EPA Grant Number: R819165-01-0
Title: Uptake of Metal Ions from Aqueous Solutions by Sediments
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Center Director: D. D. Reible
EPA Project Officer: Dale Manty
Project Period: 1996-1997
Project Amount: $20,008 (seed funding)

Objectives/Hypothesis
Theoretical and experimental studies for this project were designed to occur simultaneously. Well-characterized sediment particles were selected for batch sorption equilibrium and kinetic experiments, as well as packed-column sorption experiments, using various metal ions. Equilibrium and kinetic parameters were used as the basis to develop a transport model to predict the distribution of metal ions in sediments. In parallel, the diffuse layer potential of the particles were calculated and incorporated in particle interaction models. These models were used to calculate pairwise total potential and coagulation frequency between particles. The coagulation frequency was then incorporated in a particle population dynamics model for calculation coagulation kinetics. All three models; 1) sorption kinetics, 2) transport, and 3) population dynamics, were coupled together.

Approach
Well characterized suspensions such as kaolinite and iron oxide hematite) particles were used in this study because of their extensive presence in natural systems and in order to test the theoretical models for metal ion transport and coagulation kinetics. Kaolinite particles were obtained from commercial vendors, while hematite was synthesized in the laboratory by sol-gel methods (Sugimoto et al., 1993). Potentiometric measurements to calculate the particle surface charge were obtained by an automatic titration and pH monitoring system available in the Environmental Engineering Laboratory at Georgia tech. Electrokinetic measurements were obtained by zeta meters. Sorption kinetics and transport were monitored by taking concentration measurements of the solution. An ICP/MS and AA were used to obtain these measurements. Coagulation kinetics were monitored by measuring transient particle size using available size analyzers.

Results
The findings from an experimental and modeling investigation of metal ion sorption onto inorganic colloidal particles are outlined below. Based on preliminary experimental and modeling efforts, it is clear that copper and cadmium ion sorption alters the surface potential of ferric oxide particles. Destabilization of the ferric oxide particles is seen to occur under conditions of suspension pH and ionic strength commonly encountered in natural systems. Modeling studies indicate possibilities of particle aggregation under conditions of metal ion uptake due to alteration of surface electrostatic potential. Experimental work to validate these findings is in progress in our laboratories.

Summary of Results

- Formulated model of particle coagulation rates under sorption kinetics
- Project led to NSF award "CAREER: Influence of Sorption Rates on Particle Flocculation Kinetics", $200,000, S. Yiacoumi, Georgia Institute of Technology

Supplemental Keywords

Inorganic colloidal particles, particle coagulation, and sorption

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Students Supported

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Publications and Presentations

Chen, J., S. Yiacoumi and T.G. Blayeds, *Separations Technology*, 6, 133 (1996).

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For Further Information

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