

## **Stabilization of copper and arsenic in contaminated soils using zero-valent iron – evaluation of long-term effects**

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Immobilization of trace elements in contaminated soils by amorphous iron (hydr)oxides (HFO) has been suggested as a remediation method. Results from stabilization with zero-valent-iron (ZVI) are promising for some elements, but questions about the long-term performance of the stabilization remain unanswered. To quantify the extent of immobilization and to predict possible remobilization of contaminants on long timescales detailed knowledge about immobilization mechanisms is needed. This study aimed at assessing the long-term effect of ZVI amendments on the solubility of arsenic (As) and copper (Cu), and exploring the immobilization mechanism(s).

Samples from control and ZVI-treated plots in two field experiments (both with sandy soils) were investigated; one Cu-contaminated soil, (a wood preservative site, ZVI added 6 years prior to sampling), and one As-contaminated soil, (an agricultural field nearby an As(III) smelter, ZVI added 15 years before sampling). Batch experiments were made in the pH range from 4 to 8, and contaminant solubility was predicted with Visual MINTEQ. The bonding mechanisms of As and Cu were studied with EXAFS spectroscopy.

The solubility of Cu in the ZVI-treated soil was 7 times lower than in the untreated soil at soil pH (ca. 6.5), despite higher Cu concentration in the treated soil. The solubility was predicted well by the model. EXAFS results and modelling show that Cu was mainly bound to organic matter in the untreated soil, but that sorption to HFO predominates at pH > 6 in the ZVI-treated soil. Sorption of As was less pH-dependent but sensitive to the competition with phosphate.

We conclude that ZVI remained “reactive” during long periods (6-15 years), that the pH value is crucial for Cu stabilization, and that competition with phosphate is important for As.