

Simple Field Pilot Test Designs

In the initial stages of HRC testing, the efficacy of HRC was studied in single monitoring wells. HRC was placed in PVC canister measuring four feet in length and three inches in diameter. These small-scale field studies were designed to determine the immediate impact of HRC on water passing through the monitoring well. Each study consisted of five rounds of sampling over a period of twelve weeks. At each sampling time point, the following analyses were performed:

1. EPA method 8260 (chlorinated VOCs)
2. Gases (methane, ethane, and ethene)
3. Nutrients, electron acceptors, and inorganics (nitrogen, nitrate, phosphorous, sulfate, sulfide, iron, chloride, and manganese)
4. Volatile organic acids (lactic acid, pyruvic acid, acetic acid, and propionic acid)
5. Alkalinity, TOC, and conductivity
6. DO, redox potential, pH, and temperature
7. Microbial (total anaerobes and sulfate reducing bacteria)

The sampling intensity over the twelve weeks of testing allowed the early performance characteristics of HRC to be well-classified. In all studies, in addition to releasing lactic acid, HRC caused a reduction of redox potential and DO level in the well. Over time, pyruvic and acetic acid concentrations increased as lactic acid was metabolized by indigenous microorganisms and electron acceptor concentrations (nitrate and sulfate) were reduced. This initial set of reactions acts to “drive” the aquifer to an anaerobic state.

Once the aquifer was driven to a reduced, anaerobic state, reductive dechlorination of the CAHs began, as described in Technical Bulletin 1.1.2. At some sites, reduction of CAHs began within the first two weeks of application, while at other sites, appropriate reducing conditions were not established until eight weeks after application. This delay was mostly due to initial aquifer conditions; aquifers with highly-positive redox potentials, measurable levels of DO, and high levels of competing electron acceptors took much longer to be driven to anaerobic, reducing state. Results from one representative study are discussed in detail in technical bulletin 3.1.2.