Safe Landfill Disposal of Spent Arsenic Removal Media

By Francis Boodoo

New iron impregnated resins offer a long term solution to potential leaching of arsenic in non-hazardous landfills

The new Maximum Contaminant Level (MCL) of 10 ppb for arsenic for drinking water has stimulated the development of a slew of new and innovative solutions. Granular iron based adsorption medias (GIMs) are one of the established technologies with thousands of cubic feet of material installed at municipalities throughout the nation. After a single use, such arsenic–laden media is simply disposed of at landfills classified for handling of non-hazardous materials. Some regulators are now questioning this practice as research at the University of Arizona[1] has demonstrated conclusively that granular iron medias loaded with arsenic will leach arsenic, under landfill conditions, back into the surrounding landfill at hazardous (ppm) concentrations.

Hazardous Nightmare:

This means that several years from now, exhausted arsenic-laden granular media that was once considered safe to dispose of as non-hazardous may become a hazardous nightmare for everyone concerned. Such liability can potentially extend all the way back to the operator of the facility, the generator of the waste, and even to the manufacturer of the media.

There is a particular quirk in the test used to determine the hazardous or non-hazardous nature of arsenic-bearing granular media that should be of general concern. The primary test used is called the Toxic Characteristic Leaching Procedure (or simply TCLP). Essentially this test is designed to measure the concentrations of toxic contaminants that can be extracted from such materials when using a specified chemical solution and procedure. The extracted concentration of the each contaminant would then compared with the maximum allowable concentration for each material above which it is classified as hazardous. In the case of arsenic, if the value exceeds 5 mg/l, the material is classified as hazardous and should then be disposed of in a hazardous landfill. Such hazardous

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waste landfills are designed to operate with protective measures to prevent arsenic from getting back into the general environment.

The issue with the current test for arsenic is that it uses an extractant solution with a pH of approximately 4.5. At this pH, arsenic is very tightly bound to iron, and therefore, a minimum of the arsenic is released into the extractant solution. Unfortunately, the pH conditions that exist in such landfills are quite different, with the pH ranging from 7 to 9 typically. At such pH, the binding power of iron for arsenic is greatly reduced. Chemically reducing conditions in landfills also convert the iron to a more soluble form, causing further separation of the arsenic from the iron. This means that a material classified as safe for disposal in a non-hazardous landfill can potentially leach arsenic into the surrounding landfill at concentrations that are above the hazardous level.

Modifying the TLCP procedure to one more representative of environmental conditions existing in the landfills would be a first step toward correct classification of such medias. Once this is done, arsenic-laden media of this type would then likely be more correctly classified as hazardous and would have to be disposed of in landfills that can accept such hazardous waste. This creates a dilemma for users as the higher cost for disposing of the media as hazardous waste must ultimately be passed on to consumers.

Fortunately, a newer innovative iron-based media has been developed for solving this dilemma by providing a "landfill-safe" method of disposal of the spent media. The new Hybrid Media[2] made of ion exchange resin impregnated with nanoparticles of iron oxide works equally well as GIMs in removing arsenic from contaminated water and also offers the advantage of being regenerable. This means that before disposal the arsenic-laden media can be readily stripped of its arsenic content and the (arsenic-free) media can be sent to a non-hazardous landfill for disposal. Overall costs of treating for arsenic can be kept to a minimum due to the extended life of the media versus GIMs. Regenerability results in at least a tenfold reduction in the volume of spent media going into the landfills. The arsenic stripped from the media can be concentrated into a sludge by precipitation with ferric chloride and further encapsulated with special polymers to ensure it is impervious to leaching.

While regulators are expected to take the time to study and incorporate the new landfill disposal knowledge into a modified TCLP test procedure, users, manufacturers and facility operators must start now to think of ways to protect themselves against such potential long-term liability.

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2 POU – POE Removal of Arsenic and Uranium with ArsenX^{np} – Francis Boodoo, The Purolite Company, NGWA Feb 2005

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