

Environmental Remediation and Reclamation *Technical and Analytical Services*

Experience and Abilities

Western Research Institute (WRI) is a non-profit research institute that is uniquely situated to provide high-quality technical services to government and industry clients. Carrying the analytical and research capability of a university, WRI focuses on applied studies, technology development, analytical testing, and resolution of real world problems.

The Environmental Remediation & Reclamation (ER&R) group at WRI has developed several technologies to enhance remediation of various contaminants, including petroleum constituents, chlorinated compounds, explosives, metals, and their mixtures. In addition, WRI is leading the field in developing a Biological Source Treatment (BST) technique for identifying sources of acid mine drainage (AMD), treating impacted groundwater, and preventing future oxidation of AMD source material. WRI has also been actively involved in treating municipal and industrial wastewater for various inorganic and organic contaminants, as well as evaluating practical technologies to manage huge volumes of water produced during coal bed methane (CBM) extraction.

The ER&R group consists of scientists with a broad educational background and a wide range of expertise, including aquatic toxicology, biology, biochemistry, biogeochemistry, chemistry, chemical engineering, environmental biology, geology, geophysics, hydrogeology, microbiology, and molecular biology. Additionally, WRI's affiliation with the University of Wyoming (UW) and joint appointments of WRI scientists at UW enable our full access to specialized laboratories and analytical equipment at both WRI and UW.

Development of Innovative Technologies for Environmental Remediation

Fate, effects, and enhanced remediation of inorganic and organic contaminants in soil and groundwater

Example 1: *Biological Source Treatment of Acid Mine Drainage*

WRI has developed a unique Biological Source Treatment (BST) technique that is distinctive from other passive treatment techniques that focus on AMD effluents. Our BST technique uses readily available and inexpensive sources of bacteria inocula (e.g., wastewater effluent and solids, lagoon sediments) and substrates (e.g., returned milk, other dairy wasteproducts) to treat and prevent AMD generation at the source. Application of BST can completely eliminate or significantly reduce the acidity of effluent associated with mining operations. Additionally, we utilize electromagnetic induction survey techniques to identify AMD source material and monitor plumes without the need for expensive monitoring wells.

Example 2: *Electro-remediation and Enhanced Bio-dechlorination of DNAPL*

WRI has developed new techniques targeting DNAPL sources with high concentrations and plume areas with intermediate to low concentrations of DNAPL. For saturated source areas, we apply electro-remediation. Electrons from power sources (e.g., power line, battery, microbial fuel cell) are distributed through a network of electrodes that can be installed in a network of piezometers or existing groundwater wells. Our tests show that DNAPL such as trichloroethene (TCE) can be rapidly and completely degraded by electro-remediation with no accumulation of intermediate products. For plumes or large areas containing intermediate to low concentrations of DNAPL, we apply a selection of substrates (electron donors) and micro nutrients, achieving complete dehalogenation of the contaminants.

Example 3: *Circulating Biocell for Remediation of Petroleum-impacted Soils*

Our solid-phase circulating biocell (SCB) is designed to maximize aerobic biodegradation of petroleum contaminated soils. This technology is cost-effective, low maintenance, and especially suitable to treat mixed petroleum contaminants in semi-arid and arid environments. The WRI field bioreactor minimizes material consumption while achieving rapid degradation rates through a proprietary design and nutrient mix. For example, in one case study, the concentration of total petroleum hydrocarbons (TPH) was reduced from 15% to less than 0.07 percent within 6 weeks. In another pilot study, our SCB systems achieved a biodegradation rate of 640 mg TPH/kg/d, which is more than 4 times faster than the highest degradation rate reported for land farming (150 mg TPH/kg/d).



Specialized Analytical Services

Parameter Analyses

Total oxygen demand (TOD), chemical oxidation evaluations, major cations and anions, total organic carbon, soil paste extracts, petroleum hydrocarbon, and PAH fractionations.

Permeability

Permeability of soil cores and materials used for non-seepage applications such as landfill liners using a flex-wall permeameter with pressure control systems and material flow through various soil types.

Bacteria

Bacterial enumeration and species identification using most probable number (MPN) analyses, acridine orange staining and fluorescent microscopy, 16S rRNA, and real time PCR techniques.

Metal analyses and speciation

Analyses of dissolved and total heavy metals and metalloids in water, soil, and tissue and metal speciation using atomic adsorption, ICP-MS, XRD, EDS, and XDS.

Technical Services

Bioremediation of petroleum and halogenated contaminants

Chemical and bacterial characterizations, laboratory feasibility studies, pilot-scale implementation and monitoring in the field.

Source Treatment of Acid Mine Drainage

Site characterization, laboratory feasibility evaluations, pilot-scale implementation and monitoring in the field, and overall project management.

Aquatic Toxicology

Standard acute and chronic toxicity testing, method development, and research.

Electromagnetic Induction Surveys

For locating and monitoring sources of acid mine drainage, acid mine drainage plumes, leaking underground storage tank plumes, leakage from coal bed methane produced water impoundments and possible build up and movement of salts during and after land application of coal bed methane produced water.

Emerging Contaminants

Treatment of emerging contaminants such as 1,2-dioxane, endocrine disrupters, bacteria and viruses using innovative techniques.

Customized Services

The unique setting of WRI enables us to work closely with consulting companies, industries and government agencies. WRI has a broad range of scientific expertise and experience in solving technical problems associated with environmental assessments, remediation and reclamation. We also possess high-quality laboratory capabilities to conduct both contracted R&D and specialized analyses.

We welcome the opportunity to serve as your "extended technical team" to resolve complications and problems emerging from various remediation situations through both laboratory testing and field evaluations. We also invite your partnership to develop and apply innovative technologies to better meet environmental remediation challenges.

Publications

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- Morris, J.M.**, A.M. Farag, D.A. Nimick, and J.S. Meyer. 2006 Light-mediated Zn uptake in photosynthetic biofilm. Hydrobiologia 571: 361-371.
- Morris, J.M.** and J.S. Meyer. 2006. Extracellular and intracellular uptake of zinc in a photosynthetic biofilm matrix. Bulletins of Environmental Contamination and Toxicology 77: 30-35.
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- Jin, S.**, **P.H. Fallgren, J.M. Morris**, and Q. Chen. 2007. Removal of bacteria and viruses from waters using layered double hydroxide nanocomposites. Science and Technology of Advanced Materials 8: 67-70.
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Sample of Clients

*AECOM Environmental Group
Arcadis G&M
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Williams Energy
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