



# tech briefs

Westinghouse Savannah River Company

## ***In Situ* Generation of Oxygen-Releasing Metal Peroxides for Environmental Remediation**

### **at a glance**

Works with organic and inorganic contaminants

Enhances microbial growth

Enables precipitation

Effects redox reactions

Requires minimal infrastructure

Reduces cost of remediation

Supports quicker, easier clean up

Patent pending

### **for more information**

Joseph P. Dugan, Licensing Specialist

Westinghouse Savannah River Company  
Building 773-41A, Room 243  
Aiken, SC 29808

Phone: 803-725-0848 or 800-228-3843

Fax: 803-725-4988

e-mail: joseph.dugan@srs.gov

## **New approach increases *in situ* treatment effectiveness**

A new approach to the clean up of groundwater containing organic and/or inorganic contaminants involves the creation of *in situ* oxygen reservoirs. These reservoirs can release dissolved oxygen slowly and steadily for long periods of time over broad subsurface areas.

### **Background**

Traditional, *ex situ*, pump-and-treat methods for cleaning up contaminated groundwater are expensive and take a long time. Cheaper and quicker *in situ* methods include the use of naturally occurring microbes that digest the contaminants and turn them into harmless byproducts. Alternatively, treatment compounds can be injected into groundwater to precipitate and immobilize contaminants.

A readily available, widespread source of dissolved oxygen is needed to enhance such *in situ* remediation methods. But, providing an oxygen-rich environment in a contaminated plume is problematic. Many materials other than the contaminants will take up oxygen. And, because of its low solubility, oxygen tends to stay close to the site of injection, rendering the effective area of treatment relatively small. Also, the formation of insoluble precipitates, such as ferric hydroxide, tends to clog the injection apparatus.

To address these problems, oxygen must be constantly injected at many injection sites, which increases the cost and complexity of otherwise promising *in situ* remediation methods.

### **Metal peroxides provide source of oxygen**

Researchers at Westinghouse Savannah River Company (WSRC) have discovered a method of creating *in situ* metal peroxides, which slowly release oxygen in a soluble form in aqueous environments.

Metals are typically distributed throughout the soils through which groundwater plumes move. If not present, dissolved metals may be injected into the subsurface area to be treated.

In the new method, different chemicals are injected into the subsurface region through different injection wells. The chemicals disperse throughout the groundwater and permeate the soil. As the chemicals mix underground, they react to form free, dissolved hydroxyl radicals. The hydroxyl radicals create a highly oxidizing condition in which the metals in the soil are converted to metal peroxides.

The metal peroxides provide a widespread, long-term, *in situ* source of dissolved oxygen. This continuous release of oxygen creates oxidative conditions sufficient to promote the growth of microbial agents and to precipitate certain contaminants. The chemical combination also may be introduced to the subsurface area ahead of the groundwater plume. The result would be an oxygen-rich "wall" through which the plume would pass.

CONTINUED ON BACK . . .



A WASHINGTON GROUP INTERNATIONAL COMPANY



## ***In Situ* Generation of Oxygen-Releasing Metal Peroxides For Environmental Remediation**

### **Process can be stopped**

In most cases, the oxidizing chemical solution will dissipate naturally without harm. Where desired, a reducing agent may be introduced to neutralize any remaining oxidants.

### **Test results are positive**

A contaminated groundwater plume at the Savannah River Site in Aiken, SC, was treated successfully by the injection of chemicals. For two years after the injection, dissolved oxygen concentrations were measured at 300 percent to 500 percent of the expected values based on saturation with atmospheric oxygen.

### **Use will stimulate microbes**

Naturally released, soluble oxygen provides a critical nutrient for aerobic microbes useful in treating many types of organic contaminants. Microbial activity can be further enhanced by adding other nutrients to increase the remedial effect of the microbes.

### **Oxygen is needed for redox reactions**

This method may be of particular use for controlling oxidation states required for redox reactions. This controlled release of oxygen should increase the efficiency of treating groundwater contaminated with redox-sensitive metals that are mobile under reducing conditions.

### **Oxygen enables extraction or immobilization of metals**

For other metals, such as chromium and uranium, the presence of oxygen will enhance mobility. By using known extraction techniques, these solubilized metals can then be extracted from groundwater for treatment.

For groundwater contaminated by acid mine drainage or coal pile runoff, the continuous supply of oxygen creates an environment in which ferrous iron is converted to ferric iron. In its ferric state, iron is very effective in co-precipitating a number of contaminating metals. The precipitated metals are immobilized and will not be transported to downstream water sources.

### **Partnering opportunity**

WSRC has filed a Patent Cooperation Treaty application for this invention. WSRC invites interested companies with proven capabilities in this area of expertise to develop commercial applications for this process under a cooperative research and development agreement or a licensing agreement. Interested companies will be requested to submit a business plan setting forth company qualifications, strategies, activities and milestones for commercializing this invention. Qualifications should include past experience in the commercial uses of similar processes, reasonable schedule for product launch, an established customer base, and evidence of sufficient financial resources for process development and launch.

### **Technology transfer**

WSRC is the managing contractor of the Savannah River Site for the U.S. Department of Energy. WSRC scientists and engineers develop technologies designed to improve environmental quality, support international nonproliferation, dispose of legacy wastes, and provide clean energy sources.

WSRC is responsible for transferring technologies to the private sector so that these technologies may have the collateral benefit of enhancing U.S. economic competitiveness.

## **at a glance**

Works with organic and inorganic contaminants

Enhances microbial growth

Enables precipitation

Effects redox reactions

Requires minimal infrastructure

Reduces cost of remediation

Supports quicker, easier cleanup

Patent pending

## **for more information**

Joseph P. Dugan, Licensing Specialist

Westinghouse Savannah River Company  
Building 773-41A, Room 243  
Aiken, SC 29808

Phone: 803-725-0848 or 800-228-3843  
Fax: 803-725-4988

e-mail: joseph.dugan@srs.gov

