Research Brief 211

A New Solar-Powered Approach for Groundwater Contamination

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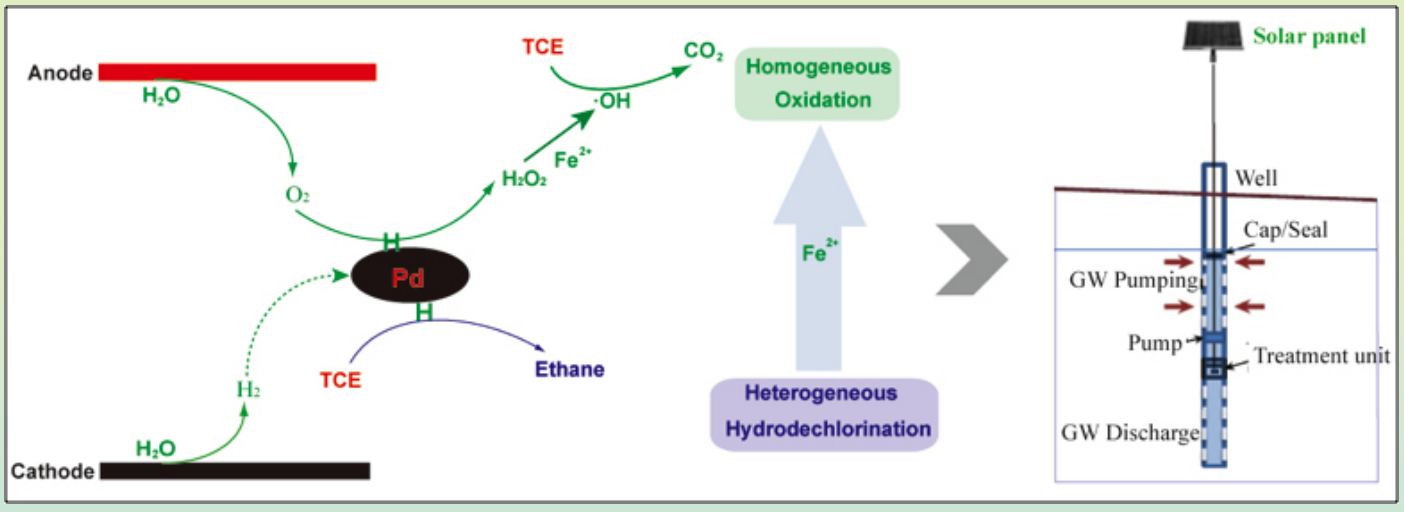
SRP-funded researchers have developed a low cost, solar-powered solution for removing trichloroethylene (TCE) from groundwater. TCE, a chlorinated hydrocarbon that is used as an industrial solvent and degreaser, is one of the most common soil and groundwater contaminants in the United States. The system, developed by Akram Alshawabkeh, Ph.D., uses the sun's rays to generate an electric current to break down TCE into ethane and other byproducts.

In a study published in the February 2012 edition of Environmental Science & Technology, the researchers outline a novel method that uses iron ions (Fe(II)) along with a palladium (Pd) catalyst to enhance oxidative degradation of TCE, which typically occurs as a side reaction during traditional TCE hydrodechlorination. Their method is particularly suited for sustained treatment of aquifers since a solar-powered system can be engineered for *in situ* implementation.

To develop the method, Songhu Yuan, Ph.D., a visiting professor from the China University of Geosciences in Wuhan, China, together with Xuhui Mao, Ph.D., a postdoctoral research associate at Northeastern University, applied mixed metal oxide electrodes to simulated TCE-contaminated groundwater to generate H_2 in a lab-controlled environment. They added palladium powder to catalyze the reaction, which degraded TCE into ethane and other byproducts. Without the addition of Fe(II), 40% of the TCE was degraded within 80 minutes. However, when Yuan added Fe(II), 95% of the TCE was degraded within the same amount of time. He found that adding Fe(II) shifts the process of TCE decontamination from hydrodechlorination (a reduction process) to a more rapid oxidative reaction. This shift was most effective when high concentrations of iron (about 10 mg/L) were present and the pH of the water was low. This is the first time a research group has reported on palladium's ability to indirectly catalyze an oxidation process for groundwater remediation.

The researchers believe that this may be a low-cost and highly efficient method to remediate contaminated groundwater. They used the results to devise a three-electrode Pd-catalytic remediation system with automatic pH-regulation, which they are currently evaluating. They are also developing an in-well solar-powered system for field testing.



Pd catalyzes the degradation of TCE. The addition of Fe(II) ions shifts the reaction to a more rapid oxidative reaction.

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To learn more about this research, please refer to the following source:

Yuan S, Mao X, Alshawabkeh AN. 2012. Efficient degradation of TCE in groundwater using Pd and electro-generated H_2 and O_2: a shift in pathway from hydrodechlorination to oxidation in the presence of ferrous ions. Environ Sci Technol 46:3398-3405; doi: 10.1021/es204546u [Online 8 Feb 2012]

Mao X, Ciblak A, Amiri M, Alshawabkeh AN. 2011. Redox control for electrochemical dechlorination of trichloroethylene in bicarbonate aqueous media. Eviron Sci Technol 45: 6517-6523; doi: 10.1021/es200943z [Online 14 Jun 2011]