

Sustainable Surfactant Enhanced Aquifer Remediation (SEAR) Combined With Multi-Phase Extraction (MPE) of Coal Tar LNAPL and DNAPL Impacted Brownfield Site

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Background and Objective

The former Bacchus Marsh gasworks (Ca. 1889 to 1973) is located within a wide alluvial plain of the Werribee River, Victoria, Australia. Shallow groundwater on the alluvial plain occurs in an upper alluvial aquifer and is highly utilized for irrigation and rationed through the auctioning of water shares. The presence of coal tar NAPL (and associated dissolved phase groundwater impacts) emanating from former gasholders and tar and liquor disposal wells into the upper alluvial aquifer impinges further on upper alluvial aquifer utilization. This presentation focusses on remediation of two coal tar NAPL plumes that was conducted in-situ attempting to meet Victorian EPA and client sustainability goals.

Methodology

After extensive review of possible sustainable remediation options, surfactant enhanced aquifer remediation (SEAR) was selected to address the coal tar NAPL in the aquifer at the site. The surfactant selected was a non-ionic surfactant engineered to dissolve long-chain petroleum hydrocarbons. The surfactant was used in a variety of push-pull and recirculation methods to enhance coal tar recovery. The majority of coal tar NAPL was slightly denser than water (1.03 SG), had low viscosity at 15 degrees Celsius and rested within the poorly sorted clayey, sandy gravel lenses of the upper alluvial aquifer. After initial push-pull applications of SEAR, recirculation was established between the injection well, and an average of three (3) extraction wells. Approximately seven (7) different injection wells were utilized in each of the two (2) coal tar NAPL plumes.

Results

The mobilized NAPL and micro-emulsified hydrocarbons were removed using multiphase extraction (MPE) technologies. Wastewater was treated on-site and reinjected under permit from the regulatory agency to the extent that was practicable. Re-injection of the water was conducted in a manner to optimize the surfactant plume behavior while it was being extracted.

SEAR remedial efforts are ongoing and have resulted in the extraction of coal tar LNAPL and DNAPL, while extracting dissolved contaminants (benzene, naphthalene, ammonia, cyanide) on to activated carbon and resin filters. Most extracted groundwater was returned to maintain/restore aquifer capacity, thereby meeting the EPA's and the client's sustainability goals.

Conclusion

SEAR is a viable method of groundwater remediation to reduce recalcitrant hydrocarbon mass and decrease overall plume lifespan in unconsolidated aquifers.

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George (Bud) Ivey is the President and Senior Remediation Specialist with Ivey International Inc. of Vancouver, Canada. He has over twenty-five years of environmental remediation experience, and has worked on more than 2500 environmental projects, taking him to over 50 countries globally. His multi-disciplinary education includes: Synthetic Organic Chemistry, Geological Engineering, and a Master's Certification in Project Management. Noticeable accomplishments include:

- Holding several International Patents;
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- Completed an IRONMAN

When he's not busy remediating contaminated sites, he enjoys trail running, hiking, kayaking, and cooking as he enjoys pairing of good wine and food in the company of friends!