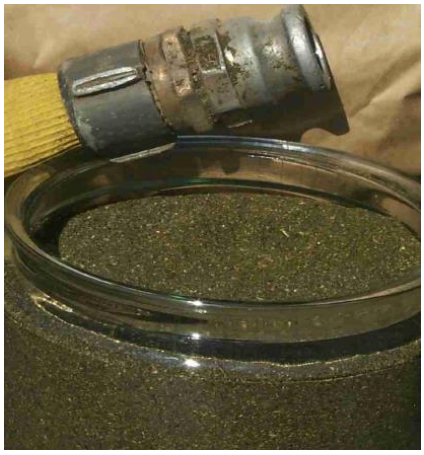
Treatment of 1,2 Dichloroethane with EHC® ISCR Reagent

INTRODUCTION



EHC® *In Situ* Chemical Reduction (ISCR) reagent is a combination of hydrophilic, controlled-release solid organic carbon and zero valent iron (ZVI). EHC degrades chlorinated organic contaminants through two primary mechanisms: (i) chemical reduction and (ii) enhanced biological degradation. This unique combination stimulates reductive dechlorination of otherwise persistent organic solvents in groundwater and source zones without the accumulation of catabolites. EHC is particularly effective for *in situ* treatment of groundwater impacted by mixtures of chlorinated solvents and/or more persistent compounds such as 1,2 dichloroethane (1,2-DCA). Extensive bench testing of EHC for treatment of 1,2-DCA has been performed confirming its superior efficiency compared to ZVI alone.

BENCH STUDY #1

A bench scale treatability study was conducted on groundwater from a site impacted predominantly with 1,2-DCA. The total chlorinated volatile organic compound (CVOC) concentration of the site groundwater was 337 mg/L and the 1,2-DCA concentration was 329 mg/L. The experimental system consisted of a column followed by two downstream soil microcosms as shown in Figure 1.

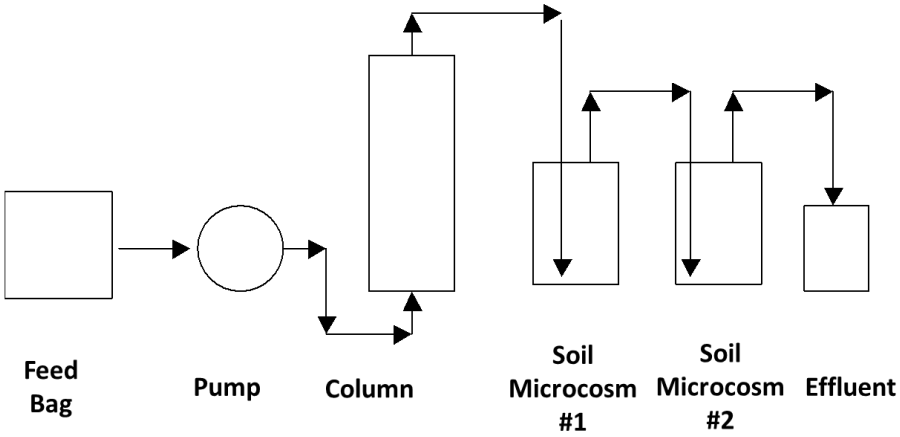


Figure 1. Schematic of experimental set up. A peristaltic pump transferred feed water from a collapsible bag into the bottom of the column. Effluent from the column flowed through soil microcosm #1 and then soil microcosm #2.

The column and first downstream soil microcosm were filled with 1% EHC (by mass) mixed with site soil. The second soil microcosm was filled with only site soil. This experimental set up was designed to mimic an injection of EHC into the subsurface at the site. The second soil microcosm, containing only site soil, was added to monitor any further degradation of CVOC that may occur down gradient of the reactive zone. A control system

was also set up as described above; except no EHC was added (i.e. the column and soil microcosms were filled with site soil). CVOC and chloride concentrations were monitored in the influent and effluents over time.

