

Evaluation of Nutrient Addition of Various Low-Cost Carbon Substrates

Donovan Smith, P.E. (dsmith@jrwbioirem.com) and Michael R. Sieczkowski, CHMM
(JRW Bioremediation L.L.C., Lenexa, Kansas, USA)

Enhanced halorespiration of contaminants in groundwater through the addition of organic substrates has become a readily accepted commercial tool for the cleanup of chlorinated solvents such as perchloroethene and trichloroethene for a number of years. This technology relies on the anaerobic metabolism of a carbon source to produce hydrogen which is then utilized for the halorespiration of the contaminant under anaerobic conditions. Although many types of substrates have been used over the years, including sugars, salt forms of metabolic acids, and highly processed forms of metabolic acids, there has always been a drive to reduce costs by injecting the cheapest unit cost material. These materials are typically effective but can be deficient in cases where longevity is a significant factor. In using these low cost but faster releasing substrates, many sites did not achieve desired results due to poor metabolic efficiencies or poor kinetics. To attain a balance between cost and effectiveness, various combinations of organic substrates, microbes, and in some cases, nutrients have been combined with some success. In many cases, these consortiums of materials have not effectively decreased the cost of a project while significantly contributing to the efficiency of the process. Bringing these parameters into balance becomes a critical goal.

To determine if low-cost substrates could be amended with nutrients to decrease donor mass while increasing metabolic kinetics, JRW Bioremediation, L.L.C. sponsored a series of microcosm studies at the University of Illinois. Sodium lactate, chitin, molasses, vegetable oil, and whey have been used as carbon sources on both dissolved-phase and nonaqueous-phase liquids. In some cases, their effectiveness has been limited by relatively slow kinetics predominantly associated with solubility. In other cases, most of their mass is fermented to materials that do not support dehalogenation. The goal of this research project was to determine if these low-cost carbon substrates can be amended with nutrients to significantly increase metabolic rates and at the same time decrease the amount of substrate used. A specific nutrient source was combined with various carbon substrates, injected into TCE-contaminated soil and groundwater in a controlled laboratory setting, and then compared to other microcosms containing other commercially available nutrients. The amount of nutrient added did not materially increase the COD in the system. Both the improved donor utilization and increased kinetics will be discussed.