



WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2004TN12B

Title: Removal of Toxic Heavy Metals from Wastewater Effluents

Project Type: Research

Focus Categories: Toxic Substances, Water Quality

Keywords: heavy metals, toxic substances, water chemistry, wastewater treatment, water quality, hazardous waste, trace elements, pollutants

Start Date: 03/01/2004

End Date: 02/28/2005

Federal Funds: \$13,415

Non-Federal Matching Funds: \$42,104

Congressional District: TN3

Principal Investigator:

Gregory J. Grant

Abstract

This project deals with research that could lead to enhanced methods for the treatment and removal of hazardous and toxic heavy metal contaminants such as mercury and lead in industrial and municipal waste-water as well as groundwater sources. We are specifically interested in exploring the complexation behavior of these heavy metal ions by crown thioether ligands and related mixed donor crowns. Given the thiophilic nature of heavy metal ions such as mercury, cadmium, and lead, it is surprising that more efforts have not been given to addressing the optimization of polythioethers ligands for the selective chelation of heavy metals. Also, mixed donor set ligands, such as crown oxathiaethers and azathiaethers, may offer promise in the fastidious extraction of heavy metals. However, they remain relatively unexplored in this capacity.

Research is needed in order to determine the following:

- (a) the nature and stability of heavy metal ion-sulfur interactions involving crown thioethers and mixed donor set ligands.
- (b) how these ligands bind to the heavy metal centers.
- (c) how selectivity for heavy metal ions may be enhanced via structural alterations on the ligands

The project will consist of the following general tasks:

1. Synthesis of polythioether and mixed donor thioether ligands
2. Synthesis and Characterization of new heavy metal complexes of these ligands, involving principally mercury, cadmium, and lead
3. Metal Competition Studies to determine the comparative effectiveness of structural alterations in the ligands for selectivity of heavy metal complexation in the presence of other less toxic metal ions (e.g., iron and mercury)

Our proposal seeks to develop further the study of the interactions of heavy metal ions such as mercury, cadmium, and lead with sulfur donor ligands in order to understand better the nature of the metal-sulfur interaction. The use of these polythioethers as chelators for toxic heavy metal ions could have important implications in the development of novel materials which could bind and remove these hazardous items from contaminated water. The proposed project can lead to a designed material which can selectively extract specific, unwanted metal ions from a complex mixture of metal cations in aqueous solution and could then be applied in waste-water remediation.