An Approach to Improve Donor and Culture Delivery over Traditional Groundwater Recirculation Systems

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The use of groundwater recirculation to improve the distribution of electron donors and microbial cultures has been demonstrated at numerous field sites. However, traditional recirculation system layouts, which treat water through aboveground amendment followed by reinjection, often lead to significant fouling of the reinjection wells and clogging of the aquifer pore spaces. These problems can cause significant delays in cleanup time and lead to increased costs. To avoid these potential issues, an innovative recirculation design has been developed such that a biologically active ring is created around, and away from, the reinjection well.

This approach for improved donor/culture delivery with recirculation is being evaluated at a former manufacturing facility in Southern California where trichloroethene (TCE) was released from a former clarifier. Based on site conditions, recirculation was selected over multiple passive injections. The remedy however, is susceptible to potential impacts of well fouling and aquifer clogging. To minimize these potential impacts, the recirculation system consists of a single extraction well at the downgradient property boundary and a single reinjection well upgradient of the former clarifier surrounded by a ring of donor/culture injection wells. This configuration allows for reinjected water to flow outward radially into the treatment ring where the water becomes inoculated with donor/culture as it continues to move outward and downgradient over the target area.

In May 2008, a total of 1,300 gallons of emulsified vegetable oil, 110 gallons of lactate, and 20 liters of KB-1® bioaugmentation culture were amended into the 12 donor/culture wells. Radius of injection calculations and post-injection sampling indicate that complete coverage of the target injection area was achieved. Following approximately 60 days of recirculation, TCE concentrations in a monitoring well located 20 feet downgradient of the injection ring near the source area had decreased from 1,500 µg/L to 11 µg/L with a corresponding increase in *cis*-1,2-dichloroethene (*cis*-DCE). *Dehalococcoides* gene counts in this well also increased by approximately two orders-of-magnitude. Monitoring data collected during the first six months of system operation indicated that amended groundwater had been distributed throughout the target treatment area and complete biodegradation of TCE to ethene was observed in wells within this area.

Monitoring results from the first year of operation demonstrate that this alternative recirculation design was successful in quickly distributing the donor/culture and reducing TCE concentrations in the target treatment area without major shutdowns due to biofouling or significant impacts to deeper clean groundwater. Some evidence of minor fouling was observed in the reinjection well and temporary increased VOC concentrations in deeper monitoring wells were observed for a brief period of time immediately following the donor/culture injection. The data suggest that the volume of donor/culture added was greater than optimum for the site conditions. Therefore, a second donor/culture amendment will be conducted using a lessor volume per well.