A CASE STUDY ON ENHANCED REDUCTIVE DECHLORINATION RESULTING FROM A CHEMICAL OXIDATION PILOT TEST

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ABSTRACT: An in-situ chemical oxidation (chemox) technology application using sodium persulfate ($Na_2S_2O_8$) and potassium permanganate ($KMnO_4$) was pilot tested at an active facility (site) to remediate residual dense non-aqueous phase liquid (DNAPL) and dissolved chlorinated volatile organic compounds [VOCs with trichloroethene (TCE) as the major identified constituent]. During the pilot test, a total of 8,200 kg of $Na_2S_2O_8$ was injected over a period of 64 days followed by 45,000 kg of $KMnO_4$ injected over a period of 172 days in the semi-confined, sand and gravel aquifer at the site. An unanticipated observed benefit of the oxidant injection was enhanced reductive dechlorination of the chlorinated VOCs in and downgradient of the injection area during post-injection monitoring at the site. The interpretation of the post-injection VOC data (including reductive dechlorination daughter product to parent compound ratios) and chloride mass balance calculations provided strong evidence of enhanced reductive dechlorination at the site. Additional data collection and analyses (including hydrogen, sulfate, dissolved iron and phospho-lipid fatty acid sampling results) indicated that sulfate-reducing bacterial activity was the primary mechanism of reductive dechlorination at the site. The observed enhancement of reductive dechlorination after the oxidant injection may be due to one or more of the following mechanisms: 1) oxidant injection providing simpler organic carbon for the bacteria (a food source) by degrading naturally occurring complex organic carbon in the aquifer; 2) oxidant injection making VOCs more bioavailable by breaking down the sorption sites (e.g., naturally occurring complex organic carbon); 3) $Na_2S_2O_8$ injection directly enhancing sulfate-reducing bacterial growth by supplying sulfate (an electron acceptor for the bacterial activity, which is a dissociation product of $Na_2S_2O_8$).

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