Recovery of Mercury from Contaminated Primary and Secondary Wastes

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Mercury was widely used in U.S. Department of Energy (DOE) weapons facilities, resulting in a broad range of mercury-contaminated wastes and wastewaters. Some of the mercury contamination has escaped to the local environment, particularly at the Y-12 Plant in Oak Ridge, Tennessee, where approximately 350 metric tons of mercury were discharged to the environment between 1953 and 1963.

Effective removal of mercury contamination from water is a complex and difficult problem. In particular, mercury treatment of natural waters is difficult because of the low regulatory standards. For example, the Environmental Protection Agency has established a national ambient water quality standard of 12 parts-per-trillion (ppt), whereas the standard is 1.8 ppt in the Great Lakes Region. In addition, mercury is typically present in several different forms, but sorption processes are rarely effective with more than one or two of these forms. To meet the low regulatory discharge limits, a sorption process must be able to address all forms of mercury present in the water. One approach is to apply different sorbents in series depending on the mercury speciation and the regulatory discharge limits.

Four new sorbents have been developed to address the variety of mercury species present in industrial discharges and natural waters. Three of these sorbents have been field tested on contaminated creek water at the Y-12 Plant. Two of these sorbents have demonstrated very high removal efficiencies for soluble mercury species, with mercury concentrations at the outlet of a pilot-scale system less than 12 ppt for as long as six months. The other sorbent tested at the Y-12 Plant is targeted at colloidal mercury that is not removed by standard sorption or filtration processes. At the Y-12 Plant, colloidal mercury appears to be associated with iron, so a sorbent that removes mercury-iron complexes in the presence of a magnetic field was evaluated. Field results indicate good removal of this mercury fraction from the Y-12 waters. In addition, this sorbent is easily regenerated by simply removing the magnetic field and flushing the columns with water.

The fourth sorbent is still undergoing laboratory development, but results to date indicate exceptionally high mercury sorption capacity. The sorbent is capable of removing all forms of mercury typically present in natural and industrial waters, including Hg^{2+}, elemental mercury, methyl mercury, and colloidal mercury. The process is also showing very fast kinetics, which allows for higher flow rates and smaller treatment units.

These sorbent technologies, used in tandem or individually depending on the treatment needs, can provide DOE sites with a cost-effective method for removing mercury concentrations to the very low levels being mandated by the regulatory community. In addition, the technologies do not generate significant amounts of secondary wastes for disposal.

Furthermore, the need for improved water treatment technologies is not unique to the DOE. The new, stringent requirements on mercury concentrations impact other government agencies as well as the private sector. Some of the private-sector companies needing improved methods for removing mercury from water include mining, chlor-alkali production, chemical processing, and medical waste treatment.

The next logical step is to deploy one or more of these sorbents at a contaminated DOE site or at a commercial facility needing improved mercury treatment technologies. A full-scale deployment is planned in fiscal year 2000.