



CALIFORNIA SCIENCE & ENGINEERING FAIR

2018 PROJECT SUMMARY

Name(s) Christopher Anklam; Haroun Khaleel; Jaeson Kim	Project Number S1102
Project Title Treatment of Contaminated Groundwater with a Bioinspired Complex-Nanoparticle Hybrid Catalyst System	
<div><div>Objectives/Goals<p>Growing scarcity of high-quality drinking water supplies across the globe heightens the need for innovative and sustainable technologies for drinking water decontamination and water-waste reuse. Perchlorate, a chemically inert but toxic oxyanion, has been widely detected in groundwater supplies and agricultural products in Southern California as a result of source water contamination from improper disposal of explosive materials, use of contaminated fertilizers, and natural atmospheric processes. Other known contaminants in groundwater, such as NDMA and TCE that are connected with health concerns, have further accentuated the demand for developing effective technologies to remove ClO₄⁻ and related recalcitrant contaminants from groundwater.</p></div><div>Abstract<p>Two separate experiments were conducted to compare the catalytic treatment of ClO₄⁻ in two different water matrices: DI water artificially spiked with ClO₄⁻ and raw groundwater. Briefly, 100 mg of Pd/C and 0.25 mg of NH₄ReO₄ stock solution were mixed together in a solution of 50 mL of DI water/50 mL of groundwater in a 50-mL round bottom flask capped with a rubber stopper. Collected aliquots of suspension were immediately filtered and analyzed (using ion chromatography) for residual ClO₄⁻ concentration at specific time intervals after initiating the batch reaction. A total of three trials were conducted for each water matrix.</p></div><div>Methods/Materials<p>The catalyst system successfully completed ClO₄⁻ reduction in both the DI water and groundwater matrix. In the DI water matrix, the catalyst reduced ClO₄⁻ to 1.02% of the original concentration in 60 minutes. In the groundwater matrix, the catalyst reduced ClO₄⁻ to 1.74% of the original concentration in 120 minutes. The experiments also revealed that the catalyst reduces ClO₄⁻ more thoroughly in DI water than it does in groundwater. In DI water, 99.9% of the perchlorate was reduced while only 98.3% of the perchlorate was reduced in the groundwater matrix.</p></div><div>Results<p>The results disproved our hypothesis. The catalyst system showed a slower rate of reaction in the groundwater matrix relative to the DI water matrix. This may be due to the fact that the groundwater matrix contains numerous contaminants in addition to perchlorate which may also react with the catalyst. However, demonstrating the catalyst's success provides an alternative method that is more efficient in treating contaminated groundwater.</p></div><div>Conclusions/Discussion</div></div>	
Summary Statement <p>The project demonstrates the success of a new catalyst system in treating perchlorate contamination in groundwater more efficiently.</p>	
Help Received <p>Kamron Saremi taught how local water treatment facilities use different methods to treat contaminated groundwater, and their limitations. Dr. Jinyong Liu taught the fundamentals of the catalysts systems and also supervised the experiment at UCR.</p>	