Field-Scale Treatability Study to Evaluate In Situ Soil Mixing of EVO and ZVI to Reduce Nitroaromatics in Saturated and Vadose Zones

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Background/Objectives. The former West Virginia Ordnance Works, now the McClintic Wildlife Management Area (MWMA) near Point Pleasant, West Virginia, was used by the US Army to manufacture 2,4,6-trinitrotoluene (TNT) during the early 1940s. Residual nitroaromatic contamination is still present in some areas of the site which is listed on the National Priorities List (NPL). A wastewater handling system, consisting of a pumping station, two small tanks, and two large earthen constructed wet wells, was used to handle red and yellow wastewaters during TNT manufacture. A Record of Decision was approved in 1988 to address contamination in these areas. The remedy included groundwater extraction and treatment until cleanup criteria were met. A groundwater treatment system was constructed and operation began in 1997. After six months of operation, the system was shut down due to discharge violations. The system was restarted in late 2000 and continued to operate nearly continuously until August 2017. Excavation and treatment of approximately 1,000 cubic yards of contaminated soil was completed in 2004 and new extraction wells were installed in a more highly contaminated area in 2005. New extraction wells were achieving capture; however, contamination levels remained essentially constant. A treatability study using in situ enhanced bioremediation was conducted 2008-2010 which was effective in reducing concentrations of nitroaromatics; however, concentrations rebounded once the carbon source was exhausted, indicating a contaminant source may still be present. A study conducted January 2014 to June 2016 further characterized soil and groundwater which identified contaminant sources in the saturated and vadose zones. A treatability study is being conducted to evaluate the effectiveness of emulsified vegetable oil (EVO) and zero valent iron (ZVI) to degrade nitroaromatics and the effectiveness of soil blending to distribute the amendments in these zones. Another objective is to determine the cost benefit of adding ZVI with the EVO to accelerate degradation of the source material.

Approach/Activities. Two areas of contamination were selected for a field-scale treatability study. One area (50 ft X 100 ft) is being treated with both EVO and ZVI to a depth of 13 ft except for the eastern 20 ft which is treated to a depth of 28 ft. The second area (50 ft X 75 ft) is being treated with only EVO to a depth of 15 ft. Depth to groundwater is approximately 4 ft. Field activities include abandonment of extraction and monitoring wells, installation of new monitoring wells, baseline sampling, soil mixing to distribute amendments into the saturated and vadose zones, surface stabilization, and performance sampling. After mixing and surface stabilization, an additional monitoring well will be installed within each mixing area and soil samples will be collected via direct push to determine how effectively the amendments were distributed within the mixing area. Soil mixing will be completed by October 2017 and the first two performance sampling events will be completed by the time of the conference.

Results/Lessons Learned. This paper will present the methods and techniques used to complete the treatability study. Results of baseline and performance sampling results to date will also be presented. Any lessons learned associated with execution of soil blending activities will be discussed, including site conditions, equipment used, amendment deployment methods, mixing techniques and surface stabilization.