

# TECHBRIEF

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## MULTI-FUNCTIONALIZED BASIC IMMOBILIZED AMINE SORBENTS FOR REMOVAL OF METAL CONTAMINANTS FROM WASTEWATER

### OPPORTUNITY:

The invention is a new type of amine-based sorbent material that has increased affinity towards heavy metal capture, from a variety of sources that exceeds the existing amine-sorbent ability by greater than 50%. This invention involves use of a polyamine that is chemically tethered to the surface of a solid silica support through use of a crosslinker and further stabilized through hydrogen bonding with a linker/cross linker. These sorbents can be used for the capture of heavy metals from a variety of aqueous sources. This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

### CHALLENGE:

The US Resource Conservation and Recovery Act (RCRA) gave the US Environmental Protection Agency the authority to establish and enforce regulatory policies and toxicity limits regarding Arsenic (As), Cadmium (Cd), Chromium (Cr), Lead (Pb), Mercury (Hg), Selenium (Se), and other metals. Many of these metals present a distinct challenge for capture because they are most commonly present in the polyatomic oxy-anion form. Sources for most of these contaminant metals include flue gas desulfurization (FGD) wastewater streams. These streams result from the treatment of fossil fuel-derived, post combustion flue gas with aqueous-based technologies. The well-known and widespread contamination of metals in drinking water and other terrestrial water sources through natural processes or human activity, demands remediation. In addition, radioactive pollutants in aqueous form have raised concerns about exposure levels in the nearby communities because of fears that these fission products could make their way into the food chain.

### OVERVIEW:

NETL researchers have discovered a method for sorbents to be used to capture heavy metals from a variety of aqueous sources. The covalent and H<sub>2</sub>O-stable sorbents resist leaching by H<sub>2</sub>O in an aqueous stream containing heavy oxyanion-based and other metals. Easily prepared immobilized amine sorbents that contain novel combinations of polyamines with at least two different monomer cross-linkers immobilized on silica are structurally stable and capture a variety of toxic heavy metals with higher capacity compared to single-crosslinker sorbents. These sorbents capture radioactive isotopes as well as heavy metal species that are found in many coal waste streams and industrial effluents like FGD and hydraulic fracturing waters.

(continued)



**FOR MORE INFORMATION:**

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**ADVANTAGES:**

- Fast and easy preparation.
- Novel single-step incorporation of multiple functional groups.
- Added functionality and potential to craft a sorbent specific to desired contaminants.
- Low raw material costs.
- High affinity towards oxyanionic forms of heavy metals while maintaining affinity towards toxic cationic metals.
- Low-cost, scalable, and robust materials with high commercial promise.

**APPLICATIONS:**

- Capture of toxic heavy metals from coal waste streams and industrial effluents.
- Commercial scale processes involving toxic heavy metal species and potentially radioactive metals.
- Flowing or stagnant aqueous environments.

**PATENT STATUS:**

U.S. Patent Pending (non-provisional patent application)

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Title: Multi-Functionalized Basic Immobilized Amine Sorbents for Removal of Metal Contaminants from Wastewater

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