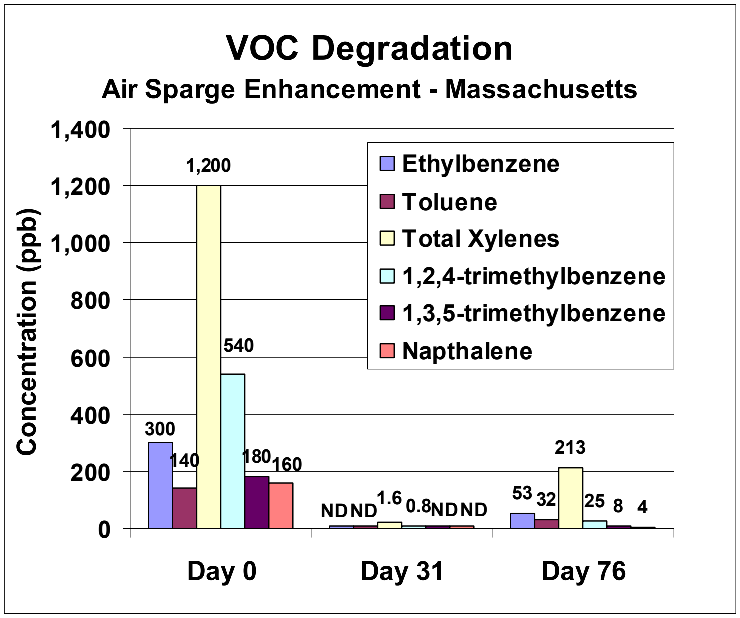
Biological Enhancement of Air Sparge Systems

Air sparging (AS) is a proven technology that has become a popular method for groundwater remediation of gasoline releases. AS systems can effectively remove a significant mass of volatile subsurface contaminants, but often have difficulty removing the last few percent of less volatile, less soluble compounds. Unfortunately, removal of these recalcitrant compounds is usually necessary for site closure. In situ biological enhancement of air sparging systems can be an effective, low-cost solution to eliminate persistent contamination. With this approach, air sparging mechanically removes volatile compounds, while the enhancements biologically degrade the recalcitrant compounds to CO_2 and water.



Requirements for Bioremediation: Successful in situ bioremediation requires efficient hydrocarbon-degrading bacteria, available nutrient compounds (N, P, K, etc.), and a consistent supply of dissolved oxygen (DO) for aerobic degradation. Air sparging dissolves a small mass of oxygen in groundwater that can be used for microbial contaminant degradation. By combining AS with specialized biological enhancements, multiple removal processes (physical, chemical, and biological) can operate simultaneously to achieve cleanup goals.

Does It Really Work, and How Will I Know? The graph above shows reductions achieved with biological enhancement of an AS system in Massachusetts. The sparge equipment had operated for over 3 years and accomplished significant contaminant removal, but persistent VOC concentrations remained in the groundwater. Biological products, including bacteria and nutrients, were injected into the existing groundwater sparge wells, and dramatic contaminant reductions were noted after 30 and 76 days of continued AS operation. Not only were the VOC results exciting, but the field readings, inorganic analysis, and microbial counts (collected before and after product injection) verified that biological treatment was largely responsible for overall contaminant reductions. Specifically, the adjacent graph shows oxidation-reduction potential (ORP) levels in the groundwater that rose dramatically, indicating increasingly strong oxidative (aerobic) subsurface conditions. Concurrently, the population of subsurface bacteria exploded by 3 orders of magnitude after inoculation; this increased microbial activity could only have resulted from growth on a carbon source, in this case the recalcitrant VOCs.