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BUCHLORAC: Program for predicting the buffer requirement for enhanced anaerobic bioremediation of chlorinated solvents

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Enhanced anaerobic dechlorination is a promising technology for the in situ remediation of chlorinated ethene DNAPL source areas. However, the accumulation of organic acids and hydrogen ions (HCl) in the source zone may lead to significant groundwater acidification. The resultant pH drop inhibits the activity of the dehalogenating microorganisms and thus may slow or stall the remediation process. Remediating source zones requires such extensive dechlorination, that it may be common for natural buffering capacity to be exceeded, and thus for acidic conditions to develop. Therefore, the addition of a buffer (e.g., $NaHCO_3$) is typically required to control the pH and thus ensure effective and sustained chlorinated solvent degradation.

To assist in the design of treatment strategies, we have developed the program BUCHLORAC to predict the amount of buffer required to maintain the pH at the source zone within the optimum range for dehalogenating bacteria. BUCHLORAC is a Windows graphical interface based on an abiotic geochemical model designed and implemented through the program PHREEQC. Through the interface the user can estimate the buffer requirement for their specific operating conditions. User-specified parameters include, for example, the site water chemistry, soil mineralogy, amount of chlorinated ethene to be degraded, type of organic amendment, buffering agent and minimum allowable pH. BUCHLORAC was developed in support of project SABRE

(Source Area BioREmediation). This 4-year, $5.7 million research and development project aims to evaluate the effectiveness and performance of enhanced anaerobic bioremediation in the treatment of chlorinated solvent DNAPL source areas. Sensitivity simulations with the tool reveal that where extensive dechlorination is likely to occur, significant buffer addition is necessary even in reasonably well-buffered systems. Applications of BUCHLORAC to the SABRE field site to calculate buffer requirements, demonstrated that it is a valuable, practical, and simply applied design tool for enhanced anaerobic bioremediation systems.