

The Association for Environmental Health and Sciences (AEHS)
18th Annual AEHS Meeting and West Coast Conference of Soils, Sediments, and Water
March 10-13, 2008; Mission Valley Marriott, San Diego, California
in Proceedings: Abstracts and Supplemental Information; Poster Presentation

**Innovative Free Product Removal Advances in
Enhanced Flushing Processes for NAPL Recovery**

James A. Jacobs, Lief Nelson and Jim Begley

Platform Presentation

Two different enhanced flushing processes have been developed within the past two years to rapidly remove gasoline and solvent free product from within an aquifer. A field trial in Ontario, Canada, of Supersaturated Water Injection (SWI) technology used carbon dioxide saturated water injection for controlled mobilization of VOCs to the water table for collection with SVE or dual phase extraction where NAPL is present. In the SWI process, water is supersaturated with CO₂ in the gPRO_{HP}. Mass transfer system The saturated water was injected into an aquifer test cell where a 200 liter hydrocarbon mixture had been placed forming a residual NAPL zone. CO₂ bubbles nucleated at the targeted area of the aquifer. The rising CO₂ bubbles contact VOC contaminated water, adsorbed VOCs and trapped NAPL causing volatilization of the VOCs into the vapor phase and mobilization of NAPL to the water table for extraction and collection.

Extraction and reinjection wells were used to recirculate CO₂ saturated water.. The CO₂ is distributed by flowing water resulting in effective gas distribution followed by heterogeneous bubble nucleation and continuous growth of gas bubbles in situ. A gas saturation front developed which expanded laterally and vertically towards the water table. VOCs mobilized to soil gas were extracted with a SVE system. Results indicated a significant proportion of VOCs were removed by SVE.

The second case study used a two-step flushing process which included high-pressure air injection and biosolvent injection to thin and mobilize used hydraulic

oil trapped below the saturated zone at a former tank pit at a northern California facility. The high-pressure air injection and biosolvents was used with high-vacuum extraction to recover both the NAPL and the biosolvent. The final stage was to separate the heavy oil from the unspent biosolvent and groundwater. Site closure is imminent.

James Jacobs

Environmental Bio-Systems, Inc., 707 View Point Road, Mill Valley, CA 94491 USA, Tel: 415-381-5195; jimjacobs@ebsinfo.com ; www.ebsinfo.com

Leif Nelson, Worley Parsons Komex; Suite 100, 4500 16th Ave. NW, Calgary, Alberta, T3B0M6 Canada, Tel: 403-247-0200; leif.nelson@worleyparsons.com

Jim Begley, inVentures Technologies of Canada, www.isocinfo.com; Tel: 647-477-2394; jim.begley@inVentures.ca

gPRO_{HP} System developed by inVentures Technologies, Inc.

Presenting Author: James Jacobs