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Emerging Technology Bulletin

Removal and Recovery of Metal Ions from Groundwater

Bio-Recovery Systems, Incorporated

Technology Description: This biological sorption process using AlgaSORB is designed to remove heavy metal ions from aqueous solutions. AlgaSORB is composed of a nonliving algal bio-mass immobilized in a silica polymer. It is a hard material where the algal cells are protected from decomposition by other microorganisms and can be packed into columns which, when pressurized, exhibit good flow characteristics. The technology is based on the natural affinity of algae cell walls for heavy metal ions and functions well for removing heavy metals from groundwaters that contain high levels of dissolved solids and/or organic contaminants.

The system functions as a biological ion-exchange resin to bind both metallic cations and metallic oxoanions. Anions such as chlorides or sulfates are weakly bound or not bound at all. The algae-silica system can be recycled. After saturation, metals are stripped from the algae using acids, bases, or other suitable reagents. High concentrations of metals are contained in a small volume of solution and require subsequent treatment.

Waste Applicability: Bio-Recovery's technology can be used to remove metal ions from groundwater or surface leachates without interference from components of hard water or high levels of dissolved solids. The technology can also be applied to rinse waters from electroplating, metal finishing, and printed circuit board manufacturing industries. The system, using various AlgaSORB preparations, can be utilized to remove heavy metals including aluminum, cadmium, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, molybdenum, nickel, platinum, silver, uranium, vanadium, and zinc from aqueous media.

Test Results: The AlgaSORB process was tested on mercury-contaminated groundwater in the Fall of 1989 at a hazardous waste site in Oakland, California. Testing was designed to determine optimum flow rates, binding capacities, and the efficiency of stripping agents. Different AlgaSORB resins, comprised of the cell walls of different algae, were tested for mercury removal from the groundwaters. Both mercury concentration and chemical speciation appeared to change over the sampling period. Removal performance was inconsistent when a single immobilized alga was used on waters collected at different times.

For the onsite, pilot-scale demonstration, two different AlgaSORB adsorbents (624 and 640) in 1 in.-diameter columns, arranged in series, were used to remove the mercury contamination. Each column had a 0.4L volume. Flow rate was 10 bed volumes per hour. Effluent samples were collected from a sample port between the two columns and from the second column exit port. AlgaSORB 624 exhibited high mercury binding capacity and high mercury leakage rates while AlgaSORB 640 showed low binding and low leakage rates.

In tests prior to the demonstration, sample pH was adjusted to the collection value of 7.9. In the first test using the two columns (AlgaSorb 624 followed by Algasorb 640), a total of 230 bed volumes (5.75L) was passed through the columns. A total of 6,820 µg of mercury was extracted by the two columns without breakthrough. In a repeat of the test, a total of 33 bed volumes (8.3L) were treated without column breakthrough. The ultimate capacity of the test design was not challenged in either test.

During the 3-week demonstration, 588 bed volumes (235L) were passed through the test apparatus (see Figure 1). The demonstration was continued until the effluent mercury exceeded the discharge limit of 10 µg/L. At least 534 bed volumes (214L) were successfully treated prior to column breakthrough. Data confirmed previous tests that AlgaSORB 624 was capable of removing the majority of the mercury and AlgaSORB 640 was capable of polishing effluent from AlgaSORB 624 below permitted discharge limits.

As a result of the success of this technology in the SITE Emerging Technology Program, Bio-Recovery Systems, Inc., has been invited to participate in the SITE Demonstration Program. The process is being commercialized for groundwater treatment and industrial point source treatment. Treatability studies are required.

For Further Information:

EPA Project Manager:
Naomi P. Barkley
U.S. EPA Risk Reduction Engineering Laboratory
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7854 (FTS: 684-7854)

Technology Developer Contact:

Thomas Powers
Bio-Recovery Systems, Inc.
Las Cruces, NM 88005
505-523-0405

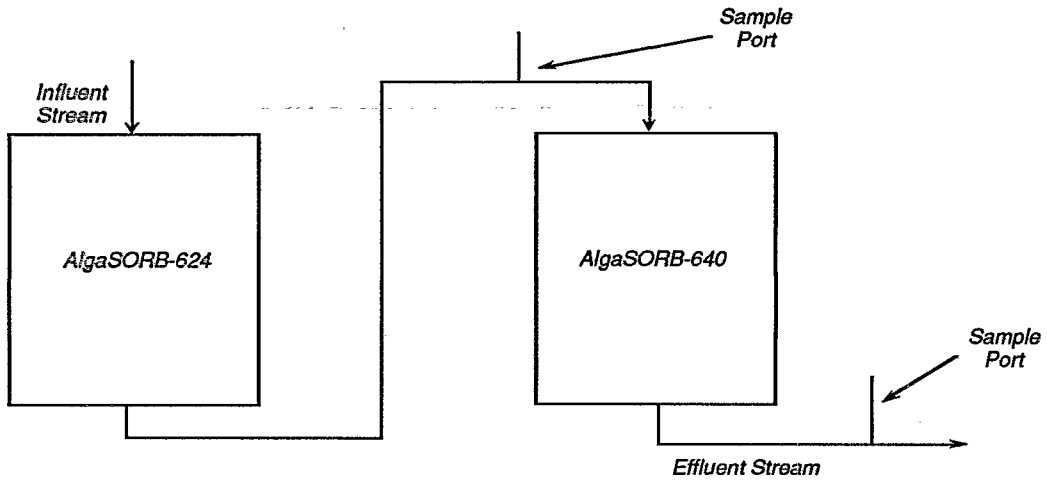

Figure 1. *Schematic of Portable Water Treatment System for Onsite Testing.*

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