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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

MTBE Adsorption/Oxidation

Project Overview and Results

A Fenton-driven mechanism for regenerating spent granular activated carbon (GAC) was recently proposed and tested[1, 2]. This technology involves the combined use of two reliable and well-established treatment technologies: adsorption on GAC and Fenton oxidation.

Environmental contaminants are immobilized and concentrated on the GAC during carbon adsorption treatment, and subsequently transformed by the Fenton mechanism generated hydroxyl radical (OH) and superoxide radical (O2-) during oxidative treatment. The objective of the treatment process is to:

- Transform the contaminants into less toxic by-products
- Re-establish the sorptive capacity of the carbon for the target chemicals
- Increase the useful life of the GAC
- Reduce costs for GAC regeneration and water or air treatment

This project involves three main components:

- Test the applicability of the adsorption/oxidation treatment technology to methyl tertiary butyl ether (MTBE)
- Optimize the treatment process
- Investigate fundamental mechanisms with the treatment process

Two regeneration cycles of MTBE-spent activated carbon under aggressive oxidant conditions were accomplished without significant deterioration of the physical structure and adsorption capacity of the carbon (91 percent regeneration)[3]. The reaction by-products from MTBE oxidation were also degraded and did not accumulate significantly on the GAC. Multiple treatments of GAC without sorbed contaminants underwent chemical and physical changes that reduced the sorptive capacity of the GAC[4]. Protection of the activated carbon during oxidative treatment can be provided by the adsorbate due to fewer reactions between OH and carbon surfaces relative to reactions between OH and the target adsorbate. Process optimization involving pH, iron, hydrogen peroxide, hydraulic loading, and reductants is also under investigation.

Future Research

A pilot-scale study is underway at the University of Arizona by Drs. R.G. Arnold and W. Ela, investigating the feasibility of the proposed technology at field scale involving perchloroethylene. It is a cooperative agreement.

Additional research is currently planned at the Kerr Research Center by Drs. S. Hwang and S.G. Huling involving Fenton oxidation. The focus will involve both fundamental mechanisms and field applications of the adsorption/oxidation technology and in situ Fenton oxidation.

References

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