

Review

The fundamental mechanism of aqueous contaminant removal by metallic iron

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Abstract

Contaminant co-precipitation with continuously generated and transformed iron corrosion products has received relatively little attention in comparison to other possible removal mechanisms (adsorption, oxidation, precipitation) in $\text{Fe}^0/\text{H}_2\text{O}$ systems at near neutral pH values. A primary reason for this is that the use of elemental iron (Fe^0) in environmental remediation is based on the thermodynamic-founded premise that reducible contaminants are potentially reduced while Fe^0 is oxidised. However, co-precipitation portends to be of fundamental importance for the process of contaminant removal in $\text{Fe}^0/\text{H}_2\text{O}$ systems, as the successful removal of bacteria, viruses and non reducible organic (e.g. methylene blue, triazoles) and inorganic (e.g. Zn) compounds has been reported. This later consideration has led to a search for the reasons why the importance of co-precipitation has almost been overlooked for more than a decade. Three major reasons have been identified: the improper consideration of the huge literature of iron corrosion by pioneer works, yielding to propagation of misconceptions in the iron technology literature; the improper consideration of available results from other branches of environmental science (e.g. CO_2 corrosion, electrocoagulation using Fe^0 electrodes, Fe or Mn geochemistry); and the use of inappropriate experimental procedures (in particular, mixing operations). The present paper demonstrates that contaminant co-precipitation with iron corrosion products is the fundamental mechanism of contaminant removal in $\text{Fe}^0/\text{H}_2\text{O}$ systems. Therefore, the 'iron technology' as a whole is to be revisited as the 'know-why' of contaminant removal is yet to be properly addressed.

Keywords: adsorption, co-precipitation, iron corrosion, iron oxhydroxides, zerovalent iron