Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

A New Microcosm Design for Treatability Assessment in Cold Region Petroleum Hydrocarbon-Impacted Clayey Sites

Aimée Schryer (ads147@mail.usask.ca), Lisa Moehlman and Steven D. Siciliano (University of Saskatchewan, Saskatoon, SK, Canada)
Trevor Carlson (Federated Cooperatives Ltd., Saskatoon, SK, CA)

Background/Objectives. Numerous studies utilize soil microcosms to investigate new methods and techniques that improve in-situ remediation of petroleum hydrocarbon (PHC) impacted sites. However, many microcosm designs that have reported significant findings in the laboratory often produce different results on site, meaning there is a poor extrapolation from controlled studies to real world settings. A frequently used step in microcosm creation is to mix, sieve, and re-spike the soil prior to starting the experiments. This alters soil characteristics such as surface area, structure, fractured flow, and the active microbial communities present as well as changing the soil's adsorption and desorption properties. We created a microcosm design that better suits the treatability assessment of cold region clayey soils. The soil was kept intact within the microcosm to better represent the soils' structure, PHC movement and microbial populations. The studies were completed by collecting a duplicate borehole core during Phase II assessment. The cores were sub-sampled into slotted PVC pipes (2 x 1.25 (OD) inch, 1/16 inch slots) and placed inside 125 ml amber jars containing bio-stimulatory solution. Due to the heterogeneous nature of PHC contaminants in clayey soils, BTEX/F1 concentrations varied greatly within a small area. We demonstrated that a linear relationship exists between the concentration of BTEX/F1 present in PHC contaminated soil and bio-stimulatory solution due to the chemical distribution between the soil and water phase. The objective of this experiment was to improve current microcosm designs to better convey the conditions of a cold region PHC contaminated site for laboratory experiments as part of the Sustainable In-Situ Remediation Cooperative Alliance (SIRCA).

Approach/Activities. Contaminated soil was obtained from three bulk sites, including gasoline and bulk transfer stations, in Saskatchewan, Canada. Each site has different cold clay properties and varying PHC contaminants concentration. The microcosms were constructed anaerobically and stored in a 10ºC fridge without light to mimic environmental soil conditions. Water samples were taken weekly for BTEX/F1 concentrations before destructively sampling the microcosms on week four to determine the final BTEX/F1 concentrations in the soil. Using Deming regression, a linear curve was formed linking the concentration of BTEX/F1 in water to the concentration of BTEX/F1 in soil. To ensure that the loss of hydrocarbons was based solely on the microbial consumption in the soil, two quality control experiments were conducted. The first quality control experiment was UV-filtered tap water while the second experiment exposed contaminated soil to gamma radiation. From these quality control experiments, the concentration of BTEX/F1 will remain constant during the four-week period, confirming microbial activity.

Results/Lessons Learned. Sample collection has occurred and experiments are now being conducted. Preliminary experiments using the microcosm design has shown that one can use water concentrations to estimate changes in soil concentrations.