

QuantArray®-Petro

Effectiveness of Oxygen Addition at a Former Gas Station



PROJECT SUMMARY



- An oxygen releasing product was injected to enhance BTEX and MTBE biodegradation at a former gas station.
- QuantArray®-Petro results demonstrated substantial increases in concentrations of toluene/benzene dioxygenase (TOD) and monooxygenase (RDEG, PHE) genes after oxygen addition. MTBE-degrading strain PM1 also increased after injection.
- Moreover, additional aerobic BTEX biodegradation pathways (RMO, TOL, EDO) not detected during baseline samples were detected after injection.
- Using the Microbial Insights Database, concentrations of aerobic BTEX degraders were high (~90th percentile) after oxygen addition.

PROJECT CHALLENGE



Groundwater at a former gasoline service station was impacted by leaking underground storage tanks and associated piping. While trend analysis suggested that BTEX and MTBE concentrations were stable to decreasing, enhanced bioremediation with injection of an oxygen releasing material was selected as the corrective action plan to enhance biodegradation and decrease time to closure.

SAMPLING AND MBT ANALYSIS



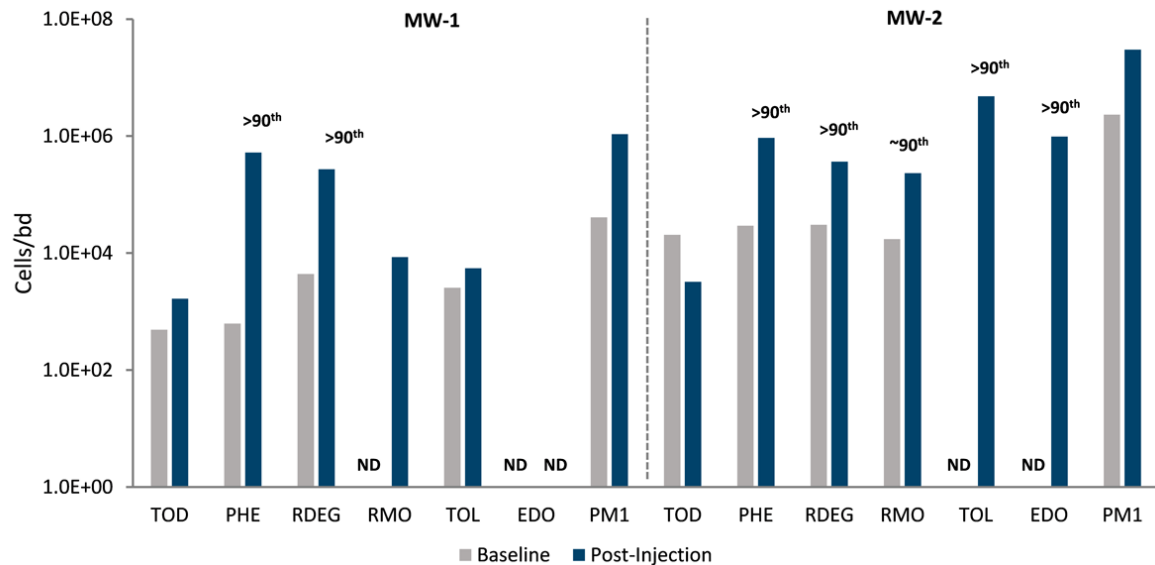
To evaluate the effectiveness of the injection of oxygen releasing product, QuantArray-Petro analysis was performed on Bio-Trap® samplers deployed in select monitoring wells within the treatment area prior to injection (baseline) and periodically after injection (performance monitoring):

- Was oxygen addition effective?
- Did concentrations of aerobic BTEX and MTBE degraders increase after oxygen addition?
- High concentrations of BTEX degraders concentrations after injection?

PERFORMANCE EVALUATION RESULTS



QuantArray-Petro results are shown below for baseline (gray bars) and post-injection (blue bars) sampling events for monitoring wells MW-1 and MW-2.



A variety of functional genes responsible for aerobic BTEX biodegradation were detected at relatively low to moderate concentrations during the baseline event. Following oxygen addition, concentrations of these functional genes increased substantially at both monitoring wells demonstrating growth of aerobic BTEX degraders in response to the treatment strategy.

- More specifically, concentrations of ring hydroxylating toluene monooxygenase (RDEG, RMO) and phenol hydroxylase (PHE) genes increased by approximately two to three orders of magnitude at MW-1 following injection.
- Likewise, PHE, RDEG, and RMO concentrations increased by more than an order of magnitude at MW-2 demonstrating growth of aerobic BTEX degraders. In fact, PHE and RDEG concentrations at both monitoring wells after the injection were very high, ranking greater than the 90th percentile in the Microbial Insights Database.
- Furthermore, concentrations of other aromatic oxygenase genes which were below laboratory detection limits prior to injection increased dramatically following injection (MW-2; TOL, EDO).

Decision: Success. Concentrations of aerobic BTEX degraders and MTBE degrading strain PM1 increased substantially in response to injection of the oxygen releasing product. Site managers will continue to monitor remedy performance.

KEY BENEFITS



QuantArray-Petro was a critical line of evidence that directly impacted site management decisions.

- **Conclusive:** Demonstrated substantial increases in aerobic BTEX and MTBE degraders in response to oxygen addition.
- **Actionable:** Confident in remedy performance, site managers continued monitoring.
- **Comprehensive & Cost-Effective:** In a single analysis, QuantArray-Petro quantifies a broad spectrum of functional genes responsible for aerobic and anaerobic biodegradation of the mixture of BTEX, PAHs and other contaminants of concern present at petroleum hydrocarbon sites.

LAB LOCATIONS



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