they were composited for PCB analyses. Precautions were taken to prevent any contamination by preceding samples. Disposable gloves were worn when handling each sample, and all throw-away materials were properly disposed.

The concentrations of samples analyzed for PCBs from this area ranged from 1 to 11,000 ppm.

A surface soil sampling program was also conducted to determine the extent of PCB contamination between the dike and river. The surface samples were collected at 20 foot intervals, with the locations of the sampling points alternating between the river's edge and the plateau between the dike and the top of the river bank. These soil samples were taken using the same procedure as described previously for surface samples. Again, precautions were taken to prevent any contamination by preceding samples.

The concentration of samples analyzed for PCBs from this area ranged from 0 to 13,000 ppm.

The first portion of the geochemical soil sampling program defined the areal extent of PCB contamination. A vertical soil sampling program was also conducted to determine the vertical distribution of PCB contamination for all areas of the site. This portion of the sampling program began with the installation of observation wells and piezometers on and near the Diecast property for the purpose of documenting groundwater levels and gradients and to sample for the presence of PCBs in the groundwater. During the drilling of the observation wells and piezometers, soil samples were obtained at specific depths for analyses of PCBs. The observation wells were drilled to a depth of 15 feet and the piezometers were drilled to a depth of 20 feet. Soil samples were collected at the surface, 3, 5, 10, and 15 foot depths from the observation well borings and at the surface, 3, 5, 10, 15 and 20 foot depths from the piezometer borings. Logs were also prepared from these borings.

The concentration of below grade samples analyzed for PCBs ranged from 1.0 to 9 ppm, with surface samples ranging from 1.0 to 470 ppm.

Groundwater samples collected from the observation wells and piezometers were also analyzed for PCBs. Concentrations ranged from 2.5 to 40 parts per billion (ppb).

In the area between the plant building and the dike, 41 sampling locations were established on a 40 x 40 foot grid pattern. At each location, soil samples were collected at the surface and at one foot increments to a depth of five feet. The samples were collected using a conventional split tube sampler.

Ten sampling locations were established along the toe of the dike at 40 foot intervals. These sampling locations alternate on each side of the dike. Soil samples were collected, at each location, at the surface, 1 foot, and 2 foot depths. The samples were also obtained by using the split tube sampler.

Between the dike and the river, five sampling locations were established at 80 foot intervals. At these locations, samples were collected at the surface, 1/2 foot, 1 foot, and 2 foot depths, using the split tube sampler.

The general sampling procedure at all locations was as follows: The split tube sampler was driven to a depth of 1 foot for the intial sample. After the hole was augered and cleaned to the 1 foot level, a 6 inch sample was obtained for PCB analysis (12"-18"). The hole was then augered and cleaned to 2 feet and again a 6 inch sample was obtained (24"-30"). This procedure continued to the final depth. The soils at each location were visually classified, logs prepared, and the samples were placed in either plastic sample bags or 9 oz. glass sample jars for future reference or laboratory testing. Precautions were taken to prevent any contamination by preceding samples.

The vertical soil sampling program in the area between the plant building and the dike yielded 246 individual samples. The concentrations of samples analyzed for PCBs ranged from 1.0 to 10,000 ppm.

The concentrations of samples analyzed for PCBs from the toe of the dike ranged from 1.0 to 2,000 ppm.

The concentrations of samples analyzed for PCBs taken from between the dike and river ranged from 1.0 to 3,800 ppm.

Random Sampling

Immediately east of the Diecast property were garden plots which were leased by the City to residents. Because surface drainage was to the east, we wanted to ascertain if erosion of PCB contaminated soils was occurring. Several surface soil samples were obtained in the garden plots. Also obtained in the garden plots were seven different vegetables.

The soil samples analyzed for PCBs ranged in concentration from 0.04 to 80 ppm. The vegetable samples analyzed for PCBs ranged in concentration from 0.01 to 0.1 ppm, well below the FDA standards permissible in baby food of 0.2 ppm.

STATUS OF PROJECT

At the present time, we are preparing a report which will present our findings to the DNR concerning the extent of PCB contamination on and near the Diecast property. We will also be preparing a plan which will address the final disposition of the PCB contaminated soils.