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)

Application of LCA to Compare Sustainability of Novel Evaporative Desorption Technology for Soil Remediation to Conventional Dig and Haul

Joe Muzzio, P.G., C.E.G. (jmuzzio@reterro.com) (Reterro, Livermore, CA, USA)
Julie Sinistore, Ph.D. (julie.sinistore@wspgroup.com) (WSP Parsons Brinckerhoff, San Francisco, CA, USA)
Glenn Burks, Ph.D., P.E. (glennb@groupdelta.com) (Group Delta, Irvine, CA, USA)

Background/Objectives. The publication of the ASTM International Inc. Standard Guide for Greener Cleanup (E2893-13) in 2013 set the stage for implementing remediation technologies with lower environmental impacts and evaluating those impacts with a Life Cycle Assessment (LCA). Using project data for a 100,000 ton VOC-impacted soil remediation project located in Fullerton, California, environmental impacts for on-site ex-situ evaporative desorption and dig and haul soil remediation alternatives were calculated using a screening-level LCA. Global warming potential (GWP), primary non-renewable energy demand (PNRED) and particulate matter (PM) were calculated for both remedial alternatives and compared. Four on-site ex situ evaporative desorption scenarios with varying duration and electricity source (i.e., 5 and 14 month durations/diesel generator and electricity grid) were compared to the one dig and haul alternative.

Approach/Activities. A screening-level LCA using a streamlined approach was completed with a cradle-to-grave system boundary. The study considered four scenarios for the evaporative desorption technology that varied by project duration and power source to create four distinct scenarios. The durations considered were: 1) full project duration (14 months); and 2) steady state duration (5 months). The power sources were: 1) grid power; 2) diesel power generation. Inputs for the evaporative desorption scenarios took into account the type of electricity used to power the evaporative desorption equipment, diesel used to power generators and equipment, municipal water, production of activated carbon, transport of spent carbon and treatment of activated carbon. Included in the dig and haul assessment were diesel used by on-site equipment (e.g., excavators, loaders and compactors), as well as trucks used for transportation of clean and contaminated soil, and municipal water.

Results/Lessons Learned. All four evaporative desorption scenarios were found to have lower and environmental impacts than the dig and haul scenario by at least one order of magnitude. The GWP (in kg CO_2 equivalents/ton of soil) ranged from 6 to 35 in comparison to the dig and haul scenario where the GWP was calculated to be 644. The PNRED (in MJ/ton of soil) for the four evaporative desorption scenarios ranged from 80 to 510 in comparison to the dig and haul value of 3,339. Lastly, particulate matter emissions, expressed as particulate matter (PM) with diameter of 2.5 microns, ranged from 0 to 0.01 kg PM 2.5/ton of soil for the evaporative desorption scenarios, while the dig and haul alternative was found to emit 0.37 kg PM2.5/ton of soil. For the dig and haul case, the driver of environmental impacts was the transport of the soil to a disposal facility. The drivers for the four evaporative desorption scenarios were either the electricity consumption when grid power was used or the diesel generators when on-site power generation was used. These preliminary results demonstrate that the use of an on-site remedial technology, despite the significant on-site energy demand, provides significantly lower environmental impacts compared to dig and haul. This is due to the avoided use of trucks with low fuel-efficiency and high tailpipe emissions to haul the soil to a disposal facility. The results also demonstrate that more careful consideration needs to be given to the use of on-site soil

remediation technologies as a means of reducing environmental impact during remediation and, in the project considered in this investigation, reducing costs to make it a win-win result.