

Quantification and Remediation of Halogenated Aromatic Compounds Found in Hartwell Lake, South Carolina

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Extended Abstract

Between 1955 and 1997, a local capacitor manufacturer released over 400,000 pounds of PCBs (polychlorinated biphenyls) into Twelve Mile Creek, a tributary flowing into Hartwell Lake in South Carolina. In recent years, plans by Federal and State natural resource agencies were made to decontaminate the lake; those included digging up contaminated soil, and removing two upstream dams allowing for sediments to cover PCBs in the lake.

To aid these efforts, Anderson University students carried out a systematic study of PCBs in sediments before and after the removal of two dams, and they also examined contamination in the food chain, eventually leading to long-term monitoring of PCB bioaccumulation.

Our project spanned over a few years and included collection of (i) core soil samples at three different locations of the lake, (ii) clams from shallow waters from the same locations, and (iii) non-migratory fish. The two sites chosen were in close vicinity to the disposal area, and the third one, designated as control, was far upstream on a different arm of the lake. Samples for GC/MS analysis were prepared by Soxhlet extraction. Selected Ion Monitoring methods SIMC12, SIMC13, SIMC14, and SIMC16 were designed to detect di- through hexa-biphenyls. Soil samples spiked with known amount of Aroclor 1016 were used as standards. Additional standards used were a mixture of congeners, Aroclor 1254, since these two Aroclors were predominantly released by the manufacturer. The contamination in soil samples before the removal of the dams was mostly limited to the core sections of sediments at the depth of 16 to 24 inches, with the highest level reaching 35 micrograms of PCB per gram of soil. Little (2 micrograms/g) or no contamination was found in the upper levels of sediments. The study done three years later, after the removal of the dams, detected PCBs in trace amounts only (est. as 0.2 ppm) in the surface soil.

The scope of contamination in clams would provide a good indicator of PCBs present in the food chain. Traces of polychlorinated biphenyls were found in all samples examined; at least five different dichloro-, five trichloro-, and pentachlorobiphenyl were detected. Since clams are stationary and come from different parts of the lake, the results indicate that the contamination is widespread. PCBs were also detected in fish filets and whole fish from sites close to the disposal area, and trace concentrations were found in control-area fish.

The project was extended to aim at the remediation of PCBs in our laboratory using microwave energy, and starting with two of the simplest halogenated compounds: pentachlorophenol and 4,4'-dichlorobiphenyl. Microwave digestions of these substances were carried out in sealed vessels either in pure water or in aqueous solution of hydrogen peroxide under a variety of conditions, with the max. temp. reaching 230°C and the max. pressure of 33 bars. In our best trial, 70% of the 4,4'-dichlorobiphenyl was decomposed, and oxidation of pentachlorophenol was quantitative (not even a trace detected by GC/MS!).