

# Technology Innovation News Survey

## Entries for March 1-31, 2017

### Market/Commercialization Information

#### DISPOSAL AND DEMIL OF EXPLOSIVE MATERIALS

Department of the Navy, Naval Sea Systems Command, NSWC IHEODTD, Indian Head, MD.  
Federal Business Opportunities, FBO-5678, Solicitation N00174-17-R-0006, 2017

This acquisition is unrestricted. The purpose of this contract is to provide support in treating reactive hazardous waste that it is not feasible to treat at the NSWC IHEODTD Strauss Avenue Burn Point because of possible detonation hazard, other permit restrictions, and treatment facility timely availability considerations. The possibility exists for multiple EPA waste codes, in addition to D003, necessitated by other components or underlying hazardous constituents, such as asbestos, ammonium perchlorate, heavy metals (e.g., lead, mercury), and others. Required support shall be provided in accordance with specific, individually written Task Orders within the general scope of the Statement of Work and the issued IDIQ contract. This contract has an initial period of performance of 12 months and provisions for four 12-month option periods. The initial task order will be for up to 7200 grams of DXN-1 primary explosive, and additional first-year tasks may follow. Offers are due by 3:00 PM ET on July 10, 2017.  
<https://www.fbo.gov/spg/DON/NAVSEA/N00174/N00174-17-R-0006/listing.html>

#### ENVIRONMENTAL REMEDIATION AND DECOMMISSIONING SERVICES

Department of Transportation, Volpe National Transportation Systems Center, Cambridge, MA.  
Federal Business Opportunities, FBO-5661, Solicitation DTRT5717R20017, 2017

The DOT National Transportation Systems Center plans to issue a total small business set-aside solicitation for Environmental Remediation and Decommissioning Services (ERDS) support for multiple 4-year contract awards under NAICS code 562910 (Environmental Remediation). The solicitation will be issued on an IDIQ basis with the ability to issue firm-fixed-price, cost-plus-fixed-fee completion, and cost-plus-fixed-fee term-type task orders. The successful offerors will need to be capable of supporting a range of ERDS at multiple sites across large geographic areas simultaneously. Release of the solicitation is expected on or about July 15, 2017. The details of a pre-proposal webinar will be provided in the solicitation.  
<https://www.fbo.gov/notices/1fd1db89827128fc456973a9f2fd892>

#### CLEBURN STREET WELL: IN SITU THERMAL REMEDIATION

Environmental Protection Agency, Office of Acquisition Management, Region VII, Lenexa, KS.  
Federal Business Opportunities, FBO-5658, Solicitation SOL-R7-17-00008, 2017

EPA Region 7 is planning a performance-based in situ thermal remediation (ISTR) requirement at the Cleburn Street Well OU2 Superfund Site in Grand Island, Nebraska. This requirement will be a total small business set-aside. The contractor shall provide the labor, equipment, materials, tools, and supplies to design, install, construct, operate, control, and monitor all required elements of an ISTR system to address soil contamination (PCE, TCE, carbon tetrachloride, and chloroform) detected at and below the water table across a thermal treatment zone of ~12,700 sq ft. The contractor shall also be responsible for preparing the site for system installation and shall identify existing PVC wells or piping affected by the ISTR process to recommend for abandonment. Additionally, the contractor shall install eight groundwater monitoring wells and perform site restoration activities associated with the ISTR system. Performance will take place over a 12-month period. Monitor FedConnect for updates to this pre-solicitation at <https://www.fedconnect.net/FedConnect/?doc=SOL-R7-17-00008&agency=EPA> [Note: It might be necessary to copy/paste the URL into your browser for direct access].

#### TANANA RIVER AREA SOIL DISPOSAL

U.S. Army Corps of Engineers, USACE District, Alaska.  
Federal Business Opportunities, FBO-5672, Solicitation W911KB-17-R-0064, 2017

This notice is a presolicitation announcement for Tanana River soil disposal, Ft. Wainwright, Alaska. Contractor services are needed to characterize, containerize, transport, dispose of, and potentially treat previously excavated soils at the site. The soils were and will be generated during the Time-Critical Removal Action at the OB/OD Tanana River Site during the 2015, 2016, and 2017 field seasons. This project is contingent on availability of funds. The solicitation will be issued as a woman-owned small business (WOSB) set-aside. Any resulting contract will be firm fixed-price. Release of the solicitation is anticipated around June 16, 2017. Access to the documents will be through a link on FedBizOpps as well as any future amendments to the solicitation. The applicable NAICS code is 562910 (Remediation Services), and the related small business size standard is 750 employees.  
<https://www.fbo.gov/spg/USA/COE/DACA85/W911KB-17-R-0064/listing.html>

### Cleanup News

#### SOLVENTS RECOVERY SERVICE OF NEW ENGLAND (SRSNE) SITE: SITE UPDATE

U.S. EPA Region 1, 3 pp, 2016

A multi-phase cleanup is underway at the SRSNE Site, located on ~14 acres of land along the Quinnipiac River in Southington, Connecticut. Thermal treatment cleared >99% of the targeted waste oils and solvents in soils beneath the site, removing nearly 500,000 lb of waste oils and solvents between 2013 and 2015 during operation of a network of 607 heating probes and 551 vapor recovery wells. The next and final step of the remedy construction involves consolidating remaining impacted soils and isolating them under a permanent waterproof cap. Construction of a solar array atop the cap is proposed to offset some of the power needs for long-term maintenance and monitoring of the cap and groundwater conditions. <http://semspub.epa.gov/src/document/01/591222> See additional information on this cleanup at <http://www.srsnesite.com/>.

#### PERMEABLE REACTIVE BARRIERS FOR PETROLEUM HYDROCARBONS COMPOUNDS (PHCs)

Tunnicliffe, B. 2017 SMART Remediation Toronto, January 26, 2017. 25 slides, 2017

A new (to Canada) in situ granular activated carbon (GAC)-based technology has been used successfully to treat PHCs and chlorinated VOCs along property boundaries. Although the use of GAC in the subsurface previously has been inhibited by GAC's limited adsorptive capacity, the "trap and treat" concept (based on BOS® products) allows for both adsorption and treatment of dissolved PHCs via permeable reactive barriers installed to allow for PHC plume capture and treatment over a long period of time. The trap and treat concept is discussed in case studies that illustrate how the technology can be applied along property boundaries, adjacent to streams, or along other sensitive receptors.  
<http://www.smartremediation.com/wp-content/uploads/2016/10/SMART-Remediation-Vancouver-2017-Bruce-Tunnicliffe.pdf>

#### DPT JET INJECTION FOR RAPID ZVI DELIVERY IN LOW-PERMEABILITY ZONES: KEY RESULTS 18 MONTHS AFTER FULL-SCALE INJECTION

Baird, D.  
2017 SMART Remediation Toronto, January 26, 2017. 45 slides, 2017

The performance of direct-push technology (DPT) jet injection was demonstrated during full-scale treatment of a chlorinated solvent source zone at a site in Denmark, where 49 tons of micro-scale zero-valent iron (MZVI) blended with sand was injected into a target treatment zone of clay till. The dataset from detailed geologic logging and magnetic susceptibility measurements of 79 soil borings comprising 1,000 meters of core supports the conclusion that DPT jet injection can consistently create subhorizontal MZVI zones with a radius of injection of at least 3 meters. Performance monitoring has focused on contaminant destruction within and mass flux out of the treatment zone. Groundwater data indicate that TCE mass discharge from the source area decreased post-injection by 71% after 12 months and 86% after 18 months. Results show the effectiveness of penetrative distribution of reactive ZVI for treating high-mass chlorinated solvent source areas in challenging, low-permeability formations.  
<http://www.smartremediation.com/wp-content/uploads/2016/09/SMART-Remediation-Toronto-2017-Drew-Baird.pdf>

#### THINKING OUTSIDE THE BOXCAR: EFFECTIVE AND SUSTAINABLE COMBINED REMEDIES USING SINGLE APPLICATION OF MULTIFUNCTIONAL AMENDMENTS

Burns, M., D. Carstens, E. Ghosh, R. Lewis, J. Zajdlik, A.M. Bakken, and R.N. De Tilly.  
Groundwater Monitoring & Remediation 37(1):42-50(2017)

The combined remedy approach to groundwater remediation optimizes contaminated site cleanup as measured by technical efficacy and sustainability. Analyses using multicomponent multifunctional amendment formulations for in situ groundwater treatment can provide an entry for combined remedy implementation without the detractors commonly associated with discrete treatment train approaches, such as potential cost escalation and schedule uncertainty. Four case studies are presented that demonstrate the efficacy of this combined remedies approach as supported with conventional concentration trends and advanced diagnostics, including compound-specific isotope analysis and genetic-based molecular biological tools. The case studies address combined abiotic and biotic degradation of chlorinated ethene and ethane compounds, combined reductive and microaerophilic treatment of chlorinated benzenes, and combined chemical oxidation and biodegradation of petroleum compounds. This paper is **Open Access** at <http://onlinelibrary.wiley.com/doi/10.1111/gwmr.12196/full>.

