Can Microbes Reduce Thermal Remediation Timeframes and Implementation Costs? A Retrospective Look at Thermal Sites

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Background/Objectives. In situ thermal remediation (ISTR) is a proven approach for rapid and successful cleanup of NAPL source zones and/or hard to access contamination (i.e., elevated concentrations in thick clay units or fractured bedrock). This is an effective remedy with measurable results within months of application and little to no rebound. The primary drawback to ISTR is the high initial upfront cost, both with infrastructure and in operational energy. Monthly operation and maintenance costs can run in the hundreds of thousands of dollars for equipment rental and energy (i.e., electricity and/or natural gas). This talk examines the role of microbes in potentially reducing the overall operational timeframe associated with ISTR to reduce lifecycle costs while also meeting treatment objectives.

Approach/Activities. Traditional application of heat during a thermal project typically targets temperatures at or above the boiling point of water (100°C). Research into optimal temperatures to stimulate microbial growth indicates there may be no significant additional benefit to microbial growth/stimulation once temperatures reach above 30°C to 40°C, and potential detrimental impact to targeted mesophilic organisms (i.e., die-off) above 60°C. While several strategies can be deployed with the primary intent of optimizing bioremediation processes through temperature adjustment, the focus of this paper is to evaluate the impact of traditional heating and its effect on microbial activity in and around the targeted treatment zone(s) following active heating. Microbial, geochemical, biodegradation daughter products and compound specific isotope analysis (CSIA) data were collected from several thermal projects pre- and post-treatment to evaluate the impacts of heat on biodegradation activities.

Results/Lessons Learned. Data from case studies will be presented to show multiple lines of evidence that indicate enhanced degradation processes stemming from heat may play a potentially significant role in polishing residual dissolved phase mass following thermal treatment, potentially allowing for a shorter runtime for ISTR systems . Lines of evidence include bench testing, microbial testing results, geochemical data, CSIA data, and volatile organic compound trend analyses. Data suggest both biological and abiotic processes are active at thermal projects and are therefore mechanisms that are participating in reduction of residual mass, thereby contributing to the rapid transition to monitored natural attenuation (MNA) and site closure observed at these sites. This can have broader ramifications as incorporating an enhanced degradation polish using residual heat may also allow for shorter heating timeframes or smaller targeted treatment areas, which can lead to a cost savings and more sustainable approach to thermal treatment design.