USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Enhanced biodegradation of organic wood-preservative contaminated wastewater by commercial surfactants.

Duration: August 1996 through July 1998.

Federal funds: $23,332 ($23,332)

(Total) Direct

Non-Federal funds: $57,290 ($34,050) ($23,240)

(Total) Direct Indirect

Principal Investigators:

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Congressional District: Third

Critical regional water problem:

The costs associated with the removal and disposal of pentachlorophenol (PCP) and creosote wastes are becoming prohibitive to the wood treatment industry because of the large volumes involved and the economically marginal nature of many wood preserving operations. This group of industries has produced and continues to produce large quantities of hazardous wastes. Each year federal environmental regulations for air, soil and water emissions are becoming more restrictive, while costs for disposing of hazardous wastes are escalating. Physical treatment methods such as adsorption, filtration, or extraction are often effective, but only converts the wastes to a different form. Chemical treatments can leave hazardous by-products or residual sludges that must be further treated. Biological treatments often provide the most complete, publicly acceptable and cost-effective treatment options. This technology, however, can be inefficient for wastes containing high concentrations of PCP or high molecular weight polycyclic aromatic hydrocarbons (PAHs) from creosote. These recalcitrant compounds are often co-metabolized, thus not completely mineralized, due to their low aqueous solubilities and strong sorption properties. The application of additives in the form of surface-active agents (surfactants) to achieve accelerated biodegradation of persistent chemicals is a promising procedure.

The limited availability of many environmental pollutants to microorganisms is a major factor that affects biodegradation. If the pollutant and microorganism cannot come into contact, no degradation will occur even if the capability to degrade is present. PADS and PCP are poorly soluble hydrophobic compounds which have been released into the environment on a large scale. Low levels of bioavailability are one of the most important factors involved in the slow rates of PADS and PCP degradation. Surfactants can enhance the bioavailability of hydrophobic compounds by reducing the interfacial tension between the aqueous and nonaqueous phase or by increasing the solubility of the hydrophobic compounds through the formation of micelles. Surfactant use in bioremediation has been found to both enhance and inhibit degradation, such that the current base of knowledge cannot predict the effect of surfactants on an untested system. The objectives of this study are to evaluate different widely used commercial surfactants and several biosurfactants (biologically produced surfactants) for enhancing the biodegradation of wood-preserving process wastewater containing a high concentration of PCP, PADS and oil and grease.

Statement of results, benefits and information expected:

This proposal is expected to yield information about the commercial feasibility of surfactant addition to enhance degradation of PCP and PADS contaminated wastewater. Surfactant -enhanced degradation would result in faster degradation (reduced treatment times), more complete degradation (the more recalcitrant compounds would be more likely to mineralize leaving no intermediate byproducts), improved water quality, and overall cheaper clean up costs. Both the environment and industry could benefit from successful completion of this project.