

THE USE OF ANAEROBIC REDUCTIVE DECHLORINATION OF 1,1-CHLOROFLUOROETHENE TO TRACK THE TRANSFORMATION OF VINYL CHLORIDE

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1,1-chlorofluoroethene (CFE) was studied as a reactive tracer to quantify the anaerobic transformation of vinyl chloride (VC) in groundwater. Batch kinetic studies of trichlorofluoroethene (TCFE), trichloroethene (TCE), CFE and VC transformation were performed with an enrichment culture, obtained from the Evanite Site in Corvallis, OR. The enrichment is capable of completely transforming TCE through cis-dichloroethene (c-DCE) and VC to ethene. The enrichment also transforms the fluorinated analogues, which have the same degree of chlorine substitution as the chlorinated aliphatic hydrocarbon (CAH), but with a fluorine atom replacing one hydrogen atom. Initial studies showed TCFE was transformed to three dichlorofluoroethene isomers (DCFes), with cis-1, 2-dichlorofluoroethene (c-DCFes) being the main isomer formed. DCFes were sequentially transformed to three chlorofluoroethene isomers (CFEs), with 1,1-CFE being the major intermediate. The CFE's isomers were finally transformed to fluoroethene (FE), when the culture transformed VC to ethene. The degree to which the fluorinated analogue was transformed was correlated with that achieved for the CAH, with the same degree of chloride substitution. With FE being resistant to defluorination, it is easily detected to provide evidence of VC transformation to ethene.

Future kinetic studies aim to quantify the transformation rate of vinyl chloride by using 1,1-CFE as a surrogate compound. The half-saturated constants (K_s) of both compounds and maximum utilization rates (k_{max}) are being measured and compared with the Evanite enrichment. An inhibition study is also having performed to verify that VC and 1,1-CFE share the same transformation mechanism, but that each compound may have a different enzymatic affinity. Using a competitive inhibition model, we are determining if rate of VC transformation can be predicted from the rate of 1,1-CFE transformation. Since the analogue and its product (FE) have a distinct analytical signature, 1,1 CFE can be potentially used as a reactive tracer in field evaluations to determine the potential of VC transformation to ethene.