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Development of S-nZVI for Field Scale Application

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Nano zerovalent iron (nZVI) is the most commonly applied nanomaterial for water and soil remediation and has been tested for several field-scale applications across the world. Despite advances in the design of nZVI, key technical challenges remain, limiting its more widespread acceptance as a viable and competitive remediation technology. These challenges mainly include poor selectivity and low subsurface mobility. The treatment of nZVI with lower valent forms of sulfur compounds (i.e., sulfidation or S-nZVI) inhibits its reaction with water, leading to improvements in the longevity and selectivity of the particles.

This presentation will discuss and compare field scale injection experiences from multiple field trials where either nZVI or S-nZVI stabilized with carboxyl methyl cellulose (CMC) were injected to remediate chlorinated hydrocarbon impacted sites. Both nZVI and S-nZVI stabilized with CMC are quite mobile in permeable aquifer materials facilitating their emplacement in the contaminated source zone for contaminant degradation. nZVI and S-nZVI led to significant decreases in contaminant mass as well as significant changes in contaminant distribution. Of note is that application of S-nZVI did not lead to the accumulation of vinyl chloride (VC) whereas some VC accumulation was observed following nZVI application. Significant shifts in microbial populations were observed, with dechlorinating bacteria proliferating. This suggests that both biotic and abiotic contaminant transformation is likely. Results from these studies suggest that S-nZVI has the potential to overcome many of the initial challenges limiting nZVI application.