Influence of Suspended Sediments on Electrochemical Remediation of Karst Groundwater: Preliminary Study

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Abstract:
Karst aquifers, often used as drinking water sources, are highly vulnerable to pollution, because pollutants can freely enter through sink holes and other areas of direct recharge. Current remediation technologies face numerous challenges when applied to these terrains and conditions. For example, natural attenuation and bioremediation are not generally applicable to fractured rock or karst, and pump and treat technologies have been shown to be often ineffective and costly when used in karst terrain. A novel remediation technique, electrochemical remediation, is a promising, cost-effective and sustainable remediation technique due to its advantages: (1) it can be performed in situ, (2) low-level direct current can create favorable redox condition for oxidation and/or reduction of wide range of contaminants; (3) groundwater chemistry can be controlled by adjustment of low-level direct current; and (4) systems can use alternative power sources. Though electrochemical remediation has been optimized by way of the generation of reactive oxygen species via electro-Fenton reaction under various conditions, environmental factors could either hinder or exacerbate the electrochemically-induced degradation pathways. In particular, suspended sediment has been shown to be present in large amounts in karst aquifers. Therefore, its presence is being evaluated for the influence on degradation pathways and reaction kinetics, especially the influence of additional redox-species such as Fe and Mn.

Data/Results

2 g/L suspended sediment decreases hydrogen peroxide measurements in the reactor

Possible Suspended Sediment Effects on Hydrogen Peroxide:
1. Catalytic transformation to •OH through Fenton reaction
2. Induces decomposition to H2O (lowers reactivity)
3. Covers Pd and inhibits production of hydrogen peroxide

Impact

The unique feature about my innovation/research is: sustainable, cost-effective remediation of contaminants in groundwater.

This addresses the problem of: bridging lab-scale remediation with realistic karst groundwater conditions.

Continuing Research: 1. Determine the chemical pathways whereby sediment decreases hydrogen peroxide. 2. Mimic karst groundwater by adding carbonates in solution.