## CASE STUDY AND RETROSPECTIVE: AEROBIC FIXED FILM BIOLOGICAL TREATMENT PROCESS FOR 1,4-DIOXANE AT THE LOWRY LANDFILL SUPERFUND SITE

Cordone, L., C. Carlson, W. Plaehn, T. Shingraw, and D. Wilmoth.  
Remediation Journal 27(1): 159-172(2016)

An aerobic fixed film biological treatment system has been successfully treating recovered groundwater/landfill leachate containing 1,4-dioxane, tetrahydrofuran (THF), and other constituents since 2003. The most likely mode of dioxane biotransformation is via a cometabolic pathway in the presence of THF. Pilot studies conducted during the process development phase established a design basis process loading factor of 0.6 g dioxane and THF (as chemical oxygen demand/g total solids/d) and proved the efficacy of the process. Full-scale design includes the use of three parallel moving bed bioreactors with effluent recycle capability. Removal efficiencies in excess of 98% have been documented for dioxane. Evolving operational challenges are associated with recent trends in dioxane pretreatment discharge limitations in combination with ongoing process optimization and increased influent flow-rate conditions associated with seasonal precipitation patterns. *See additional information in 26 slides at*  
<https://www.aiche.org/sites/default/files/community/165156/aiche-community-site-event/165206/2012-10lowrylandfillsuperfundsites.pdf>

## Demonstrations / Feasibility Studies

### FIELD DEMONSTRATION OF POLYMER-AMENDED IN SITU CHEMICAL OXIDATION (PA-ISCO)

Silva, J.A.K., M. Crimi, T. Palaia, S. Ko, and S. Davenport.  
Journal of Contaminant Hydrology 199:36-49(2017)

The first field-scale demonstration of polymer-amended in situ chemical oxidation (PA-ISCO) took place at Marine Corps Base Camp Lejeune, NC, between October and December 2010. PA-ISCO utilizes viscosity-modified fluids to improve the in situ delivery and distribution (i.e., sweep efficiency) of chemical oxidants within texturally heterogeneous contaminated aquifers. This treatment can enhance subsurface contact between injected oxidant and target contamination within the treatment zone. The PA-ISCO fluid formulation used in this demonstration included sodium permanganate as oxidant, xanthan gum biopolymer as a shear-thinning viscosifier, and sodium hexametaphosphate as an anti-coagulant. An approximate 100% improvement in sweep efficiency was achieved for the PA-ISCO fluid, as compared to a permanganate-only control injection. *See additional information on ESTCP Project ER-200912 at*  
<https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-200912>.

### NANOREM PILOT SITE — NEOT HOVAV, ISRAEL: TRANSPORT OF IRON NANOPARTICLES IN FRACTURED CHALK

Cohen, M. and N. Weisbrod.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 11, 4 pp, 2017

A pilot study is underway at a research facility in Israel to investigate the transport of iron nanoparticles (NPs) in fractured chalk. NP transport was shown to be heavily dependent on the stability of the NP suspension and hence on particles properties, stabilizer concentration, and solution properties like viscosity and ionic strength. Transport potential in a fractured rock matrix is high and can be manipulated by changing stabilizer concentration and particle properties, such as single particle size, aggregate size, and particle stability. Flow velocity also impacts particle transport. The authors concluded that stability analysis of particulate suspensions combined with evaluation of field hydraulic parameters could provide good estimation for NP mobility.  
[http://www.nanorem.eu/Stream.aspx?p=/App\\_Data/docs/user62Gallery/NanoRem\\_Bulletin11%20-%20final%20version%20hi-res.pdf](http://www.nanorem.eu/Stream.aspx?p=/App_Data/docs/user62Gallery/NanoRem_Bulletin11%20-%20final%20version%20hi-res.pdf)

### NANOREM PILOT SITE — NITRASTUR, SPAIN: REMEDIATION OF ARSENIC IN GROUNDWATER USING NANOSCALE ZERO-VALENT IRON

Otaegi, N. and E. Cagigal.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 12, 6 pp, 2017

The Nitrastur site is characterized by high concentrations of As in both soil and groundwater. According to scientific literature, both arsenates [As(V)] and arsenites [As(III)] can be fully transformed into metalloid arsenic As(0) by reaction with NZVI. From February 23 to 27, 2016, a total of 250 kg of NANOFE STAR was injected in the pilot area. According to oxidation-reduction potential (ORP) recorded values, there was first an initial partial increase in all wells, followed by a steady situation, with no significant variations. At 180 days after injection, redox values remained below pre-injection conditions. Although in general terms results were encouraging, additional long-term lab tests and technology modeling tools for predicting the effects are recommended for future applications, particularly considering the possibility of arsenic partial desorption.  
[http://www.nanorem.eu/stream.aspx?p=/App\\_Data/docs/user14Gallery/1\\_Toolbox/3\\_Bulletins/NanoRem\\_Bulletin12.pdf](http://www.nanorem.eu/stream.aspx?p=/App_Data/docs/user14Gallery/1_Toolbox/3_Bulletins/NanoRem_Bulletin12.pdf)

### NANOREM PILOT SITE — SPOLCHEMIE I, CZECH REPUBLIC: NANOSCALE ZERO-VALENT IRON REMEDIATION OF CHLORINATED HYDROCARBONS

Stejskal, V., T. Lederer, P. Kvapil, J. Slunsky, and P. Skacelova.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 7, 8 pp, 2017

The Spolchemie site was chosen to test two types of nanoparticles (NPs): NZVI, the subject of this bulletin, and the iron oxide Nano-Goethite (see NanoRem Bulletin #8). NZVI was applied for the remediation of chlorinated hydrocarbons (CHCs), mainly PCE, TCE, and cis-1,2-DCE. Remedial activities have been ongoing at Spolchemie since 2005. The main aim of this pilot was to verify migration characteristics and remedial efficiency of two types of NZVI—NANOFE 255 and NANOFE STAR—using advanced procedures for monitoring NPs and vertical stratification of contamination. The first application of the NZVI NANOFE 255 on the Spolchemie I site took place in November 2014 and was monitored until the summer of 2015. The second NZVI direct-push injection (NANOFE STAR) was carried out in October 2015 together with a tracer (LiCl). Both NZVI products effected a decrease in redox potential, a significant reduction in CHCs (up to 85% for NANOFE 255 and up to 95% for NANOFE STAR), and an increase in final degradation products, ethane and ethene.  
[http://www.nanorem.eu/stream.aspx?p=/App\\_Data/docs/user14Gallery/1\\_Toolbox/3\\_Bulletins/NanoRem\\_Bulletin7.pdf](http://www.nanorem.eu/stream.aspx?p=/App_Data/docs/user14Gallery/1_Toolbox/3_Bulletins/NanoRem_Bulletin7.pdf)

### NANOREM PILOT SITE — SPOLCHEMIE II, CZECH REPUBLIC: REMEDIATION OF BTEX COMPOUNDS USING NANO-GOETHITE

Lederer, T., V. Stejskal, P. Kvapil, R. Meckenstock, and B. Krok.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 8, 6 pp, 2017

