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A QUARTERLY NEWSLETTER FROM THE LEADER IN SUBSURFACE INJECTION & FRACTURING

## ARS Performs two Ferox<sup>SM</sup> Projects for the NAVY

ARS has recently been awarded two contracts to demonstrate the Ferox<sup>SM</sup> technology for the United States NAVY. During the early part of 2002, ARS field teams will be installing Ferox<sup>SM</sup> systems at two source areas located at Charleston Naval Yard. One source area will focus on reducing Hexavalent Chromium (Cr+6)

to Trivalent Chromium (Cr+3) at depths ranging down to 30 feet below the surface.

The second source area at the facility will treat eight "hotspots" which contain TCE concentration in groundwater as high as 36,000 ppb. DNAPL is suspected to be present at this site.

## ARS Enters Into Alliance with Canadian BioTech Firm

ARS has entered into a business agreement with a Canadian firm, Hobbs, Miller and Maat (HMM). This business alliance provides HMM with the full rights to market ARS' soil fracturing, atomized injection and Ferox<sup>SM</sup> technologies in Canada and provides ARS with greater exposure in the Canadian marketplace.

Currently, the firms are working on several Pneumatic Fracturing projects being jointly implemented in the provinces of Ontario and Alberta.

HMM is an international biotechnology firm established in 1994 with offices across Canada, Alaska and the United Kingdom. The firm uses an innovative approach to bioremediation involving the integration

of microbiology and biochemistry. This integrated approach includes the use of proprietary microbial identification, extraction and culturing procedures in conjunction with proprietary delivery systems for compounds such as oxygen, surfactants, dispersants, micro and macronutrients, biostimulants, enzymes and disinfectants.

With the use of ARS' fracturing and atomized injection process to effectively deliver HMM specified bio-substrates, bioremediation can be applied in more challenging formations and across a broader range of site conditions.

Visit HMM on the web at:  
<http://www.hmmenvirotech.com>

## Additional work regarding Ferox<sup>SM</sup> Treatment of Freon-113

ARS continues to assess the ability of the Ferox<sup>SM</sup> powder in dechlorinating Freon-113. A recent lab study evaluated how Freon-113 is affected by the presence of the zero-valent iron during a treatability study for a site with CVOC-contaminated groundwater and soils. During the 74-day study, the major contaminant of concern, TCE, was completely reduced while the dissolved concentration of Freon-113

decreased by 55% from 3,300 ug/liter. A portion of the compound appeared to have adsorbed onto the iron particles. Concentrations of 1,2-dichloro-1,1,2-trifluoroethane, the immediate daughter product of Freon-113 were observed to increase with time. There is less evidence of sequential daughter products of 1,2-dichloro-1,1,2-trifluoroethane during the length of the treatability study. The re-



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## Ferox<sup>SM</sup> Chromium (Cr<sup>+6</sup>) Treatment (Lab.)

Recently completed bench-top treatability tests on the reduction of hexavalent chromium in groundwater and soils by our Ferox<sup>SM</sup> ZVI powder. The goal of the study was to derive field design parameters and dosage levels to reduce (Cr<sup>+6</sup>) contamination to its less toxic and soluble tri-valent (Cr<sup>+3</sup>) state. As shown in the photo,



groundwater and soil from the site had an initial lime-green color due to the high concentrations of (Cr<sup>+6</sup>). The studies evaluated several dosages of Ferox<sup>SM</sup> powder in reducing the Cr<sup>+6</sup> to Cr<sup>+3</sup> within 30 days. As the Cr<sup>+3</sup> precipitates out, the groundwater is treated. As shown, the color of the groundwater changed from lime-green to clear as Cr<sup>+6</sup> was reduced.

## Ferox<sup>SM</sup> (Cr<sup>+6</sup>) Reduction (Field Application)

Based on lab treatability results, a Ferox<sup>SM</sup> field application was recently performed at Charleston Naval Yard in South Carolina. Approximately 38,000 pounds of Ferox<sup>SM</sup> powder was injected at 15 separate injection points targeting various intervals from 11 to 31 feet below ground surface.

The atomized powder slurry was injected using pressures ranging from 60 to 150 psig. During the injections, pressure response was measured in nearby monitoring wells that were screened at various depths. Pressure readings indicated that injections were influencing these wells at distances greater than 50 feet in some instances. Varying pressure readings made during injections at different depths indicated that powder was propagating horizontally outward from the injection points.

