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Oxidant Nanoparticles

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Abstract

The goal of this project is to develop new oxidant nanoparticles for targeted environmental applications. Specific objectives include:

1) Sodium persulfate and mixed oxidants for degradation of carbon tetrachloride (CT, CCl_4) and other chlorinated organic solvents;
2) Calcium peroxide and mixed oxidants as controlled oxygen release compounds (CORCs) for enhanced bioremediation and soil/sludge treatment.

The iron-palladium nanoparticle technology, invented in Lehigh in 1996, has shown much promising as an innovative environmental technology for treatment of a wide range of contaminants in soil and water. Nanoparticles are extremely reactive toward a wide variety of contaminants. Due to the small sizes, they offer tremendous flexibility in applications, e.g., mixing with soil and injection into groundwater. Up to now, nanoparticles developed at Lehigh are reductants (i.e., electron donors)

Recent discussion with FMC suggests that oxidant nanoparticles (i.e., electron acceptors) may have significant **market potential**. A recent federal governmental report suggests that cost for MTBE (a gasoline additive) remediation in the next ten years will be at least $29 billion dollars. The total market for petroleum hydrocarbon (PHCs) remediation is even bigger (> $500 billion for the next two decades). Both MTBE and PHC remediation requires the supplement of oxidants and/or oxygen release compounds. On the average, 5-10% of the total remediation cost is on materials and chemical reagents. A significant fraction of that could be environmental oxidants. Lehigh is well positioned to develop new oxidant nanoparticles based upon our experience in nanoparticle synthesis and environmental applications.

Selected experiments will be designed to understand the environmental chemistry of nanoparticles of sodium persulfate, and delineate the optimal environmental and application conditions of sodium persulfate for groundwater remediation and industrial waste treatment. For example, factors influencing the sodium persulfate reactions

(temperature, solution pH, presence of environmental reductants, metal catalysts, addition of another oxidant such as hydrogen peroxide, sequence and ratio of the addition etc.) will be investigated.