A pilot test of Nano-Goethite, an iron oxide nanoparticle (NP), was conducted to evaluate its potential for enhancing the natural biodegradation of BTEX compounds. Nano-Goethite is an iron oxide modified by humic substances, developed at the Helmholtz Centre Munich and the University of Duisburg-Essen. It was supplied as an aqueous suspension. The ongoing remediation approach for the site's BTEX compounds is removal of free phase by skimming, groundwater pump and treat, and enhanced biodegradation. The main aim of this pilot was to assess the ability of Nano-Goethite to enhance microbial activity in the pilot study area and thus to degrade BTEX compounds more effectively. In the first Spolchemie II Nano-Goethite pilot application in October 2015, the site was saturated with the Nano-Goethite suspension in the most permeable zones. Contact between contaminated groundwater and NPs was proved at every monitoring point. The suspended microbial community in the water phase did not react significantly to the ferric iron injection. The great majority of the microorganisms are attached to the sediment; hence, changes in the microbial community composition are not immediately reflected in the water phase.  
[http://www.nanorem.eu/stream.aspx?p=/App\\_Data/docs/user14Gallery/1\\_Toolbox/3\\_Bulletins/NanoRem\\_Bulletin8.pdf](http://www.nanorem.eu/stream.aspx?p=/App_Data/docs/user14Gallery/1_Toolbox/3_Bulletins/NanoRem_Bulletin8.pdf)

### NANOREM PILOT SITE — SOLVAY, SWITZERLAND: NANOSCALE ZERO-VALENT IRON REMEDIATION OF CHLORINATED SOLVENTS

Bitsch, R., P. Matz, P. Kvapil, and N. Klaas.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 9, 6 pp, 2017

The target contaminants—PCE, TCE, and hexachloroethane (HCA)—are concentrated at about 16 m bgs in the lower part of the aquifer, where mainly aerobic conditions prevail. Concentration values of 20 µg/L PCE and 35 µg/L TCE can be considered as the final remediation goal, although a concentration value for HCA has yet to be defined. Injection of FerMEG12 took place in March 2015 during three days of injection. NZVI as FerMEG12 was injected directly into a DNAPL secondary source zone where the contaminants are present in pools, as residual phase, and more permanently adsorbed into the opalinuston. The remediation goal is to eliminate the plume by treating the source and thus shorten the operating time of the existing pump-and-treat system. Three months after injection, contaminant concentrations at sampling level F in the injection zone fell by 49-89% for PCE, 81-97% for TCE and 97-98% for HCA. A slight rebound was not observed until one year after injection. The quantity of contaminant found in the test area (mainly in the deepest part) exceeded what was expected; hence, a second NZVI injection is planned. [http://www.nanorem.eu/stream.aspx?p=/App\\_Data/docs/user14Gallery/1\\_Toolbox/3\\_Bulletins/NanoRem\\_Bulletin9.pdf](http://www.nanorem.eu/stream.aspx?p=/App_Data/docs/user14Gallery/1_Toolbox/3_Bulletins/NanoRem_Bulletin9.pdf)

### NANOREM PILOT SITE — BALASSAGYARMAT, HUNGARY: IN SITU GROUNDWATER REMEDIATION USING CARBO-IRON® NANOPARTICLES

Laszlo, T. and M. Szabo.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 10, 6 pp, 2017

A pilot study of in situ remediation using Carbo-Iron® nanoparticles (NPs) was conducted to address a groundwater plume, mainly dissolved-phase PCE. Carbo-Iron, an air-stable powder developed at The Helmholtz Centre for Environmental Research-UFZ, consists of activated carbon colloids that are doped inside with nanoiron structures. These colloids can be used to target halogenated organic contaminants or heavy metals in groundwater. Following Carbo-Iron injection in September 2015, a significant decrease of PCE was detected in the monitoring wells closest to the injection points; however, the ROI was limited, and Carbo-Iron traces were observed only in very close proximity to the injection points. The on-site activities (dispersing Carbo-Iron and adding carboxymethyl cellulose [CMC]) before the injection needed careful preparation and made the process quite slow at the site. Several lessons were learned on

this project: (1) the CMC stabilizer needs to be chosen carefully according to site-specific conditions, (2) modeling is recommended to predict injectant migration, and (3) site preparation can be enhanced by using on-site equipment to disperse the materials to be injected. [http://www.nanorem.eu/stream.aspx?p=/App\\_Data/docs/user14Gallery/1\\_Toolbox/3\\_Bulletins/NanoRem\\_Bulletin10.pdf](http://www.nanorem.eu/stream.aspx?p=/App_Data/docs/user14Gallery/1_Toolbox/3_Bulletins/NanoRem_Bulletin10.pdf)

#### **CARBO-IRON AS IMPROVEMENT OF THE NANOIRON TECHNOLOGY: FROM LABORATORY DESIGN TO THE FIELD TEST**

Mackenzie K., S. Bleyl, F.-D. Kopinke, H. Doose, and J. Bruns.  
Science of the Total Environment 563-564:641-648(2016)

Carbo-Iron®, a composite material of colloidal activated carbon and embedded nanoiron structures, was pilot tested for remediation of a PCE-contaminated field site in Lower Saxony, Germany. Results of the 2-step field test confirmed the properties intended by its design and the particle performance achieved in lab experiments. The material showed transport lengths of several meters in the field and fast PCE decomposition with no vinyl chloride formation. The investigators also noted an extended longevity of the PCE decrease in the treated area and evidence for microbiological participation. See additional information in a poster at [http://www.nanorem.eu/Stream.aspx?p=/App\\_Data/docs/user117Gallery/99\\_ACS/Posters/1C.6-4%20Golder\\_mack.pdf](http://www.nanorem.eu/Stream.aspx?p=/App_Data/docs/user117Gallery/99_ACS/Posters/1C.6-4%20Golder_mack.pdf).

#### **BIOAUGMENTATION IN A WELL-CHARACTERIZED FRACTURED ROCK DNAPL SOURCE AREA**

Lavorgna, G.M., E.B. White, and M.D. Annable.  
Groundwater Monitoring & Remediation 37(2):35-42(2017)

In a field demonstration performed at Edwards AFB to assess bioaugmentation for treatment of a well-characterized PCE DNAPL source area in fractured rock, groundwater recirculation was employed to deliver remedial amendments, including bacteria. An active treatment period of 9 months preceded a 10-month post-treatment rebound evaluation. Dechlorination daughter products were observed in both the shallow and deep fracture zones following treatment. In the shallow fracture zone, the calculated DNAPL mass removed was close to the DNAPL mass estimated using partitioning tracer testing, and no rebound in chlorinated ethenes or ethene was observed post treatment. A maximum DNAPL dissolution enhancement factor of 5 was observed in the shallow fracture zone. In the deep fracture zone, however, only ~45% of the DNAPL mass (as estimated via partitioning tracer testing) was removed, and rebound in the total molar chlorinated ethenes + ethene was observed. The DNAPL architecture and the fracture flow field may account for the difference in behavior between the shallow and deep fracture zones.

#### **LAND APPLICATION OF SULFATE SALTS FOR ENHANCED NATURAL ATTENUATION OF BENZENE IN GROUNDWATER: A CASE STUDY**

Kolhatkar, R. and M. Schnobrich.  
Groundwater Monitoring & Remediation 37(2):43-57(2017)

This paper presents a case study involving the land application of commonly available sulfate salts (gypsum and Epsom salt) over a groundwater plume (predominantly benzene) footprint as an alternative delivery approach to conventional well-based injection of dissolved sulfate solution. This approach capitalizes on natural surficial infiltration processes available at the site to provide sustained elevated sulfate concentrations in the impacted soil source area and facilitate enhanced attenuation. Design specifications for successful sulfate land application as a delivery mechanism for enhanced attenuation are discussed. Groundwater monitoring data demonstrate the technique's viability. This paper is **Open Access** at <http://onlinelibrary.wiley.com/doi/10.1111/gwmr.12209/full>.