The CVOC sampling on day 98 revealed a 99+% reduction in 1,2-DCA from 329 mg/L in the feed to 83 mg/L in the column effluent and 0.041 mg/L in the first soil microcosm effluent (Figure 2). The 1,2-DCA concentration was further reduced to 0.019 mg/L in the second soil microcosm. Chloroethane, a potential break-down product of 1,2-DCA, was not detected in the effluents. The 1,2-DCA concentration in the final effluent of the control system (no EHC present) was 221 mg/L, which corresponded to a 33% removal of 1,2-DCA. This reduction was likely the result of native dechlorinators present in the site soil and groundwater.

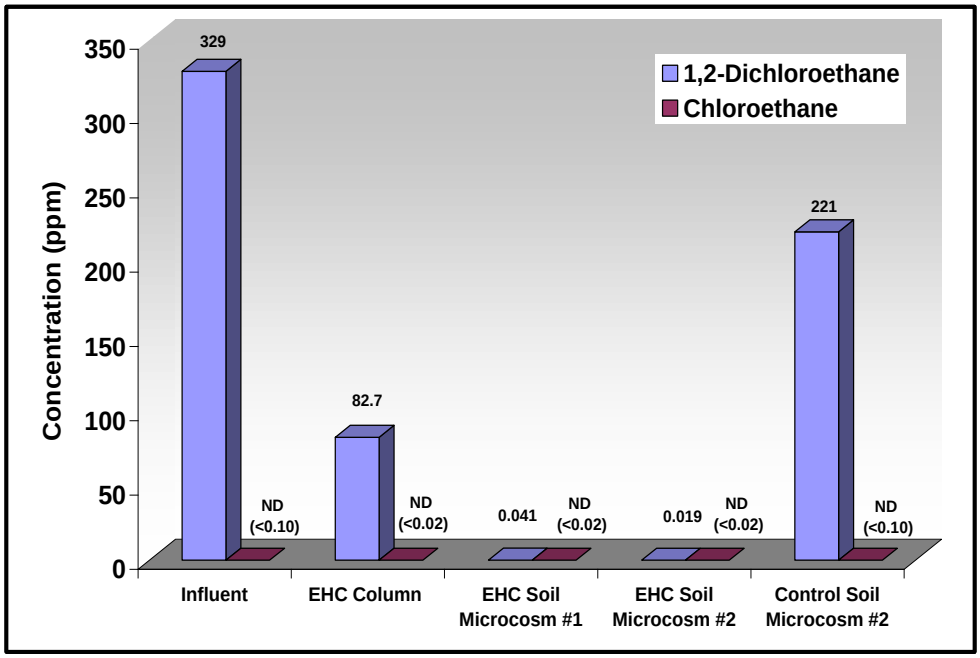


Figure 2. Influence of EHC on 1,2-DCA concentrations after 98 days of operation

Since the dechlorination of CVOCs is accompanied by an increase in the chloride concentration, a chloride mass balance was obtained by comparing the measured increase in chloride concentration ($[Cl^-]_{effluent}$ - $[Cl^-]_{feed}$) with the theoretical concentration of chloride produced (calculated from VOC concentrations). The results from the chloride mass balance confirmed complete dechlorination of the treated CVOCs (Table 1) while the control system showed little production of chloride.

System	Concentration (mg/L)		Chloride Mass Balance
	Theoretical	Measured	
1% EHC	239	239	99.9%
Control	80	10	12.5%

Table 1. Chloride mass balance in EHC and control system after 98 days of operation

BENCH STUDY #2

In another bench-scale study, the treatment of 1,2-DCA in the presence of ZVI or EHC in amended soil columns was compared over a period of 223 days. Results show that EHC amended soil columns reduced 1,2-DCA from an initial concentration of 24 mg/L by 95% with a 100% molar conversion to chloroethane (CA) in 35 days (Figure 3). In this case, the molar ratio of CA was reduced to 42% after 64 days, and after 223 days there were no detections of 1,2-DCA and CA in the column effluent. On the other hand, the soil column amended with ZVI only showed 26%, 20% and 4% reductions in 1,2-DCA on days 35, 65 and 223, respectively. This concluded that 1,2-DCA can be effectively treated under ISCR conditions created with EHC but not with ZVI alone, and that the direct chemical reduction pathway for degradation of CVOCs by ZVI does not apply to 1,2-DCA.

