

Using Fly Ash Based Synthetic Zeolite Permeable Reactive Barrier to Remove Arsenic, Cadmium, and their Mixture from Aqueous Solution

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Abstract : Over the next quarter of a century, the US government and the private sector will spend billions of dollars annually to clean the contaminated sites from pollution such as petroleum products, heavy metals, and solvents organic compounds. During the past three decades, almost 750,000 sites that require remediation have been reported to the United States federal and state agencies. Out of these contamination sites, approximately 300,000 are still in need of remediation. In these sites, the most widespread forms of contamination are petroleum products and heavy metals. At least half of US Department of Defense, US Department of Energy, Superfund sites, and Resource Conservation and Recovery Act (RCRA) sites have been reported to contain heavy metals. Heavy metals most often found in the contaminated water are lead, mercury, chromium, cadmium, arsenic, and zinc. This investigation emphasizes the elimination of arsenic and cadmium from aqueous solution. During the past several years, we developed a novel material called Alkali-Activated fly ash Material Permeable Reactive Barrier (AAM-PRB), which includes fly ash, fine aggregates, coarse aggregates, activating chemicals, and water. AAM can be produced with high permeability, 10-1 cm/s, then crushed into pelletized form. Laboratory experiments showed that water containing 10 ppm, 100 ppm, and 1000 ppm of arsenic and cadmium ion passing through AAM-PRB reduced to less than 0.1 ppm. However, water containing 10,000 ppm arsenic ion passing through AAM- PRB shows that the breakthrough was achieved. The removal of the mixture of arsenic and cadmium from aqueous solutions was also tested by using AAM-PRB. The results indicate that the efficiency of AAM-PRB for simultaneous removal of arsenic and cadmium from 10 ppm, 100 ppm, and 1,000 ppm were marginally below that of arsenic alone. Still, it was significantly lower for cadmium from the aqueous solution. The basic science behind removing heavy metal and microstructural investigation AAM-PRB will be the focus of our future work.

Keywords : arsenic, cadmium, contaminated water, fly ash, permeability, reactive barrier

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