#### **THE USE OF ZERO-VALENT IRON (ZVI) TECHNOLOGY TO PROMOTE DDT AND DIELDRIN DEGRADATION AT POINT PEELE NATIONAL PARK**

Dahmer, C.P., A. Rutter, B.A. Zeeb.  
Remediation Journal 27(2):65-76(2017)

Point Pelee National Park (PPNP) is highly contaminated with DDT and dieldrin due to the historical use of these two persistent organochlorine pesticides. Two commercially available zero-valent iron (ZVI) products, DARAMEND® and EHC®, were tested for promoting DDT and dieldrin degradation in PPNP's soil and groundwater. DARAMEND applied to PPNP's soil in a lab study and an in situ pilot-scale plot had no significant effect on DDT or dieldrin degradation in the treated soils. EHC effectiveness tested in a lab experiment that simulated the park's groundwater environment using PPNP's pesticide-contaminated soil likewise showed no significant increase in DDT or dieldrin degradation. Neither of these commercially available ZVI products appears suitable for in situ remediation at PPNP. This paper is **Open Access** at <http://onlinelibrary.wiley.com/doi/10.1002/rem.21511/full>. See additional details in Chapter 5 of C.P. Dahmer's thesis at <https://espace.rmc.ca/handle/11264/1181>.

#### **DEMONSTRATING CONTAMINANT DEGRADATION AT AN MGP SITE WITH METABOLIC GAS FLUX AND RADIO CARBON DATING**

Carroll, S.M., A.D. Peacock, J. Zimbron, K.N. Alepidis, and J.A. Clock.  
Remediation Journal 27(2):51-64(2017)

A field demonstration was conducted of monitored natural recovery in river sediments affected by manufactured gas plant contaminants. Metabolic gas flux was performed in an urban area section of a river in northeastern Indiana where CO<sub>2</sub> sorbent traps were deployed to measure CO<sub>2</sub> flux from the river sediments. Sediment samples were collected and analyzed for PAH concentrations and for microbial community composition using molecular techniques. The deployment successfully measured CO<sub>2</sub> flux at all sediment locations, demonstrating that microbial contaminant-degrading activity was occurring in the sediments. This paper is available with other **Open Access** articles at <http://onlinelibrary.wiley.com/doi/10.1002/rem.2017.27.issue-2/issuetoc>.

#### **PRELIMINARY OBSERVATIONS FROM ROBOT-ENABLED SURFACE METHANE CONCENTRATION MONITORING AT A MSW LANDFILL**

Bateman, J., D. Zekkos, E. Olson, S.M. Messenger, C. Kershaw, X. Fei, and J. Lynch.  
American Society of Civil Engineers, Reston, VA. Geotechnical Special Publication No 273:740-749(2016)

A land-based robot coupled with commercially available, relatively low-cost methane detection technology for field monitoring was tested at an active MSW landfill. Three test areas within the landfill were selected, and surface methane concentration surveys were performed both manually and by robot using the Landtec TDL-500, a tunable diode laser methane detector. Preliminary field observations indicate that a robotic platform can significantly improve quality in data acquisition for surface methane concentrations at MSW landfills. The authors also address the limitations of land-based robots for site-wide emission monitoring. <https://april.eecs.umich.edu/media/pdfs/bateman2016geo.pdf>

## **Research**

#### **RELEASE OF AIRBORNE POLYCHLORINATED BIPHENYLS FROM NEW BEDFORD HARBOR RESULTS IN ELEVATED CONCENTRATIONS IN THE SURROUNDING AIR**

Martinez, A., B.N. Hadnott, A.M. Awad, N.J. Herkert, K. Tomsho, K. Basra, et al.  
Environmental Science & Technology Letters 4(4):127-131(2017)

Researchers demonstrated qualitatively and quantitatively that airborne PCB concentrations in the air surrounding New Bedford Harbor (NBH) result from its water-PCB emissions. Measurement of airborne PCBs at 18 homes and businesses near NBH in 2015 gave values ranging from 0.4–38 ng/m<sup>3</sup>, with a very strong Aroclor 1242/1016 signal (reproducible over three sampling rounds) most pronounced nearest the harbor. U.S. EPA water-PCB data from 2015 and local meteorology data were used to predict gas-phase fluxes of PCBs from 160–1200 µg/m<sup>2</sup>/day. Fluxes were used as emissions for AERMOD atmospheric dispersion model to predict airborne PCB concentrations. The AERMOD predictions were within a factor of 2 of the field measurements. PCB emission from NBH (110 kg/yr, average 2015) is the largest reported source of airborne PCBs from natural waters in North America, and the source of high ambient air PCB concentrations in locations close to NBH. [http://precaution.org/lib/martinez\\_pcbcs\\_emitted\\_from\\_new\\_bedford\\_harbor.170215.pdf](http://precaution.org/lib/martinez_pcbcs_emitted_from_new_bedford_harbor.170215.pdf)

#### **MECHANOCHEMICAL REMEDIATION OF PCB CONTAMINATED SOIL**

Wang, H., J. Hwang, J. Huang, Y. Xu, G. Yu, W. Li, K. Zhang, K. Liu, Z. Cao, X. Ma, Z. Wei, et al.  
Chemosphere 168:333-340(2017)

Although mechanochemical destruction (MCD) has been recognized as a promising technology for the destruction of persistent organic pollutants (POPs) and other organic molecules in both solid waste and contaminated soil, few studies have been published about MCD application to remediation of PCB-contaminated soil. In an investigation of the feasibility of destroying PCBs in contaminated soil by co-grinding with and without additives in a planetary ball mill, >96% of PCBs in contaminated soil samples were destroyed after 4 h milling time. Residual PCB concentrations fell from 1000 mg/kg to below the provisional Basel Convention limit of

#### **REMEDICATION OF PCB-CONTAMINATED SOIL USING A COMBINATION OF MECHANOCHEMICAL METHOD AND THERMAL DESORPTION**

Zhao, Z.-H., X.-D. Li, M.-J. Ni, T. Chen, and J.-H. Yan.  
Environmental Science and Pollution Research 24(12):11800-11806(2017)

A test of the combination of a mechanochemical method and thermal desorption for remediating PCBs in contaminated soil entailed an investigation of the effects of grinding time and heating time on PCB removal efficiency. The contaminated soil, mixed with CaO powder at 1:1 weight ratio, was first ground using

a planetary ball mill. After 4 h of grinding, the total PCB concentration and its toxic equivalence quantity decreased by 74.6 and 75.8%, respectively. After heating at 500°C for 60 min, residual PCBs in the mechanochemical + thermally treated soil declined to 247 ng/g, indicating a removal efficiency of 99.95%. The removal effect can be promoted by longer grinding time and heating time at a cost of increased energy consumption, which suggests a need to optimize the combination of grinding time and heating time in practical application.

#### DIOXINS REFORMATION AND DESTRUCTION IN SECONDARY COPPER SMELTING FLY ASH UNDER BALL MILLING

Cagnetta, G., M.M. Hassan, J. Huang, G. Yu, and R. Weber.  
Scientific Reports 6:Article 22925(2016)

Experiments were conducted to evaluate the effectiveness of high-energy ball milling with calcium oxide and silica to detoxify copper smelting fly ash containing 79,090 ng TEQ/kg polychlorinated dibenzo-p-dioxins and dibenzofurans. Mechanochemical treatment obtained 76% dioxins reduction in 4 h, but longer milling time induced a partial *de novo* formation of dioxins catalyzed by copper. After 12 h treatment, the dioxin content fell substantially (85% reduction), while copper content, thanks to the phenomena of incorporation and amorphization that occurred during milling, was almost inactivated.  
<http://www.nature.com/articles/srep22925>

#### PROSPECTS FOR ARBUSCULAR MYCORRHIZAL FUNGI (AMF) TO ASSIST IN PHYTOREMEDIATION OF SOIL HYDROCARBON CONTAMINANTS

Rajtor, M. and Z. Piotrowska-Seget.  
Chemosphere 162:105-116(2016)

Arbuscular mycorrhizal fungi (AMF) form mutualistic associations with the roots of 80-90% of vascular plant species and may constitute up to 50% of the total soil microbial biomass. AMF mycelium forms a widespread underground network between plant roots, soil, and rhizosphere microorganisms. This paper presents and evaluates the role and significance of AMF in phytoremediation of hydrocarbon-contaminated sites with a focus on (1) hydrocarbon impact on arbuscular mycorrhizal symbiosis, (2) AMF potential to enhance phytoremediation, and (3) determinants that influence the effectiveness of hydrocarbon removal from contaminated soils. This knowledge may be useful for selection of proper plant and fungal symbionts and for optimization of environmental conditions for effective AMF-mediated phytoremediation. Three-component phytoremediation systems based on synergistic interactions between plant roots, AMF, and hydrocarbon-degrading microorganisms have demonstrated high effectiveness in dissipation of organic pollutants in soil.

