Passive Hydrocarbon Remediation in a Foreshore Marine Environment

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Background/Objectives. Non-aqueous phase liquid (NAPL) seeps were observed along the southern foreshore of Burrard Inlet, down slope of the Chevron Burnaby Refinery, British Columbia, Canada in April 2010. Chevron responded immediately with soaker pads and booms to mitigate the effects of the NAPL seeps. In the spring of 2011, 10 and 30 meter long Interim Remedial Action (IRA) Barriers were constructed. The IRA Barriers consisted of sand and organoclay trenches and CETCO® Reactive Core Material (RCM) mats along the high tide line. The trench was extended in 2012 because NAPL was seen down slope of the IRA Barriers. The objectives of this work were to assess the performance of these barriers and to assess new technologies for the design of a comprehensive multicomponent foreshore final remedy.

Approach/Activities. The performance of the IRA Barriers and the assessment of the mobility and petroleum flux onto the foreshore were completed through traditional soil and porewater field sampling and laboratory analysis and through porewater extraction testing. Two-dimensional gas chromatography with mass spectrometry (GCxGC-MS) analysis was utilized to better identify the petroleum hydrocarbons and the polar metabolites present, and microbial DNA/RNA analysis was completed to probe for the presence and activity of petroleum hydrocarbons degrading organisms. As part of final remedy design, treatability studies were performed on Aquagate+Powdered Activated Carbon® (AG+PAC) with light extractable petroleum hydrocarbons (LEPH) from up gradient refinery groundwater to determine AG+PAC loading capacity.

Results/Lessons Learned. The IRA successfully mitigated NAPL impacts to the foreshore for six years and will be replaced by a multicomponent final remedy in 2017. The permeability of the sand and organoclay mixture decreased over time and necessitated a different flow design for the final remedy. LEPH was determined to be the controlling aqueous contaminant which required inclusion of activated carbon as an adsorbent. To better control sheens, an oleophilic biobarrier (OBB) was added to the final remedy. Delivery piping was placed for the addition of amendments to stimulate microbial degradation of petroleum hydrocarbons. The combination of the organoclay, activated carbon and OBB provides a robust multilayer approach to limiting exposure of surface water to contaminants. The materials were structured to address the daily tidal changes in water level and long term impacts of coastal erosion. This multicomponent remediation approach is unique in its design and applicability in a marine foreshore environment.