

Proposal for USGS 104 Grant Program

1. **Title.** Leaching Tests for Encapsulation of Waste after Arsenic Removal from Drinking Water
2. **Project Type.** Research
3. **Focus Categories.**
 1. Toxic Substances.
 2. Treatment.
 3. Water Supply.
4. **Research Category.** Water Quality
5. **Keywords.** Arsenic; arsenic removal; drinking water; concrete.
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8. **Principal Investigators.**

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10. Abstract.

Limestone-based technology for arsenic removal from water is an innovative and promising method. The technology offers the potential for low-cost disposal of waste product after arsenic removal, either in an ordinary landfill or by encapsulation in concrete. Research by the principal investigators has shown that the waste product from the limestone-based technology passes the Toxicity Characteristic Leaching Procedure (TCLP) test. Disposal of arsenic-enriched waste is critical for commercial viability of removal technologies. Low-cost disposal of waste in an ordinary landfill gives the method an advantage that could help communities meet the new maximum contaminant level for arsenic. The ability to reuse the waste material in concrete would add a significant economic benefit, reducing overall costs. Other methods of arsenic removal, such as iron-based material, suffer from the disadvantage of higher disposal costs because of the potential for leaching of arsenic from the waste product.

This project will investigate encapsulation of waste product in concrete and will focus on leaching tests of the concrete. The tests, if successful, will help demonstrate the potential for reuse of the waste material, thereby decreasing overall costs of limestone-based technology. Ground water from City Well No. 4 at Keystone, South Dakota, will be used as the water source. The researchers will use limestone-based material such as granules and a newly developed material with a limestone base and an additional arsenic-removal medium. In laboratory tests, arsenic-contaminated water will be run through the material until breakthrough arsenic concentrations are reached. Breakthrough curves will be plotted for the tests. Breakthrough in this study will occur when the arsenic concentration goes from undetectable to 10 ppb, the new drinking water standard. The waste material then will be removed, combined with concrete mortar, and encapsulated in a concrete cylinder for later TCLP tests to determine whether encapsulation of waste product in concrete is a viable reuse. If successful, the proposed work could give limestone-based technology a distinct advantage for use in small rural water systems.

The objectives of this work are to:

- 1) Determine breakthrough of arsenic in ten column tests using limestone-based material as the treatment media and Keystone city well water as the arsenic source.
- 2) Remove the waste material after breakthrough and combine the product in concrete mortar. Prepare concrete cylinders with material from each leaching column, using the concrete mortar and waste material from the column. At least ten concrete cylinders will be prepared.
- 3) Obtain samples from the concrete cylinders and conduct Toxicity Characteristic Leaching Procedure (TCLP) tests.
- 4) Analyze TCLP test results and determine the suitability of encapsulating the waste material as concrete in structural or non-structural works.

The research presented in this proposal will focus on improving the economic advantages of disposal of limestone-based material by encapsulating the waste product in concrete. Overall goals include future application as a pilot study at a wellhead with naturally occurring arsenic contamination, and commercial viability of the technology.

The TCLP tests in this work are designed to determine the mobility of contaminants in wastes. Infiltrating water and other liquids that come into contact with the waste can potentially leach toxins from the material. The U.S. Environmental Protection Agency's D List indicates the maximum concentration of arsenic for toxicity characteristic is five parts per million (ppm). Previous work by the researchers has shown that waste product from limestone-based material, after arsenic removal, is considered benign and suitable for disposal in a landfill. Testing is needed for encapsulated waste in concrete, however. The proposed research will help demonstrate the viability of this approach.