Seven of the fifteen injection points were located within an occupied historic building, which made the project both logistically and technically challenging. Computer modeling of the building structure was first performed to ensure that the building was structurally sound when



subjected to even the slightest of column movements. During injections, structural columns were closely monitored to ensure that the movement criteria, as determined from the computer modeling, was not breached. In addition, crack gauges were installed on the outside of the building to quantify any differential movement.

The field operations were scheduled in a manner as to not disrupt the day-to-day operations of the tenant within the building. Working closely with the tenant, injection points were situated between equipment inside the building. The project was completed safely and on schedule, requiring a total of 18 workdays.

Post injection groundwater sampling is scheduled for the first and second Quarter of 2002.

## Brownfield Project Becomes ARS' new Office

In November 2001, ARS relocated its headquarters from Highland Park across the Raritan River to New Brunswick, New Jersey - home of Johnson and Johnson Corporate Headquarters and Rutgers University. The new office sits on a Brownfield Site consisting of a 23,000 sq. foot office/warehouse building. ARS, contracted as the regulatory and remediation consultant, was instrumental in obtaining funding through the New Jersey State Brownfield Initiative program. Financing for the acquisition and site redevelopment (including remediation) was provided by the NJ Redevelopment Authority and the NJ Economic Development Authority. Both the federal and state governments have several programs that provide financial assistance in the form of outright grants and/or low interest loans to acquire and redevelop Brownfield Sites. ARS' Ferox<sup>SM</sup> is a state approved innovative technology under the Grant Programs.

### OUR NEW ADDRESS IS:

114 North Ward Street,  
New Brunswick, NJ 08901

Phone Numbers remain the same:

732-296-6620 Tel

732-296-6625 Fax

For information on how the Brownfield Initiative Program can pay for your site remediation call or email us.

## ARS Manager asked to serve on NGWA Advisory Subcommittee

Steve Markesic, ARS' Senior Hydrogeologist, was recently asked to serve on the National Ground Water Association's (NGWA) Ground Water Protection and Management Subcommittee. This group assists in the establishment of policies toward the protection of the nation's ground water. This position is for three years.

# Pneumatic Fracturing in North Carolina

***PF proves best option when remediating a manufacturing facility without interrupting plant day-to-day activities.***

In November, 2001, a three-day pilot scale test at a manufacturing facility in North Carolina was completed. Pneumatic Fracturing was applied in four separate boreholes targeting discrete intervals from 6 feet to 27 feet below ground surface. The goal of this project was to increase flow rates in the low permeable saprolitic formation that has been contaminated with trichloroethene (TCE).

This project was challenged by the presence of a load bearing wall, located within 6 feet and 25 feet of a pair of injection locations, respectively. Extensive survey of the walls and computer modeling were performed on the load bearing structure to determine its allowable movement and insure that no detrimental impact would occur from the fracturing. The load bearing columns were monitored closely during all fracturing events to ensure that heave did not exceed the movement criteria, as determined from the computer modeling.

Using pressures of less than 150 psi, the formation was fractured. Pressure response measured in surrounding monitoring wells using pressure gauges supported a fracturing radius of influence of 25+ feet. Extraction and air sparging tests performed by the client subsequent to the completion of pneumatic fracturing, indicated very promising results. ARS is scheduled to return to the facility in early 2002 to perform additional fracturing at deeper depths to target the lower strata.



***With the target area located within the manufacturing complex, this project proved to be challenging not only from a logistical standpoint, but also from a safety standpoint.***

## ARS to present at Battelle Chlorinated Conference in May

During the up coming annual Battelle International Conference on Remediation of Chlorinated and Recalcitrant Compounds to be held in Monterey, CA this May, Steve Chen of ARS will deliver a platform presentation entitled "Injection of Zero-Valent Iron into a Shale Bedrock Formation for the Reduction of Trichloroethene." It will be a case study based on a former industrial site in New



Jersey currently undergoing a Ferox<sup>SM</sup> pilot study. This pilot test is considered one of the key technological advance for ARS during the year 2001 as it was the first Ferox<sup>SM</sup> application in a bed-rock aquifer environment.

