WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: SD1541

Title: Arsenic Remediation of Drinking Water: Phase II

Focus Categories: Treatment, Water Quality

Keywords: Water Treatment, Water Quality Standards, Water Quality, Water Chemistry, Groundwater Quality, Geochemistry, Arsenic, Adsorption and Exchange

Start Date: 05/01/2001

End Date: 02/28/2002

Federal Funds: $9,469

Non-Federal Matching Funds: $18,938

Congressional District: First

Principal Investigators:
Arden D. Davis
Professor, South Dakota School of Mines and Technology

Cathleen J. Webb
Associate Professor, South Dakota School of Mines and Technology

David J. Dixon
Associate Professor, South Dakota School of Mines and Technology

Abstract

Arsenic retention and mobility in surface water and ground water are of great concern because of toxic effects on the environment. Arsenic is a persistent, bio-accumulative toxin. The drinking water standard for arsenic, currently set at 50 parts per billion (ppb), is likely to be significantly lowered in the next year because of links to cancer. Current remediation technologies are expensive. Thus, any lowering of the standard will put increased economic pressure on rural communities with high levels of arsenic in their drinking water. The American Water Works Association has estimated the cost of decreasing the arsenic standard to 10 ppb in South Dakota at $8.25 million. The South Dakota Department of Environment and Natural Resources estimates 65 (18.6%) of the state's public water systems would violate a 5 ppb arsenic standard.

The specific objectives of this work are to: (1) establish the surface chemistry of the interaction between limestone and arsenic, (2) improve the adsorption efficiency of the arsenic removal process, (3) characterize the long-term stability of the waste product, and (4) establish the efficiency of the process under real-world conditions through investigation of the engineering constraints.

The proposed research has the potential to reduce arsenic in drinking water at the source, with the added benefit of low-cost disposal of a stable and benign waste product in ordinary landfills. In Phase I of this on-going work sponsored by the USGS-104 program in 2000 and completed during the past year, research by the principal investigators demonstrated arsenic adsorption of greater than 90% by limestone. The second phase of this work, proposed herein, will establish the surface chemistry of the arsenic removal process and investigate ways of improving the efficiency of the process as well as waste disposal options. We anticipate

the development of a remediation technology that will significantly concentrate the arsenic onto limestone. Treatment of large quantities of water with arsenic above drinking water standards should produce a relatively small and compact amount of solid limestone with adsorbed arsenic. Arsenic retention by limestone appears to be an effective process that offers great potential for source reduction. Because of the ready availability of limestone, its use for arsenic remediation would be relatively inexpensive. If successful, the technology could be readily adapted to small rural water supply systems as well as private, domestic, and stock wells. For example, elevated levels of arsenic in water from wells in the Arikaree aquifer have been observed on the Rosebud Indian Reservation as well as other parts of South Dakota. Benefits of this research will include a low-cost treatment technology for source reduction that will reduce arsenic below maximum contaminant levels, helping operators of small or rural water supply systems to meet anticipated new rules. Additional benefits include the potential for low-cost disposal of the waste product in a stable form. We anticipate commercial application of the technology could be available within two years.