Removal of aqueous Hg(II) using indium-modified iron particles

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In this study, the surface of ZVI was impregnated with Ni, Cu, and In to maximize the reactivity and durability of microscale ZVI for aqueous Hg(II) removal. In the removal efficiency test carried out for 60 minutes with 0.1 mM of aqueous Hg(II) under pH 7, In-doped ZVI (In-ZVI) showed the highest Hg(II) removal efficiency of 99% along with the highest concentration of Hg(0) in the headspace, while the Hg(II) removal efficiency was only 3% with Ni and 15% with Cu modification. The sorption of Hg was better explained by the Freundlich model than the Langmuir model, suggesting that it took place in a multilayer adsorption manner with irregular energy distributions. The was no significant decrease in the Hg(II) removal efficiency after seven successive runs with In-ZVI, while it was largely decreased in the fourth cycle without In doping. The control tests result suggests that simple Hg sorption or Hg reduction by In(0) or Fe(II) on the ferric layer cannot support the largely increased removal efficiency of In-ZVI than bare ZVI. In impregnation on the ZVI surface seemed to form galvanic cells between In(0) and Fe(III), and consequent generation of atomic hydrogen increased Hg(II) reduction rate. Furthermore, XPS data suggest that Hg reduced by atomic hydrogen was present on the surface of In-ZVI and amalgamated with In(0), explaining why Hg removal efficiency was largely enhanced with In-ZVI as compared to bare ZVI.