*More information on this particular project can be found on ARS'*

*website under Case Study No. 15:*  
<http://www.arstechnologies.com/pdf/cs15.pdf>

## ARS Opens Office in North Carolina

ARS is excited to announce the opening of its third US regional office in Raleigh/Durham, North Carolina.

The new office will focus upon clients in both North Carolina and Coastal South Carolina to as far north as Southern Virginia. This office will allow ARS to have a more centralized presence in the southeast region and allow us to more effectively serve our clients along the eastern seaboard.

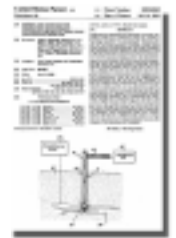
David Wagner, a professional geologist with more than 16 years of experience in the environmental remediation field, will be the regional manager of this new office. You can contact Dave at 919.968.9961 or [dw@arstechnologies.com](mailto:dw@arstechnologies.com)

## Exclusive Licenses for Pneumatic Fracturing Patent Available

As announced in our prior newsletter, ARS has received exclusive rights to

five environmental process patents (United States Patent No's 5,032,042, 5,560,737, 5,908,267, 5,984,578 and 6,012,517) covering a wide range of environmental treatment methods including Pneumatic Fracturing of soils/rock, atomized liquid injection of biological substrates, methods for injecting dry materials/chemicals into the subsurface for environmental and land development purposes, and the use of sonic energy to treat contaminated soils and groundwater. ARS is offering these technologies to qualified firms through commercial sublicense agreements.

Currently there are active discussions with several domestic and international firms regarding sublicense agreements. Contact ARS for more details on becoming a licensee.

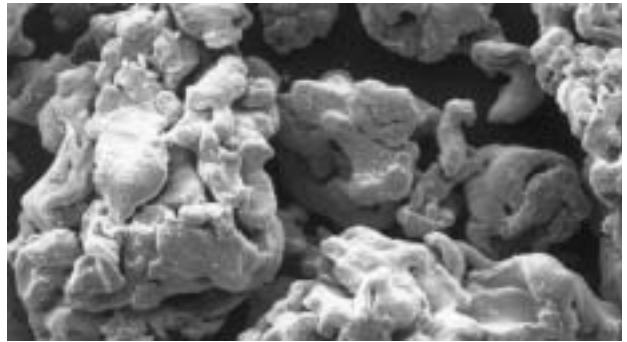


# Ferox<sup>SM</sup> Project Selected for NATO Meeting in Rome, Italy

A Ferox<sup>SM</sup> project was recently selected for presentation at the NATO/CCMS Pilot Program scheduled for May 2002 in Rome. In 1985, the North Atlantic Treaty organization (NATO) partners initiated a pilot study program to identify and review innovative technologies being applied around the world.

At each annual meeting, more than 70 delegates from different countries present updates on promising technologies being applied in their respective countries.

ARS' Ferox<sup>SM</sup> demonstration project implemented at NASA's Marshall Space Flight Center was selected for presentation at the opening 2002 meeting. Recent data from this system installed almost 2 years ago shows TCE groundwater concentrations decreasing from 77,000 ppb to 2000 ppb.



Ferox<sup>SM</sup> Particles magnified x 500

## ARS Major Projects Coming to a Site Near You

### California

Ferox<sup>SM</sup> project at government facility in Central California

### New Jersey

Pneumatic Fracturing and biotreatment using PHoster process

### Alabama

Chemical Oxidation by injecting  $\text{KMnO}_4$  for treatment of CVOCs and Hydrocarbons.

Pneumatic Fracturing and atomized injection of Biostimulation Substrates

### South Carolina

Metals Reduction injection project at private client site using limestone.

Chromium (Cr+6) Source Reduction using Ferox<sup>SM</sup> at Government Facility

CVOC source reduction using Ferox<sup>SM</sup> at Government Facility

### North Carolina

Pneumatic Fracturing of Saphrolite Fractured Rock aquifer to enhance hydraulic conductivity

### Texas

Ferox<sup>SM</sup> Injection in Central Texas



### Georgia

Ferox<sup>SM</sup> application at government facility in Central Georgia

Pneumatic Fracturing and Hydrogen Sparging Project in Georgia

### Canada

Toronto, Canada - Pneumatic Fracturing for Permeability Enhancement

Calgary, Canada - Pneumatic Fracturing for Permeability Enhancement



### ARS TECHNOLOGIES

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