# Field Applications of Anaerobic BTX Bioaugmentation Cultures

***Jeff Roberts*** (jroberts@siremlab.com), Sandra Dworatzek, and Jennifer Webb (SiREM, Guelph, ON)
Elizabeth Edwards, Nancy Bawa, Shen Guo, and Courtney Toth (University of Toronto, Toronto, ON)

**Background/Objectives.** Anaerobic bioaugmentation cultures for benzene, toluene, ethylbenzene and xylene (BTEX) have been identified, investigated, and demonstrated to completely degrade BTX into carbon dioxide and methane. This occurs in the absence of molecular oxygen and is what makes these cultures unique and useful for anoxic field applications where alternative (aerobic) remediation approaches would be impracticable or impossible to implement. The cultures, collectively referred to as DGG-PlusTM include a methanogenic benzene enrichment culture (DGG-BTM), toluene degrading culture (DGG-TTM) and a o-xylene degrading culture (DGG-XTM) originally developed at the University of Toronto. The microorganisms responsible for benzene, toluene and o-xylene (BTX) transformation have been identified and bioaugmentation cultures have been laboratory and field tested. In Canada, these cultures, now have been assessed through Environment Canada's New Substance Notification (NSN) program and can be used at sites across the country and globally.

**Approach/Activities.** Results from laboratory treatability studies demonstrated enhanced benzene, toluene and o-xylene biodegradation rates with DGG-PlusTM bioaugmentation and provided information to aid in field pilot-test design. One field pilot-test performed in November 2019 at a site in Saskatchewan included three injection points, two of which received up to 10 liters of the DGG-BTM culture. Four additional bioaugmentation points were added to the site in September 2021. Benzene degradation rates were accelerated in situ through bioaugmentation as observed in corresponding treatability studies. Additional field applications (in Ontario and the US) where bioaugmentation with the DGG-Plus culture occurred are also being monitored.

**Results/Lessons Learned.** These first-to-field projects will establish a better understanding of dosing requirements, timeframes for obtaining results and ranges of conditions over which the cultures are effective. As with chlorinated solvents, bioaugmentation for BTEX compounds has the potential to decrease remediation time frames and increase the range of sites to which bioremediation is applicable providing a much-needed, cost-effective alternative for BTEX remediation in groundwater.

This presentation will summarize data from regulatory approvals and highlight several field applications (both pilot and full-scale) where these anaerobic cultures were used.