

A new method for As(V) removal from waters by precipitation of mimetite $\text{Pb}_5(\text{AsO}_4)_3\text{Cl}$ on Pb-activated zeolite

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A new method for removal of arsenate AsO_4^{3-} ions from aqueous solutions is proposed. The principle of the method stems from precipitation of very insoluble crystalline lead arsenate apatite (mimetite $\text{Pb}_5(\text{AsO}_4)_3\text{Cl}$) induced by bringing in contact Pb-activated zeolite and As-contaminated water in the presence of Cl^- . Zeolite is activated by sorption of Pb^{2+} followed by washing with water to remove the excess of Pb and to desorb weakly adsorbed ions. Lead adsorbed on zeolite is bound strong enough to prevent desorption by water but weak enough to undergo desorption induced by heterogeneous precipitation of mimetite nanocrystals on the surface of zeolite.

The experiment consisted of two steps. In the first step, aliquots of 0.5 g of natural clinoptilolite zeolite (from Zeocem a.s., Bystré, Slovak Republic) were reacted with 40 mL of solutions containing 20, 100, 500, and 2000 mg Pb/L (pH = 4.5; reaction for 30 minutes followed by centrifugation). The amount of Pb sorbed was calculated from the drop of Pb concentration in solution. Centrifuged zeolite was washed three times by mixing with 10 mL of DDI water, followed by centrifugation. No Pb was detected in the water after second washing. Wet pulp resulting from this stage was exposed to solutions containing 70 mg/L Cl^- and various concentrations of AsO_4^{3-} (2 and 100 mg As/L; pH = 4). Complete removal of As was observed for 2 mg As/L solutions mixed with zeolite-20 and zeolite-100. The precipitation of mimetite $\text{Pb}_5(\text{AsO}_4)_3\text{Cl}$ in the form of hexagonal crystals ca. 0.25 μm in size was observed using SEM/EDS.

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