#### ARBUSCULAR MYCORRHIZAL FUNGAL HYPHAE ALTER SOIL BACTERIAL COMMUNITY AND ENHANCE POLYCHLORINATED BIPHENYLS DISSIPATION

Qin, H., P.C. Brookes, and J. Xu.  
Frontiers in Microbiology 7:939(2016)

An investigation of the role of arbuscular mycorrhizal fungal (AMF) hyphae in alteration of soil microbial community and Aroclor 1242 dissipation was conducted in a 2-compartment rhizobox system with double nylon meshes in the central part. This system was used to evaluate the influence of *Cucurbita pepo* L. root exudates on hyphal compartment soil. To assess the quantitative effect of AMF hyphae on the soil microbial community, researchers separated the hyphal compartment soil into four horizontal layers from the central mesh to the outer wall. Soil total PCB dissipation rates ranged from 35.67% up to 57.39% in the AMF-inoculated layers, significantly higher than the 17.31% of the control. The dissipation rates of tri- and tetrachlorinated biphenyls as well as total PCBs correlated with soil hyphal length. Results suggest that the AMF hyphal exudates as well as the hyphae per se have quantitative effects on shaping the soil microbial community, and consequently could modify PCB dissipation processes. <http://journal.frontiersin.org/article/10.3389/fmicb.2016.00939/full>

#### ECOSYSTEM SERVICES AND PLANT PHYSIOLOGICAL STATUS DURING ENDOPHYTE-ASSISTED PHYTOREMEDIATION OF METAL CONTAMINATED SOIL

Burges, A., L. Epelde, F. Blanco, J.M. Becerril, and C. Garbisu.  
Science of the Total Environment 584-585:329-338(2017)

Endophytic plant growth-promoting bacteria were isolated from two metal-(hyper)accumulating plant species grown in a metal-contaminated mine soil. After characterizing their plant growth-promoting traits, consortia of putative endophytes were used to carry out an endophyte-assisted phytoextraction experiment with plantings of *Noccaea caerulea* and *Rumex acetosa* (singly and in combination) under controlled conditions. Researchers evaluated the influence of endophyte-inoculated plants on soil physicochemical and microbial properties, plant physiological parameters, and metal concentrations. When *N. caerulea* and *R. acetosa* plants were grown together, a 41% and 16% increase in growth, respectively, was observed, as well as higher values of Zn phytoextraction and soil microbial biomass and functional diversity. Inoculation of the consortia of putative endophytes did not lead to higher values of plant metal uptake, but it improved the plants' physiological status by increasing the content of chlorophylls and carotenoids, thus indicating a reduction in plant stress levels. Endophyte inoculation also stimulated soil microbial communities.

#### LONG-TERM EFFECTS OF AIDED PHYTOSTABILIZATION ON MICROBIAL COMMUNITIES OF METAL-CONTAMINATED MINE SOIL

Gariyurebaso, O., C. Garbisu, F. Blanco, A. Lanzen, I. Martin, L. Epelde, J.M. Becerril, et al.  
FEMS Microbiology Ecology 93(3):(2016)

The long-term effectiveness of different organic amendments was examined as part as an aided phytostabilization field trial on an abandoned Pb/Zn mine in areas with LESS and MORE levels of heavy metal contamination. Heavy metal bioavailability along with biological indicators of soil health and microbial biodiversity (16S and 18S rRNA sequencing) were analyzed. The paper-mill sludge mixed with poultry manure (2:1, v/v) treatment achieved the highest reduction of Cd, Pb, and Zn extractability over cow, sheep, and poultry manure treatments. Beneficial effects of this amendment were also observed in terms of recovering microbial biodiversity and activity, especially in the LESS contaminated site. Cow slurry was the least successful amendment.

#### SOIL VAPOR EXTRACTION ENDSTATE TOOL CALCULATIONS FOR THE 216-Z-9, 216-Z-1A, AND 216-Z-18 WASTE SITES IN THE 200-PW-1 OPERABLE UNIT

ECF-200PW1-16-0077, 14 pp, 2016

This calculation supports evaluation of the soil vapor extraction (SVE) systems in the 200-PW-1 Operable Unit. The calculation was used to estimate the groundwater contaminant concentration resulting from a carbon tetrachloride source in the vadose zone. The Soil Vapor Extraction Endstate Tool (SVEET) software was used to help identify the impact of the remaining vadose zone source on groundwater concentrations.  
<http://pdw.hanford.gov/arpir/pdf.cfm?accession=0075558H>

#### COMPOUND-SPECIFIC ISOTOPE ANALYSES TO ASSESS TCE BIODEGRADATION IN A FRACTURED DOLOMITIC AQUIFER

Clark, J.A., R.L. Stotler, S.K. Frape, and W.A. Illman.  
Groundwater 55(1):88-99(2017)

The potential for TCE biodegradation in a fractured dolomite aquifer at a former chemical disposal site in Smithville, Ontario, Canada, was assessed using chemical analysis and TCE and cis-DCE compound-specific isotope analysis of carbon and chlorine collected over a 16-month period. Groundwater redox conditions change from suboxic to much more reducing environments within and around the plume, indicating that oxidation of organic contaminants and degradation products is occurring at the study site. TCE and cis-DCE were observed in 13 of 14 wells sampled. VC, ethene, and/or ethane were also observed in 10 wells, indicating that partial/full dechlorination has occurred. In most wells, isotopic values remained steady over the 15-month study. Isotopic enrichment from TCE to cis-DCE varied between 0 and 13‰ for carbon and 1 and 4‰ for chlorine. Combined, isotopic and chemical data indicate very little dechlorination is occurring near the source zone but suggest bacterially mediated degradation is occurring closer to the edges of the plume. This paper is **Open Access** at <http://onlinelibrary.wiley.com/doi/10.1111/gwat.12440/full>.

#### ACETYLENE FUELS TCE REDUCTIVE DECHLORINATION BY DEFINED DEHALOCOCCOIDES/PELOBACTER CONSORTIA

Mao, X., R.S. Oremland, T. Liu, S. Gushgari, A.A. Landers, S.M. Baesman, and L. Alvarez-Cohen.  
Environmental Science & Technology 51(4):2366-2372(2017)

Acetylene (C<sub>2</sub>H<sub>2</sub>) can be generated in contaminated groundwater sites as a consequence of chemical degradation of TCE by in situ minerals. C<sub>2</sub>H<sub>2</sub> is known to inhibit bacterial dechlorination. Investigators found that while high C<sub>2</sub>H<sub>2</sub> (1.3 mM) concentrations reversibly inhibit reductive dechlorination of TCE by *Dehalococcoides mccartyi* isolates as well as enrichment cultures containing *D. mccartyi* sp., low C<sub>2</sub>H<sub>2</sub> (0.4 mM) concentrations do not inhibit growth or metabolism of *D. mccartyi*. Co-cultures of *Pelobacter* SFB93, a C<sub>2</sub>H<sub>2</sub>-fermenting bacterium, with *D. mccartyi* strain 195 or strain BAV1 were actively sustained by providing acetylene as the electron donor and carbon source, while TCE or cis-DCE served as the electron acceptor.  
<http://superfund.berkeley.edu/pdf/517.pdf>

#### REMEDIATION OF ORGANIC CONTAMINATED INDUSTRIAL SITES BY OZONE MICRO-NANO BUBBLES

Xia, Z. and L. Hu. American Society of Civil Engineers, Reston, VA. Geotechnical Special Publication No 273:371-380(2016)

A combination of the micro-nano bubble (MNB) technology and ozonation was proposed for the treatment of organic contaminants at an industrial site in Nanjing, China. Site groundwater was extracted to be treated by ozone MNBs in bench-scale lab tests. The ozone MNBs showed remarkable utility in remediation of the contaminated groundwater. Following the lab test, an in situ test was performed in a 4 m x 4 m area. One extraction well and one injection



well formed an extraction-remediation-injection system. Extracted groundwater was treated with ozone MNBs and hydrogen peroxide for 3 h, and then the mixture was injected back into the contaminated site. Remediation efficiency was measured in three site observation wells. Results highlighted the potential of ozone MNBs for in situ remediation of organic contamination in the subsurface.

