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)

An Adaptive, Green and Sustainable Outlook on Bioventing-Based Remediation

Davinder Singh Randhawa (davinder.randhawa@arcadis.com) (Arcadis US Inc., Columbus, OH, USA)
Cullen Flanders and Kevin Jay (Arcadis US Inc., Wexford, PA, USA)
Jeff Burdick (Arcadis US Inc., Newtown, PA, USA)

Background/Objectives. Soil vapor extraction (SVE) and bioventing (BV) have occasionally been used interchangeably among practitioners, even though they are completely different techniques. SVE is fundamentally designed to maximize the volatilization and removal of low molecular-weight compounds, with some biodegradation occurring. In contrast, bioventing is focused on biodegradation of aerobically biodegradable compounds, regardless of their molecular weight and is primarily designed to limit volatilization. Compared to SVE, the capital and operational costs for BV can be lower by an order of magnitude. BV is a much more cost effective, green and sustainable approach compared to SVE and significantly reduces the carbon footprint of a traditional remediation approach. As an additional dimension to the applicability of BV, temporary BV systems have also been used to reduce the tonnage of potential soil excavation at several sites in the Midwest.

Approach/Activities. While all potential SVE applications cannot be replaced by BV, there are quite a number of instances where BV becomes a more appealing approach for a site where traditionally SVE would have been selected. Additionally, costs of converting an existing SVE system into a low-energy BV system could significantly outweigh the operational costs of an SVE system over multiple years of remediation. This is a shift that many stakeholders are capitalizing on with fair amount of success, resulting in site closures in an effective, green and sustainable way.

Results/Lessons Learned. Data from four former retail service stations located in the Midwestern U.S will be presented to describe various BV approaches tailored to site specific conditions and closure objectives. At one site chemicals of concern were benzene, toluene, ethylbenzene, xylene (BTEX), gasoline range organics (GRO; C6-C12), 1,2,4-trimethylybenzene, 1,3,5-trimethybenzene and benzo(a)pyrene. GRO values as high as 14000 mg/kg were reported in the source area. After three years of SVE operation and vigilant data evaluation, the system was modified into a low energy air-injection bioventing system. A year later, at site closure, compared to SVE, BV reduced project electrical costs by an order of magnitude, operation/maintenance costs by one-third and recorded almost a hundred percent system runtime. From greenhouse gas reduction perspective, bioventing reduced CO_2 equivalents by 72 metric tons per year. Other sites to be presented in this paper involve three times reduction in excavation costs due to temporary BV, replacement of mobile high vacuum extraction events with BV installation, thus, limiting waste generation and hauling. The paper will also present site screening, respirometry, design and operational details.