Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37735

Reactive Samplers for Monitoring In Situ Abiotic Transformation of Chlorinated Solvents

WEILE YAN[1], MOHAMMAD BAGHERIKASHANI[1], LINGFEI FAN[1], BRIDGETTE BUDHLALL[1], JACOB CHU[2] AND RAUL TENORIO[2]

[1]University of Massachusetts Lowell
[2]Haley and Aldrich

There is significant interest in monitoring abiotic decomposition of chlorinated solvents at contaminated sites due to uncertainties in measuring the rates of abiotic attenuation of trichloroethylene (PCE) and perchloroethylene (PCE) under field conditions. In this study, we developed an innovative reactive sampling tool to quantify acetylene, a diagnostic product of abiotic reduction of TCE or PCE, in groundwater. The sampler's working mechanism is based on the highly specific and efficient azide-alkyne "click reaction", in which acetylene reacts with an azide compound to form a biologically and chemically stable triazole product. We discuss the evolution of the sampler design and current laboratory validation results. The original prototype employed a porous polydimethylsiloxane (PDMS) membrane impregnated with an azide reagent and a copper catalyst. Product formation exhibited a linear relationship with aqueous acetylene concentrations. Furthermore, the product yield was unaffected by groundwater pH and the presence of common electrolytes and natural organic matter (NOM). In the improved design, we incorporate additional features to enhance sampler sensitivity and reliability. An alkyne compound embedded in core–shell polymer beads is used as an internal reference to enable mass flux quantitation. Furthermore, an azide reagent is covalently grafted onto silica nanoparticle surfaces to increase reactive surface area and minimize product loss during extended deployment. Ongoing laboratory validation results and planned field testing will be discussed. The high specificity and sensitivity of this sampler provide a promising new diagnostic tool for assessing abiotic degradation of chlorinated ethenes at complex legacy contamination sites.