

Reductive Dechlorination Reactor (RDR) Studies

The reductive dechlorination reactor (RDR), developed under the guidance of Dr. Joseph Hughes at Rice University, is used to determine the efficacy of different HRC formulations. The system, shown in Figure 1, recirculates CAH-laden water through a bed of activated microbes that are capable of metabolizing CAHs. This system can be fed and monitored consistently, allowing continuous removal kinetics to be studied.

The reactor is comprised of a packed bed of glass beads which simulate the soil system. Bacteria that are acclimated to the dechlorination of TCE and PCE are allowed to colonize the beads and HRC is placed in a tube between the pump and the packed bed. The TCE-laden solution flows from the liquid reservoir and through the pump, then enters the system, flowing through the HRC and then the packed bed, finally dripping back into the liquid reservoir. Each day, the solution in the liquid reservoir is augmented with 5 mg/L of TCE. A small sample is taken and measured for concentration TCE via gas chromatography and for lactic acid concentration (from HRC) via liquid chromatography. After approximately 8 hours, the solution is sampled and measured again. This sampling procedure is repeated for several days, until it can be affirmed the particular HRC formulation used is facilitating the reductive dechlorination of TCE.

An anaerobic state is maintained in the system through keeping it closed-off from the environment and removing samples through valves and designated sampling ports. In addition, an oxygen indicator is used to indicate the presence of dissolved oxygen. If any air does manage to penetrate the system, anaerobic conditions can usually be restored within a few hours due to the presence of lactic acid.

As of yet, there has not been a single case where HRC failed to facilitate remediation of TCE in the bioreactor. A typical RDR result is presented in Figure 2, which shows continuous TCE remediation at all concentrations of TCE added to the system. Although it is not illustrated in the figure, it is interesting to note that when TCE is added to the system there is an initial burst of vinyl chloride in the gas headspace analysis. As the TCE concentration is reduced to near zero, the vinyl chloride also decreases and is eventually remediated by the time of the next inoculation of TCE.

Figure 1

