

The Persulfate-Peroxide Sandwich and Use of Multiple Activators for Polishing of a Large-Scale ISCO Site

Paul M. Dombrowski, P.E. (paulm.dombrowski@aecom.com) and

Barbara A. Weir, Ph.D., P.E., LSP (AECOM, Wakefield, MA)

Peter Pelletier (AECOM, Chelmsford, MA)

James Brown, P.E. (US Environmental Protection Agency, Region 1, Boston, MA)

Evan Barman, P.E. (Watermark Environmental, Lowell, MA)

Prasad Kakarla, P.E. and William Caldicott (ISOTEC, Lawrenceville, NJ)

ABSTRACT: Drum re-finishing operations contaminated soil and groundwater at the Ottati and Goss Superfund Site in Kingston, NH with volatile organic compounds (VOCs) and 1,4-dioxane. Full-scale in situ chemical oxidation (ISCO) was completed in three areas in Summer 2008, and was the largest single-site injection of sodium persulfate completed at that time with approximately 394,000 pounds injected. Significant reductions in concentrations of VOCs (60-90%) and 1,4-dioxane (50-80%) and plume size were observed following the first round of full-scale ISCO. Follow-up ISCO was performed in 2009 and 2010, with each approximately half the scope of the previous year. For the second ISCO event, catalyzed hydrogen peroxide (CHP) was proposed for a small area in close proximity to a stream, but when only limited volumes of peroxide could be injected due to shallow groundwater table and low soil permeability, the remaining peroxide was applied to an area with the highest observed residual VOC concentrations following injection of base-activated persulfate. With significant reduction in VOC concentrations (90% to 95%) observed where this additional peroxide was injected in 2009, a combined persulfate-peroxide injection plan was implemented in 2010. In areas with the highest residual VOC concentrations, hydrogen peroxide was injected first, followed by base-activated persulfate injected across the entire 2010 treatment area. CHP was then injected for final desorption, additional oxidation, and enhanced persulfate oxidation. The sequential injection of peroxide, persulfate, and peroxide has been designated as the persulfate sandwich.

INTRODUCTION

This paper presents design, implementation, and monitoring results of a combined ISCO approach utilizing catalyzed hydrogen peroxide and activated persulfate including multiple activators for the third full-scale event at the Ottati and Goss Superfund site. When planning the third full-scale ISCO event in 2010, it was assumed that this would be the final ISCO activity performed at the site.

Site History and Description. Drum reconditioning activities were performed at the site from late 1950 to 1980. Operations included caustic rinsing of drums and disposal of the rinse water in a dry well, and two leaching pits (lagoons) were also used for disposal. Investigations revealed that shallow soil throughout the site was contaminated with VOCs, polychlorinated biphenyls (PCBs), metals, and cyanide, and that groundwater was contaminated with chlorinated VOCs including tetrachloroethene (PCE) and trichloroethene