Retention Pond to Contain/Treat Perchlorate in Surface Water

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The anaerobic reduction of perchlorate via stimulated indigenous bacteria is becoming a widely accepted treatment for the bioremediation of perchlorate in groundwater but similar treatments for surface waters are not well documented. A full-scale, integrated containment/treatment bioremediation system was designed and constructed in August 2003 as an interim measure to treat perchlorate-impacted stormwater and groundwater prior to migration away from a known perchlorate source area within an industrial Facility. An infiltration trench, installed 50 feet upgradient of the primary source area, together with shallow collection trenches, direct perchlorate-impacted storm water into a retention pond that was constructed to contain/treat the storm water approximately 300 feet downgradient of the source area.

The dimensions of the pond are approximately 130-feet long by 85-feet wide with a maximum depth of 11-feet. The pond is sized to accommodate an estimated 100-year storm water runoff of an eight-inch rainfall. The pond includes a shallow portion to promote the growth of emergent wetland plant species, as well as a deeper portion to facilitate the generation of an anoxic/anaerobic treatment zone. The pond was backfilled with a mixture of gravel and mulch to provide adequate surface area and substrate for the growth and stimulation of indigenous microorganisms. A submersible pump was installed in the deepest portion of the basin to both control pond depth (prevent run-off) and to recirculate anoxic/anaerobic pond water back into the infiltration trench. The overall retention pond design was intended to simulate a naturally-occurring shallow anoxic pond, complete with native flora and fauna. An existing manmade pond similar to the retention pond was periodically sampled at the site, and aqueous perchlorate concentrations were observed to decrease by 99% over a 36-month period.

Field data collected from the pond water has indicated conditions that are conducive to the reduction of perchlorate, with a stratification of dissolved oxygen (DO) levels. The DO levels are higher at the surface (ambient air interface) of 3.7 mg/L and become considerably more anaerobic in the deeper zone of the pond (typically less than 0.3 mg/L). Laboratory data indicates that the average perchlorate concentrations in the pond have decreased with each successive wet season, from 0.2 mg/L in 2003 to 0.03 mg/L in 2006. Downgradient surface water data has also shown significant reductions from 0.055 mg/L in December 2002 to no detectable perchlorate in December 2005 indicating that the pond has mitigated the migration of impacted surface water from the source area.

This integrated approach of using natural site-specific biological processes together with engineered in situ treatment can minimize the capital and labor costs associated with more conventional remediation system installation, operation, and maintenance. This type of remedial approach can also accelerate achieving risk-based remedial goals that are protective of human health and the environment, providing additional reductions in costs.