Abstract C-45, in: Bruce M. Sass (Conference Chair), *Remediation of Chlorinated and Recalcitrant Compounds—2006.* Proceedings of the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2006). ISBN 1-57477-157-4, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

A Case Study Evaluating Zero-Valent Iron Injection Treatment Technology

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In fall 2004, Innovative Technical Solutions, Inc. (ITSI), working closely with the Navy, successfully conducted a Zero-Valent Iron (ZVI) Injection treatability study at Hunters Point Shipyard (HPS), San Francisco. The Navy used a phased approach at the site. The suspected source area was first addressed in late 2002/early 2003 using the ZVI injection technology as part of a focused technology demonstration that resulted in >99.9% reduction of trichloroethene (TCE) in the "hottest" monitoring well. The primary objective of the second phase study described herein was to further evaluate and document the effectiveness of ZVI injection technology in reducing chlorinated solvents in groundwater. The site conditions included difficult-to-reach residual chlorinated contamination within a complex geologic lithologic setting. In this study, a baseline TCE concentration of 1,400 µg/L in one well was reduced to 2.7 µg/L two weeks after treatment and 2.5 µg/L TCE 12 weeks after treatment.

The study site is located along a former shoreline of San Francisco Bay, which was extensively modified and enlarged in the 1940's by the placement of heterogeneous artificial fill at the bay margins. The fill and unconsolidated sediments directly overlie shallow Franciscan Formation bedrock, which is extensively fractured and deeply weathered. Groundwater occurs in several discontinuous hydrogeologic zones within the anthropogenic and naturally occurring lithologic units, including the fractured bedrock. Previous industrial activities associated with the use of solvent dip tanks at the site were the source of groundwater contamination. The treatment zone extends beneath two adjacent buildings with numerous identified and unknown underground structures. Information from the site characterization activities and from pre-existing borehole logs contributed to an improved understanding of the spatial relationships between contaminant plumes, artificial fill, and fractured bedrock, allowing for the development of an effective and site-specific treatment strategy.

The treatment process included an integrated application of two proprietary technologies. Pneumatic Fracturing was first conducted in the injection boreholes to enhance the bulk permeability of the treatment zone; this was followed by the application of the Ferox℠ process, a technology which entails the injection of a highly reactive micro-scale ZVI powder, roughly 70 µm in size, using an innovative pneumatic injection technique to effectively disperse the iron powder and water slurry directly into the treatment zone. In the second phase, 72,000 pounds of the ZVI powder was injected into the formation utilizing 13 boreholes. Strongly reducing conditions were created resulting in an overall percent reduction of TCE ranging from 95.7 to 99.9 % at various monitoring wells within the treatment zone. Similar reductions in other chlorinated VOCs further demonstrated the effectiveness of the treatment technology in meeting the objectives of the study. The presentation will summarize the use of ZVI Injection technology at HPS and, particularly,

the effective use of the technology in a phased approach to treat both elevated source area concentrations and, subsequently, more dilute and widespread concentrations across the remaining plume.