

## **A Combination of Biostimulation and Bioaugmentation through Horizontal Well**

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Enhanced anaerobic bioremediation (EAB) technology, which involves addition of nutrients and electron acceptors (biostimulation) and/or microorganisms (bioaugmentation), has emerged as a cost-effective remediation strategy for petroleum hydrocarbon (PHC) impacted sites. However, low removal efficiency of recalcitrant PHC chemicals like benzene has often been observed during the biostimulation practice. A study conducted as part of the Sustainable Insitu Remediation Co-operative Alliance (SIRCA) will be carried out to further optimize EAB process via a combination of biostimulation and bioaugmentation with PHC-degrading microorganisms using a developed amendment solution through the available well network.

A study site where a horizontal well and several vertical monitoring wells were installed, will be divided into three areas: control (without amendment and microorganisms injected), biostimulation (with only amendments injected), and a combination of biostimulation and bioaugmentation (with both amendments and microorganisms injected). The amendment solution will be injected through the horizontal well. The amendment solution and the inoculated PHC degraders entrapped in chitosan will be injected through select vertical monitoring wells.

The amendments and the microbial consortium will be uniformly delivered to a larger area through gravity injection of the available well network. The introduced PHC degraders will grow inside the chitosan, allowing for acclimatization and survival in the new environment when released from the chitosan decomposition, provided there are sufficient nutrients supplied by the biostimulation. The growth of the PHC degraders is expected to result in increased removal of the recalcitrant PHCs compared to the control and biostimulation areas.