#### CRUDE OIL METABOLITES IN GROUNDWATER AT TWO SPILL SITES

Bekins, B.A., I.M. Cozzarelli, M.L. Erickson, R.A. Steenson, and K.A. Thorn. Groundwater 54(5): 681-691(2016)

Two groundwater plumes in north central Minnesota with residual crude oil sources contain 20 to 50 mg/L of non-volatile dissolved organic carbon (NVDOC). These values are over 10 times higher than benzene and 2-3 times higher than diesel-range organics in the same wells. On the basis of previous work, most of the NVDOC consists of partial transformation products from the crude oil. Monitoring data from 1988 to 2015 at one of the sites located near Bemidji, Minn., show that the plume of metabolites is expanding toward a lakeshore located 335 m from the source zone. Other mass balance studies of the site have demonstrated that the plume expansion is driven by the combined effect of continued presence of the residual crude oil source and depletion of the electron-accepting capacity of solid-phase iron oxide and hydroxides on the aquifer sediments. These plumes of metabolites are not covered by regulatory monitoring and reporting requirements in Minnesota and other states, but a review of toxicology studies indicates that polar metabolites of crude oil can pose a risk to aquatic and mammalian species. Results suggest that at sites where residual sources are present, monitoring of NVDOC might be warranted to evaluate the fates of plumes of hydrocarbon transformation products. *Additional information:* <https://www2.usgs.gov/newsroom/article.asp?ID=4497>.

#### PETROLEUM METABOLITES: LITERATURE REVIEW AND ASSESSMENT FRAMEWORK

Stenson, R., U. Hellmann-Blumberg, D. Elias, K. Brown, N. Fry, A. Naugle, L. Meillier, and C. Prowell. San Francisco Bay Regional Water Quality Control Board, 56 pp, 2016

Petroleum mixtures present challenges at multiple levels, from the determination of the exact concentration of each chemical to the evaluation of the toxic effects on different receptors individually and in combination. Weathering further complicates these issues because it creates numerous additional compounds, which often behave differently than the parent petroleum hydrocarbons. This report presents the results of a literature review of petroleum hydrocarbon-derived partial degradation or breakdown products (i.e., *petroleum metabolites*) that documents adverse effects of metabolites on both human and ecological receptors, confirming concerns of California's Regional Water Board staff and supporting the conclusion that petroleum metabolites pose risks to human and environmental receptors. The reviewers concluded the polar breakdown products should be considered as part of site-specific, petroleum-related risk assessments and also when evaluating cumulative risk.

[http://www.waterboards.ca.gov/sanfranciscobay/publications\\_forms/documents/SF\\_WB\\_Petroleum\\_Metabolites.pdf](http://www.waterboards.ca.gov/sanfranciscobay/publications_forms/documents/SF_WB_Petroleum_Metabolites.pdf)

#### 1,4-DIOXANE DRINKING WATER OCCURRENCE DATA FROM THE THIRD UNREGULATED CONTAMINANT MONITORING RULE

Adamson, D.T., E.A. Pina, A.E. Cartwright, S.R. Rauch, R.H. Anderson, T. Mohr, J.A. Connor. Science of the Total Environment 596-597:236-245(2017)

Data collected from U.S. public drinking water supplies in support of the third round of the Unregulated Contaminant Monitoring Rule (UCMR3) were evaluated to better understand the persistence of 1,4-dioxane and the importance of groundwater contamination for potential exposure. The detection frequency for dioxane in surface water was only marginally lower than in groundwater, but groundwater concentrations were higher and contributed to a higher frequency of exceeding the reference concentration, indicating that surface water sources tend to be more dilute. Dioxane detections in drinking water were highly associated with detections of other chlorinated compounds, particularly 1,1-DCA, which is associated with the release of dioxane as a chlorinated solvent stabilizer. Based on aggregated nationwide data, dioxane showed evidence of a decreasing trend in concentration and detection frequency over time. *The UCMR 3 (2013-2015) occurrence data are posted in zipped files at* <https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule#3>.

#### 1,4-DIOXANE MONITORING IN THE CAPE FEAR RIVER BASIN OF NORTH CAROLINA: AN ONGOING SCREENING, SOURCE IDENTIFICATION, AND ABATEMENT VERIFICATION STUDY

North Carolina Department of Environmental Quality, Division of Water Resources, 15 pp, 2017

In October 2016, the North Carolina Division of Water Resources completed the second year of a study designed to examine ambient concentrations, identify potential sources, and document water quality improvements due to abatement efforts of 1,4-dioxane in major surface waters of the Cape Fear River basin. Four primary areas of elevated dioxane were identified in the upper portion of the basin. Three of these areas are located immediately downstream of domestic wastewater treatment facilities, indicating that these facilities are likely conduits for dioxane from industrial sources into surface water. The fourth area is located farther downstream of a wastewater facility and in proximity to potential legacy sources of the contaminant. During the second year of the study, quarterly sampling indicated a reduction of dioxane concentrations in many areas of the basin. Further reductions will be necessary to achieve federal and state health advisory levels for the contaminant in drinking water supplies.

[https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/Dioxane/DioxaneYear2ReportWithMemo\\_20170222.pdf](https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/Dioxane/DioxaneYear2ReportWithMemo_20170222.pdf)

#### AUTOMATED ANALYSIS OF 1,4-DIOXANE IN WATER BY LARGE VOLUME INJECTION GC/HRMS

Korenkova, E., J. Chao, K. Jobst, M. Burlak, and K. MacPherson. Abstracts of the 52nd Annual Canadian Trace Organic Workshop, Milton, ON, 2017

For a sensitive, accurate, and rugged method for the analysis of 1,4-dioxane in water, the sample preparation process is performed by automated multi-purpose sampler. A 10 mL aliquot of the sample is extracted using ITSP cartridge containing 20 mg coconut charcoal with 30 µm polyethylene pre-filter frit. Sample loading speed and cartridge elution volume with dichloromethane are optimized at 50 µL/s and 500 µL, respectively. 10 µL of the final extract is analyzed by large-volume splitless injection with concurrent solvent recondensation GC/HRMS. Aimed to meet the potential regulatory requirements in Ontario, Canada, the method is able to analyze low-level 1,4-dioxane concentration in drinking and groundwater in the calibration range 0.02-3.0 µg/L. The method detection limit is 0.009 µg/L. At 0.1 µg/L, method repeatability and reproducibility was 3.2% and 4.7% RSD, respectively, and expanded uncertainty was 11%. *The method is available at* [http://www.itpsolutions.com/sites/default/files/Poster%20SBA\\_CTC\\_Debiopharm\\_ITSP\\_EBF\\_2013\\_1.pdf](http://www.itpsolutions.com/sites/default/files/Poster%20SBA_CTC_Debiopharm_ITSP_EBF_2013_1.pdf)

#### HINDERANCE OF 1,4-DIOXANE BIODEGRADATION IN MICROCOSMS BIOSTIMULATED WITH INDUCING OR NON-INDUCING AUXILIARY SUBSTRATES

Li, M., Y. Liu, Y. He, J. Mathieu, J. Hatton, W. DiGuseppi, and P.J.J. Alvarez. Water Research 112:217-225(2017)

A microcosm study was conducted to assess two biostimulation strategies (relative to natural attenuation) to bioremediate 1,4-dioxane contamination at a site in west Texas. Dioxane concentrations were relatively low (<http://alvarez.rice.edu/files/2012/02/230-11xe570.pdf>)

#### NEW DEVELOPMENTS IN 1,4-DIOXANE SITE MANAGEMENT: FACT SHEET

Adamson, D. SERDP Project ER-2307, 4 pp, 2016

New research is changing the conventional conceptual model for how 1,4-dioxane behaves following its release to the environment. This fact sheet summarizes the results of a recent SERDP-sponsored project that was designed to develop a more informed conceptual model for dioxane, especially in comparison to co-occurring contaminants like chlorinated solvents. A combination of data mining, modeling, and bench- and field-scale studies was used to meet the project objectives. The goal is to use the project results as a basis for improved decision-making and management of dioxane-contaminated sites.

