Treatment of Polycyclic Aromatic Hydrocarbons in Groundwater from a Former MGP Site to the Parts per Trillion Level for Discharge into Lake Superior

Brian Bell, P.E. (Envirocon, Missoula, MT, USA)
Richard Onderko, P.E (richard.onderko@foth.com) and ***Matthew Schowengerdt, P.E.*** (matt.schowengerdt@foth.com) (Foth Infrastructure & Environment, LLC, Milwaukee, WI, USA)
Brian Symons, P.E. and Brian Hanks, P.E. (Foth Infrastructure & Environment, LLC, Kansas City, KS, USA)

Background/Objectives. Manufactured gas plants (MGP) were common in the production of fuels in the late nineteenth and early twentieth centuries. One such MGP legacy site, located on the southern shore of Lake Superior, required remediation of the sediments, soils, and groundwater. There were multiple liquid phases in groundwater which include a distinct dense non-aqueous phase liquid (DNAPL), an emulsified phase, and groundwater impacted by dissolved organic compounds. The primary contaminants of concern were polycyclic aromatic hydrocarbons (PAHs, 60,000 micrograms per liter [µg/L]), benzene, ethylbenzene, toluene, and xylenes (BTEX, 10,000 µg/L). The metric that defined treatment success, as dictated by the Wisconsin Pollution Discharge Eliminating System, was discharge into Lake Superior with a concentration of BTEX of <750 µg/L and a composite concentration of 10 PAHs of less than 0.10 µg/L (99.999% removal). The treatment facility is surrounded by a central business district, a residential area, and a popular public park.

Approach/Activities. In spring 2016, construction was completed on a 100 gallon per minute (gpm) ex-situ treatment plant and associated well field collection system. The well field collection system incorporated two pumping approaches, one using multi-staged submersible centrifugal pumps for the control of dissolved contaminants in groundwater and the other using submersible positive displacement piston pumps to collect DNAPL. The treatment process included initial DNAPL separation which consisted of equalization, pH adjustment, coagulant, and polymer addition, and dissolved air flotation (DAF). Following separation, treatment included sand filtration, bag filtration, organoclay media filtration, granular activated carbon filtration, pH adjustment, and final bag filtration. The fate of the PAHs was in the separated oil and solids recovered from the DAF unit. The oil and solids were concentrated, filter pressed, and, disposed of at a landfill. The system was designed to incorporate a remote backwash system for efficient employment of manpower. During unmanned operation, a number of shutdown alarms and a turbidity monitoring system ensured that the process was operating properly and could be monitored near real time remotely by the operator.

Results/Lessons Learned. This paper will discuss the successful startup, initial operation, and optimization of the treatment plant. Of particular interest is the process of determining the steps to maximize DNAPL removal while minimizing odors outside of the plant, minimizing exposure of the treatment plant workers to volatile organic compounds (VOC), and minimizing the recycling of DNAPL from filter press effluent to the equalization tank that receives plant influent. On-site operator jar testing to dial in the chemical dosing will also be discussed. The only discharge point is directly to Lake Superior, and as such, the system is a closed loop system that presented its own interesting challenges, especially during upset conditions.