Surprising Efficacy of "Sipping" Heavy DNAPL without Disturbing Formations, Using Low-Flow, Above-Grade Piston Pumps

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Background/Objectives. Remediation pumping of DNAPL product that is prone to subsurface migration -- such as coal tar, creosote, No. 6 fuel oil and other heavy hydrocarbons -- typically extracts a magnitude percentage of effluent compared with the small amount of contaminant product actually recovered. Transporting and treating the contaminated liquid is difficult and expensive, often with little to show for the work. Particularly in closely monitored sites, the common reaction to unmet cleanup timelines is to boost pump flows, which can roil formations – further reducing product-to-effluent ratios and increasing transport/treatment costs. The objective is to pull up more DNAPL with less effluent, reducing plumes reliably and safely, at lower costs.

Approaches/Activities. Several remediation sites have opted for a solution that appears counter-intuitive. They pump less fluid, not more, targeting the sinking product at its lower depths with lightweight, low-flow piston pumps that "sip" the DNAPL with little disturbance to the effluent above. Essentially miniature versions of oilfield pump jacks, the low-profile, low-maintenance, virtually non-polluting piston pumps are built with drive mechanicals and power cleanly and safely above the wellhead. This presentation will demonstrate piston-pumping results from three representative case studies: 1) Removing coal tar that has migrated from a century-old power plant to an underground pool beneath a Midwestern U.S. municipal park, 2) pumping subsurface tar from an Australian steel-plant works, and 3) remediating a Lake Superior mixed-source U.S. Superfund site.

Results/Lessons Learned. At the municipal park, coal tar has been collecting in a bedrock depression 50 feet below the surface. The weight of the underground tar pond has been forcing tar into smaller bedrock fissures. As a test, two piston pumps began sipping a cup of tar each twice an hour, 6 gallons a day. Because of the tar's high viscosity, shallow groundwater contaminated by lighter oil also collected in the underground pool above the tar. The site's ongoing recovery goal is to remove tar and oil but not groundwater. The tactical challenge addressed by the test was to bring up the product without roiling the formation. The successful multi-month test, monitored by transducers, demonstrated the viability of piston pumps to handle difficult product. Data will support. In Australia, engineers in 2015 discovered tar in an environmental-monitoring bore. As part of the investigation and plan for remediation, the company put in a 2-foot diameter, 12-foot-deep well, topped with a low-flow piston pump. Engineers linked the discharge hose to a skip bin (dumpster). When filled, the bin is emptied by a vacuum truck and the tar is recycled. In 2016, the pump began continuous operations. Roughly 10,000 liters (2,600+ gallons) were extracted in the four months. A 30-second video will show pump discharge viscosity and flow The Lake Superior Superfund site study demonstrates the significant increase in free-product recovery when electric piston pumps replaced common airlift pumps, even as total effluent rates remained steady. Contaminants at the Ashland, Wis., site found in sediment, groundwater, soil and a buried ravine include tar, oil and other waste consisting of PAHs, VOCs and metals.

During 78 weeks, 1,550 gallons of free product were recovered, 2.85 gal/day. Previous reported daily average and daily maximum rates ranged between 1.0 and 2.0 gal/day. Effluent totaled 392,800 gallons, a 5,035 gal/wk discharge rate, comparable with earlier reported averages. Cumulative summary tables will be presented.