<https://www.serd-estcp.org/content/download/41298/394372/file/ER-2307%20Lessons%20Learned%20Fact%20Sheet.pdf>

#### DISCOVERY OF 40 CLASSES OF PER- AND POLYFLUOROALKYL SUBSTANCES IN HISTORICAL AQUEOUS FILM-FORMING FOAMS (AFFFS) AND AFFF-IMPACTED GROUNDWATER

Barzen-Hanson, K.A., S.C. Roberts, S. Choyke, K. Oetjen, A. McAlees, N. Riddell, R. McCrindle, P.L. Ferguson, C.P. Higgins, and J.A. Field. Environmental Science & Technology 51(4):2047-2057(2017)

Recent data on groundwater affected by aqueous film-forming foams (AFFFs) used in fire fighting and training indicates that ~25% of the PFASs remain unidentified. In a systematic evaluation of 3M and fluorotelomer-based AFFFs, commercial products, and AFFF-impacted groundwaters from 15 U.S. military bases, 40 classes of novel anionic, zwitterionic, and cationic PFASs were discovered, and an additional 17 previously reported classes were observed for the first time in AFFF and/or AFFF-impacted groundwater. All 57 classes received an acronym and IUPAC-like name derived from collective author knowledge. Thirty-four of the 40 newly identified PFAS classes derive from electrochemical fluorination (ECF) processes, most of which have the same base structure. Of the newly discovered PFASs found only in AFFF-impacted groundwater, 11 of the 13 classes are ECF-derived and the remaining two classes are fluorotelomer-derived, which suggests that both ECF- and fluorotelomer-based PFASs are persistent in the environment.

#### SORPTION OF PERFLUOROALKYL PHOSPHONATES AND PERFLUOROALKYL PHOSPHINATES IN SOILS

Lee, H. and S.A. Mabury. Environmental Science & Technology 51(6):3197-3205(2017)

Perfluoroalkyl phosphonates (PFPA) and perfluoroalkyl phosphinates (PFPIA) are recently discovered perfluoroalkyl acids (PFAAs) that have been widely detected in house dust, aquatic biota, surface water, and wastewater environments. The sorption of C6, C8, and C10 monoalkylated PFPA and C6/C6, C6/C8, and C8/C8 dialkylated PFPIA was investigated in seven soils of varying geochemical parameters. No single soil-specific parameter (e.g., pH or organic carbon content) was observed to control the sorption of PFPA and PFPIA, which lack may be attributable to competing interferences in the naturally heterogeneous soils. The PFPA were observed to desorb to a greater extent and likely circulate as aqueous contaminants in the environment, while the more sorptive PFPIA would be preferentially retained by environmental solid phases. *For additional information, see Chapter 5 in H. Lee's dissertation at <https://tspace.library.utoronto.ca/handle/1807/65442>.*

#### **ADSORPTION OF PERFLUOROCTANE SULFONATE ON SOILS: EFFECTS OF SOIL CHARACTERISTICS AND PHOSPHATE COMPETITION**

Qian, J., M. Shen, P. Wang, C. Wang, J. Hou, Y. Ao, J. Liu, and K. Li.  
Chemosphere 168:1383-1388(2017)

Results from experiments on three soils without the addition of phosphate (P) suggested that a high amount of soil organic matter (SOM) in soil can increase the sorption affinity of PFOS on soils, while a greater amount of ferric oxides can reduce it. Overall results suggest that for soils dominated by ferric oxides, P is a more effective competitor than PFOS for the adsorption sites in the binary system, whereas in soils containing more SOM, P is a weak competitor.

#### **SORPTION KINETICS, ISOTHERMS AND MECHANISMS OF PFOS ON SOILS WITH DIFFERENT PHYSICOCHEMICAL PROPERTIES**

Wei, C., X. Song, Q. Wang, and Z. Hu.  
Ecotoxicological and Environmental Safety 142:40-50(2017)

The sorption kinetics of perfluorooctane sulfonate (PFOS) on six soils demonstrated that PFOS sorption reached equilibrium within 48 h, and the well-fitted pseudo-second-order kinetic model of experimental data suggested that chemisorption was involved in PFOS sorption on soils. Results from the intraparticle diffusion model indicated that both film diffusion and intraparticle diffusion were the rate-limiting steps for five of the six soil samples, while intraparticle diffusion was the only limiting step in PFOS sorption on the sixth soil. PFOS sorption isotherms can be well described by the Freundlich model for all six soils. FTIR showed that hydrophobic interaction, ion exchange, surface complexing, and hydrogen bonding might all play a role in PFOS sorption onto soil.

#### **RATES AND EQUILIBRIA OF PERFLUOROCTANOATE (PFOA) SORPTION ON SOILS FROM DIFFERENT REGIONS OF CHINA**

Miao, Y., X. Guo, D. Peng, T. Fan, and C. Yang.  
Ecotoxicological and Environmental Safety 139:102-108(2017)

The sorption-desorption of PFOA onto 10 soil samples was found to depend on soil organic carbon content and composition of soil minerals. The sorption and desorption isotherms of PFOA on most of the soils were linear, except for the sorption of PFOA onto a few soils better described by the Freundlich equation with the parameter  $N > 1$ . The main sorption mechanism of PFOA was hydrophobic interaction between the perfluorinated carbon chain and the organic matter of soil, as evidenced by the correlation between the solid-liquid distribution coefficient and the fraction of soil organic carbon. PFOA sorption in the soils was highly irreversible.

#### **A NEVER-ENDING STORY OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs)?**

Wang, Z., J.C. DeWitt, C.P. Higgins, and I.T. Cousins.  
Environmental Science & Technology 51(5):2508-2518(2017)

More than 3,000 per- and polyfluoroalkyl substances (PFASs) are, or have been, on the global market, yet most research and regulation continues to focus on a limited selection of rather well-known long-chain PFASs, particularly perfluorooctanesulfonate (PFOS), perfluorooctanoic acid (PFOA), and their precursors. The authors offer recommendations for how to proceed with research and cooperation to tackle the vast number of PFASs on the market and in the environment.

#### **CONTRIBUTION OF POLYFLUOROALKYL PHOSPHATE ESTERS (PAPs) AND OTHER PRECURSOR COMPOUNDS TO PERFLUOROALKYL CARBOXYLATES (PFCAs) IN HUMANS AND THE ENVIRONMENT**

Eriksson, Ulrika, Ph.D. thesis, Orebro University, Orebro Studies in Chemistry 18,102 pp, 2016

The aim of this thesis was to assess the contribution of PAPs and other precursors to the exposure of PFCAs to humans and the environment by analyzing a wide range of PFASs in human serum, wild bird eggs, indoor dust, wastewater, and sludge. Selected precursors contributed significantly to the total amount of PFASs in the abiotic compartments of indoor dust, wastewater, and sludge. Levels of PAPs found in house dust exceeded those of PFCAs and perfluorosulfonic acids (PFSAs), revealing PAPs as an important exposure source. A net increase during treatment was observed for several PFASs in Swedish wastewater treatment plants, which in combination with other observations suggests that degradation of PFCA precursors contributed to the increase of PFCAs. Detection of precursors in human serum, together with slow declining trends of PFCAs, revealed an ongoing exposure of PFCAs to the general population of Australia.  
<http://oru.diva-portal.org/smash/get/diva2:958301/FULLTEXT01.pdf>

#### **THE ECOTOXIC POTENTIAL OF A NEW ZERO-VALENT IRON NANOMATERIAL, DESIGNED FOR THE ELIMINATION OF HALOGENATED POLLUTANTS, AND ITS EFFECT ON REDUCTIVE DECHLORINATING MICROBIAL COMMUNITIES**

