# Optimization and Performance of ZVI Amendments for In Situ Chemical and Biological Reduction: Less is More

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**Background/Objectives.** In situ chemical reduction (ISCR) is an innovative environmental remediation technique used for soil and/or groundwater remediation that involves the placement of a reductant or reductant generating material in the subsurface to reduce the concentrations of targeted environmental contaminants to acceptable levels. Zero-valent iron (ZVI) is most commonly used for remediating halogenated ethenes and ethanes, pesticides, energetic compounds and some metals/metalloids into harmless end products (ITRC, 2011). The process combines both biological processes and ZVI particle-driven abiotic pathways to chemically reduce the contaminants. The incorporation of ZVI enhances remediation by enabling various chemical reduction pathways and for halogenated ethenes limits the formation of undesirable breakdown products such as cis-DCE and vinyl chloride.

**Approach/Activities.** Recent studies were undertaken to evaluate the reactivity of various commercially available ZVI powders. The reactivity of 2-3 µm iron sulfide modified ZVI was compared with commercially available ZVI powders (BASF OM carbonyl iron and Peerless 90D ZVI). Experiments involved adding 2 g/L of iron sulfide modified ZVI powder to buffered tap water with 36 mg/L TCE and 3 mg/L PCE. Off-the-shelf ZVI powders were dosed at 10 g/L.

**Results/Lessons Learned.** The study concluded that the major difference between iron sulfide modified ZVI powders and off-the-shelf ZVI powders is the increased reactivity of the modified ZVI. Iron sulfide modified ZVI powders have a greater efficacy against chlorinated contaminants using a lower dose versus off-the-shelf ZVI powders. The iron sulfide modified ZVI powders showed a 97% removal in five days at a dose of 2 g/L. The carbonyl iron showed a 59% removal in seven days at a dose of 10 g/L.