WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: MT261

Title: Enhanced Wet Air Oxidation of Sediment and Soil Contaminated with Recalcitrant Organic Compounds

Focus Categories: Treatment, Sediments

Keywords: Treatment, Sediment, Wet Oxidation, Organochlorine compounds

Start Date: 03/01/2001

End Date: 02/28/2002

Federal Funds: $18,000

Non-Federal Matching Funds: $36,428

Congressional District: at-large

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Abstract

Problem: The presence of sediments, soils, and sludges contaminated by recalcitrant organochlorine compounds is a major problem in Montana, across the United States, and worldwide. In Montana and other states, there exists a legacy of soil and sediment contamination resulting from the preservation of wood using creosote and pentachlorophenol. Outside of Montana, many coastal areas of the world have sediment that is contaminated with PAHs and organochlorine compounds including polychlorinated biphenyls (PCBs) and DDT. Slow release of these contaminants to surface and groundwater provides a route for animal and human exposure, and because of the hydrophobic nature of these compounds, they tend to bioaccumulate throughout the food web. Many of these compounds (e.g. PCBs, DDT, pentachlorophenol, dioxins, and furans) are classified as hormonally active agents and significant prenatal exposure from consumption of contaminated fish, meats, and dairy products can cause low birth weight, shorter gestation periods, IQ and memory deficits, and delayed neuromuscular development. Wet air oxidation (WAO) is a commercial process used to remediate aqueous waste streams containing organic solutes and to regenerate powdered activated carbon (US Filter/Zimpro PACT Process). Fairly simple modifications to commercially available WAO systems would allow for the treatment of excavated sediment and soil with minimal initial processing. However, as determined in several studies, many organochlorine compounds are not effectively degraded by conventional wet oxidation.

Hypothesis: The addition of a readily degradable waste stream (activated sludge) during wet air oxidation of sediment contaminated with PCBs will result in enhanced degradation of PCBs through the generation of active intermediate oxidation products. The objectives of this project are to investigate the potential for kinetic coupling between PCBs and an easily oxidized waste stream and generate data that may provide the basis for a relatively low-cost treatment method for sediments contaminated with PCBs.

Approach: The methodology employed for these experiments will be similar to that reported previously for WAO experiments using hydrogen peroxide as a radical chain initiator. In short, aqueous slurries containing 10% (w/w) sediment will be oxidized in a 0.5-liter, high-pressure, semi-batch reactor at a temperature of 250C. Effluent concentrations of PCBs adsorbed on the sediment and dissolved in the water

and gas phases will be determined by high-resolution gas chromatography. Experiments will be performed to determine the extent of degradation enhancement resulting from the addition of activated sludge to the reacting slurry and the conditions required to achieve near complete destruction of the PCBs. Using these data, the economic feasibility of the process will be analyzed.

Potential Impact: Data from this project will improve our base level of knowledge about wet oxidation in slurry systems, kinetic coupling during wet oxidation, and technologies alternative to incineration for the treatment of recalcitrant organochlorine compounds. Successful completion of this project may result in the development of an economically competitive treatment technology for contaminated sediment and soil. Moreover, funding for this project will help initiate the research program for a beginning investigator and provide research opportunities for undergraduate students interested in environmental applications of chemical engineering.