Anaerobic Degradation of Sulfolane Using Passive Anode-Cathode Technology

Aimée Schryer (ads147@mail.usask.ca) and Steven D. Siciliano
(University of Saskatchewan, Saskatoon, SK, Canada)
Trevor Carlson (Geosyntec Consultants Inc., Saskatoon SK, Canada)
Terry Obal (Maxxam Analytics, Missisauga, ON, Canada)
Scott R. Burge (Burge Environmental Inc., Tempe, AZ, USA)

Background/Objectives. Sulfolane [2,3,4,5-tetrahydrothiophene-1,1-dioxide] is a highly stable, colorless and polar compound (CCME, 2006). Due to its chemical and physical properties, it has been used extensively in industrial settings. The identification of sulfolane impacted groundwater at historical and operating industrial sites associated with sulfolane has become increasingly common. Biodegradation of sulfolane is favored within aerobic environments; however, it is recalcitrant under anaerobic conditions. Passive anode-cathode technology (PACT) is being evaluated as a potential tool in the anaerobic biodegradation of sulfolane. The PACT system uses electrodes to assess electron deposition on the cathode, which in turn measures microbial activity in the solution. We hypothesized that PACT could monitor microbial activity linked to sulfolane degradation and/or stimulate sulfolane degradation under anaerobic conditions. Recent data associated with other experiments our laboratory demonstrated that PACT can stimulate anaerobic benzene degradation.

Approach/Activities. A total of 20 microcosms (250 mL amber jars) under nitrate reducing conditions were created. These systems were inoculated with an anaerobic consortium known as the Ulrich culture. We will compare results between treatments, where (i) PACT technology is used in the presence of microbes (ii) PACT technology in the absence of microbial communities (iii) no PACT technology in the presence of microbes and (iv) no PACT technology in the absence of microbial populations. Initial sulfolane concentrations were taken prior to incubation at room temperature within a N_2 environment glove box. Every week, PACT results are evaluated to determine: (i) redox and (ii) potential microbial activity. Potential microbial activity is assessed by determining the rate at which microbial populations deposit electrons on the anode surface. At select times, microcosms will be sampled for sulfolane. All sulfolane analysis will be completed by Maxxam Analytics.

Results/Lessons Learned. Inoculated microcosms demonstrated a decreasing redox potential over the initial four week period. Furthermore, the voltage gain, i.e. the potential microbial activity, has also consistently increased in the inoculated microcosms. We are currently awaiting sulfolane analysis to confirm that these changes in electrical activity are linked to sulfolane degradation.