Schiwy, A., H.M. Maes, D. Koske, M. Flecken, K.R. Schmidt, H. Schell, A. Tiehm, et al.  
Environmental Pollution 216:419-427(2016)

Abiotic dechlorination through a newly developed nanoscale zero-valent iron material and its effects on dechlorinating bacteria were investigated in anaerobic batch and column experiments. The nanomaterial has a flake-like appearance and an inhomogeneous size distribution. The aged (i.e., oxidized) iron material was characterized with dynamic light scattering, transmission electron microscopy and energy-dispersive x-ray analysis, x-ray diffractometry, and cell-free reactive oxygen measurements. The material was evaluated in aerobic ecotoxicological test systems with algae, crustacean, and fish. The anaerobic column experiments showed co-occurrence of abiotic and biological dechlorination of PCE. No prolonged toxicity of the nanomaterial (measured for up to 300 days) toward the investigated dechlorinating microorganism was observed. The EC50 toxicity values to crustacean and fish were calculated as 163 mg/L and 458 mg/L, respectively. The nanomaterial showed no mutagenicity. It physically interacted with algae. The novel iron nanomaterial was slightly toxic in its reduced state, but no prolonged toxicity was recorded. <http://www.rafaledb.com/papers/J-2016-Environmental-Pollution-ecotoxic-potential.pdf>

#### **APPLICATION OF HANDHELD LASER-INDUCED BREAKDOWN SPECTROSCOPY (LIBS) TO GEOCHEMICAL ANALYSIS**

Connors, B., A. Somers, and D. Day.  
Applied Spectroscopy 70(5):785-793(2016)

While laser-induced breakdown spectroscopy (LIBS) has been in use for decades, only within the last few years has technology progressed to the point of enabling true handheld, self-contained instruments. Several instruments with a range of capabilities and features are now commercially available. This paper offers a review of the SciAps Z-500 handheld LIBS instrument functionality and subsystems as applied to several assayed geochemical sample sets, including igneous rocks and soils. Calibration data are presented for multiple elements of interest along with examples of elemental mapping in heterogeneous samples. Sample preparation and the data collection method from multiple locations and data analysis are discussed.

## **General News**

#### **A GUIDE TO NANOPARTICLES FOR THE REMEDIATION OF CONTAMINATED SITES**

Sweeney, R. and N. Harries.  
CL:AIRE (Contaminated Land: Applications in Real Environments) & NanoRem. NanoRem Bulletin 4, 4 pp, 2017

Nanoparticles (NPs) typically are defined as particles with one or more dimension of  
[http://www.nanorem.eu/stream.aspx?p=/App\\_Data/docs/user14Gallery/1\\_Toolbox/3\\_Bulletins/NanoRem\\_Bulletin4.pdf](http://www.nanorem.eu/stream.aspx?p=/App_Data/docs/user14Gallery/1_Toolbox/3_Bulletins/NanoRem_Bulletin4.pdf)

#### **ENVIRONMENTAL TECHNOLOGIES OF WOODY CROP PRODUCTION SYSTEMS**

Zalesny, R.S. Jr., J.A. Stanturf, E.S. Gardiner, G.S. Banuelos, R.A. Hallett, A. Hass, C.M. Stange, et al.  
Bioscience Research 9(2):492-506(2016)

The development of woody crop production systems for the advancement of environmental technologies is reviewed, including phytoremediation, urban afforestation, forest restoration, and mine reclamation. The primary goal of these collective efforts is to develop systems and tools that can help to mitigate ecological degradation and thereby sustain healthy ecosystems across the rural to urban continuum. <https://www.treeseearch.fs.fed.us/pubs/52003>

#### **DIOXINS: A TECHNICAL GUIDE (9th ED.)**

New Zealand Ministry of Health, Wellington. ISBN: 978-0-947515-61-4, HP 6485, 46 pp, 2016

After introducing general background information on dioxins, this guide discusses their environmental occurrence in New Zealand and health effects on that country's populations. <https://www.health.govt.nz/system/files/documents/publications/dioxins-technical-guide-aug16.pdf>

#### **TOXICITY AND WASTE MANAGEMENT USING BIOREMEDIATION**

Rathoure, A.K. and V.K. Dhatwalia (eds).  
Engineering Science Reference, IGI Global imprint, Hershey PA. ISBN: 9781466697348, 421 pp, 2016

Contributors from a variety of scientific disciplines describe theories and practices of using living organisms to clean up areas contaminated by hazardous compounds. The topics include bio-management of heavy metal pollution; application of genomics and proteomics in bioremediation; utilization of agro-industrial residues as bioremediation substrates; phytoremediation by endophytic microorganisms; and effective wastewater treatment. *View the table of contents and chapter abstracts at* <http://www.igi-global.com/book/toxicity-waste-management-using-bioremediation/139319>.

#### **REMEDIATION JOURNAL SPECIAL ISSUE TARGETS 1,4-DIOXANE**

The Winter 2016 issue of *Remediation Journal* is dedicated to recent developments in 1,4-dioxane investigation and remediation techniques. The nine papers in this issue offer two case studies in addition to treatment overviews, innovations in characterization, and sustainability issues. <http://onlinelibrary.wiley.com/doi/10.1002/rem.2016.27.issue-1/issuetoc>

#### **ASSESSMENT, MANAGEMENT AND REMEDIATION GUIDANCE FOR PERFLUOROOCTANESULFONATE (PFOS) AND PERFLUOROOCTANOIC ACID (PFOA)**

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, Newcastle, Australia. CRC CARE Technical Report no. 38, 5 vols, 2017

Given the evolving nature of the science relating to per- and polyfluorinated compounds (PFASs), the values used in the five related but stand-alone volumes of Technical Report no. 38 are considered interim information that can be used at PFAS-contaminated sites across Australia. The separate documents consist of the following:

- Part 1: Background (38 pp)
- Part 2: Health screening levels (HSLs) (101 pp)
- Part 3: Ecological screening levels (ESLs) (61 pp)
- Part 4: Application of ESLs and HSLs (26 pp)
- Part 5: Management and remediation of PFOS and PFOA (60 pp).

*These documents are available for download with other resources about PFOA and PFOS at* <http://www.crccare.com/knowledge-sharing/pfos-and-pfoa-guidelines>.

#### **RISK-BASED MANAGEMENT AND REMEDIATION GUIDANCE FOR BENZO(A)PYRENE**

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, Newcastle, Australia. CRC CARE Technical Report no. 39, 81 pp, 2017

This report provides information and a framework that is designed to aid practitioners, regulators and site owners in Australia in the effective management and remediation of benzo(a)pyrene [B(a)P]-contaminated media. The intent is to provide an overview of risk-based management and remediation strategies for B(a)P-contaminated soil and groundwater that accounts for site-specific variables such as bioavailability, bioaccumulation, and likely exposure, thereby allowing more targeted remediation and potentially reducing the cost of managing contamination while continuing to protect human health and the environment. See Report 39 at <http://www.crccare.com/publications/technical-reports>.

#### **GUIDANCE FOR THE ASSESSMENT, REMEDIATION AND MANAGEMENT OF MTBE**

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, Newcastle, Australia. CRC CARE Technical Report no. 36, 72 pp, 2016

This document provides MTBE-specific information for the assessment, remediation, and management of potentially contaminated sites in Australia. Drawn from international guidance, this guide addresses an odor-based screening level in water, ecological screening levels, and contaminant-specific factors to consider in site investigations, including the development of the conceptual site model. See Report 36 at <http://www.crccare.com/publications/technical-reports>.

The Technology Innovation News Survey welcomes your comments and suggestions, as well as information about errors for correction. Please contact Michael Adam of the U.S. EPA Office of Superfund Remediation and Technology Innovation at [adam.michael@epa.gov](mailto:adam.michael@epa.gov) or (703) 603-9915 with any comments, suggestions, or corrections.

Mention of non-EPA documents, presentations, or papers does not constitute a U.S. EPA endorsement of their contents, only an acknowledgment that they exist and may be relevant to the Technology Innovation News Survey audience.