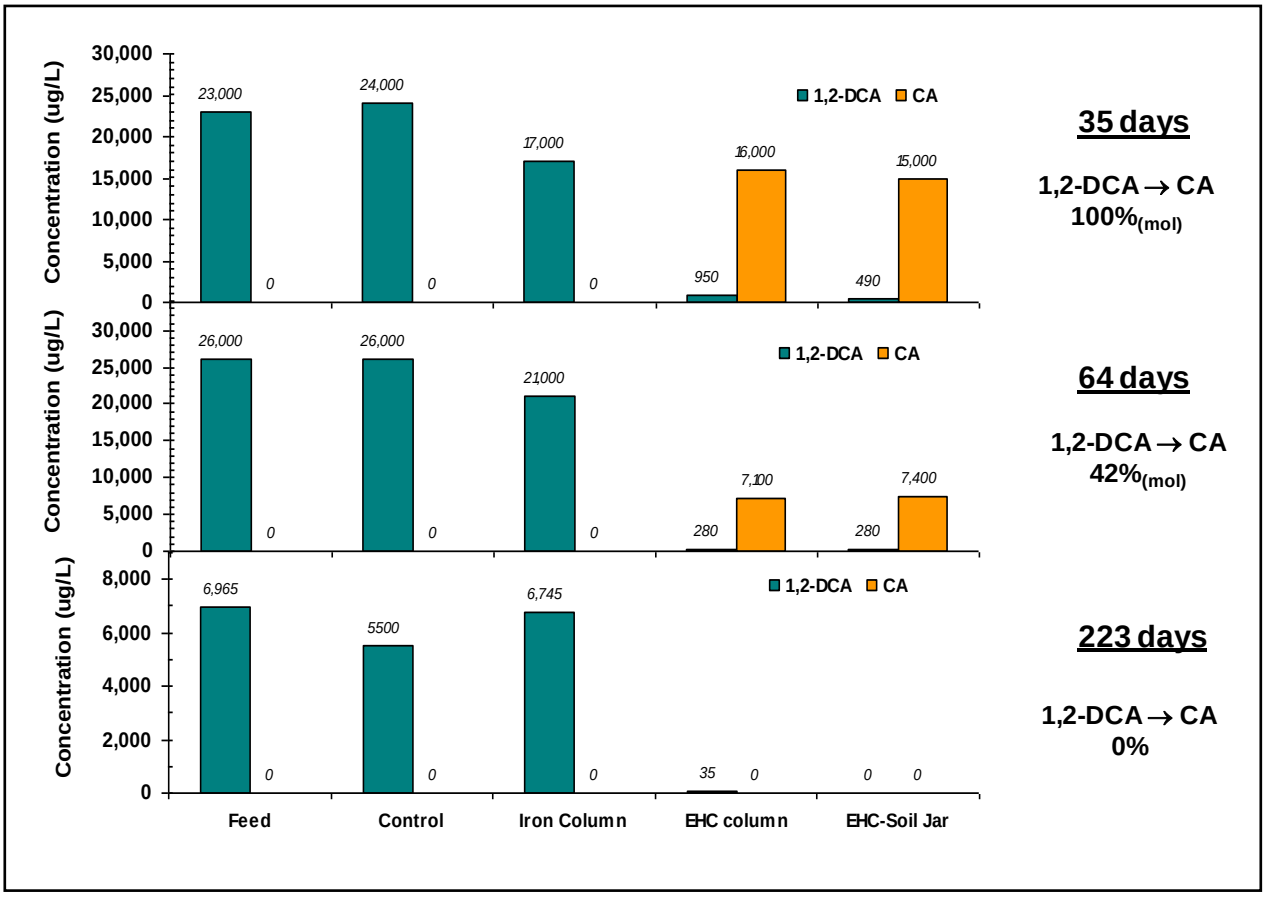


Figure 3. Influence of EHC and ZVI on Treatment of 1,2-DCA