

# Technology Innovation News Survey

## Entries for January 1-31, 2017

### Market/Commercialization Information

#### JACOBSVILLE REMEDIAL ACTION

U.S. Environmental Protection Agency, Office of Acquisition Management, Region V, Chicago.  
Federal Business Opportunities, FBO-5622, Solicitation SOL-R5-17-00002, 2017

This acquisition is completely set aside for HUBZone small business concerns under NAICS code 562910. EPA Region 5 seeks a contractor to provide environmental remediation services at the Jacobsville Neighborhood Soil Contamination Superfund Site, Evansville, Indiana. These services include the cleanup of privately owned residential yards on 50 properties contaminated by lead and/or arsenic and all actions associated with cleanup on residential properties. The requirement magnitude range is between \$1M and \$5M. Offers are due by 5:30 PM ET on May 30, 2017. See FedConnect for the solicitation and other attachments, including a draft statement of work, at <https://www.fedconnect.net/FedConnect/?doc=SOL-R5-17-00002&agency=EPA> [Note: It might be necessary to copy/paste the URL into your browser for direct access].

#### REMEDIAL ACTION OPERATIONS AND LONG TERM MONITORING FOR SITE TA500 AT LAUGHLIN AIR FORCE BASE, TX

Department of the Air Force, AFICA - CONUS, Laughlin Air Force Base, Del Rio, Texas.  
Federal Business Opportunities, FBO-5636, Solicitation FA8903-17-R-0051, 2017

The 772 ESS/PKS intends to award a single firm-fixed-price contract for conducting remedial action operations and long term monitoring for Site TA500 at Laughlin Air Force Base, Texas, in an area affected by historical leaks from a gasoline fueling system for watercraft. This requirement is a 100% small business set-aside under NAICS code 562910. The period of performance will be 12 months. Proposals are due by 2:00 PM CT on May 31, 2017. Additional information is attached to the FedBizOpps notice at <https://www.fbo.gov/notices/69b14acc280cd408950a88c5fd7205c5>.

#### BULK FIELD-CONSTRUCTED UNDERGROUND STORAGE TANK (BFCUST) REMEDIATION AND PILOT STUDY

Defense Logistics Agency, Fort Belvoir, VA.  
Federal Business Opportunities, FBO-5630, Solicitation SPE60017R5X13, 2017

The Defense Logistics Agency-Energy is conducting market research to evaluate the availability and interest of sources that can provide environmental remediation services. No solicitation is available at this time. DLA Energy anticipates issuing task orders for Defense Fuel Supply Point San Pedro, CA, for services to include implementing a pilot study to support ongoing remediation efforts at the main tank farm and administration area. DLA plans to implement pilots of two different technologies: (1) electro-resistive heating at one BFCUST and (2) steam injection at another BFCUST. DLA also plans to design and implement soil vapor extraction/air sparge systems at remaining tanks or areas where conditions do not support the use of thermal technologies. Capabilities statements are due by 1:00 PM ET on May 22, 2017. <https://www.fbo.gov/spg/DLA/J3/DESC/SPE60017R5X13/listing.html>

### Cleanup News

#### EXPLANATION OF SIGNIFICANT DIFFERENCES: BUILDING 25A IN SITU SOIL FLUSHING SYSTEM MODIFICATION

Lawrence Berkeley National Laboratory, 20 pp, 2016

This Explanation of Significant Differences provides the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) with a description of and rationale for Lawrence Berkeley National Laboratory's proposed modification of the Building 25A in situ soil flushing system, the DTSC-approved corrective measure for the Building 25A Lobe of the Old Town Groundwater Plume (mainly dissolved-phase TCE and daughter products). The system currently injects treated groundwater into a trench on the west side of Building 30 and extracts groundwater from wells south of the building. The proposed modification will convert the injection trench to one that can also be used to extract contaminated groundwater when heavy rains cause the groundwater elevation to rise above ~916 ft, to preserve the integrity of the building slab and prevent the deposit of contamination beneath the building. Corrective measures approved for contaminated soil were all completed by the end of 2006. Corrective measures approved for groundwater currently are in the stage of long-term operation, maintenance, and monitoring. These measures consist primarily of in situ soil flushing and groundwater capture systems plus subsurface injection of Hydrogen Release Compound®, soil vapor extraction, and monitored natural attenuation at some locations. <http://www2.lbl.gov/ehs/erp/assets/Other%20Documents/ESD%20B25A%20Soil%20Flushing%20System%20Modification.pdf>

#### TRAVIS ENVIRONMENTAL RESTORATION PROGRAM IS CERTIFIED, SUSTAINABLE

Schilter-Lowe, M.  
U.S. Air Force News, Jan 2017

By replacing some traditional and costly groundwater remediation technologies, such as pump and treat, the environmental restoration program (ERP) team at Travis AFB is saving the thousands of dollars it would have cost to construct, operate, and maintain such systems in the future. Since 2008, the ERP team has worked with the site contractor and the U.S. Army Corp of Engineers to use sustainable cleanup technologies and test ways to optimize their performance at sites across the base. The team installed a subgrade (underground) biogeochemical reactor to treat a Stoddard solvent spill site near Hangar 811. One of the first subgrade biogeochemical reactors was installed at Travis AFB in 2008 as part of an Air Force research project. The unit was constructed by excavating a series of trenches near the hangar and backfilling them with a mix of gravel, calcium peroxide, and infiltration pipe. The difference between it and other bioreactors on base is its "washboard" effect, created by the way the extraction wells operate. Each well operates on a different schedule to allow the water table to tilt and fluctuate across the site, increasing the amount of oxygen in the groundwater and promoting intrinsic biodegradation. Phytoremediation was one of the first bioremediation technologies implemented at Travis AFB. In 1998, the ERP team and a team from Utah State University planted 100 red ironbark eucalyptus trees to address a large groundwater plume at the site of a former battery and electric shop. The team planted an additional 340 trees over the 2.24-acre plot in 2000. Monitoring results showed removal of ~50% of dissolved-phase TCE in a 10-yr period. The ERP team later installed a bioreactor and an emulsified vegetable oil biobarrier—a row of 34 injection wells aligned perpendicular to groundwater flow—near the same site, which further reduced contamination below cleanup standards. <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/1052834/travis-environmental-restoration-program-is-certified-sustainable.aspx>

#### LAUNCH COMPLEX 39A, SWMU 008, OPERATIONS, MAINTENANCE, AND MONITORING REPORT, KENNEDY SPACE CENTER, FLORIDA

NASA, Kennedy Space Center, Florida. LC39A OMMR, 46 pp, 2016

This report presents the findings, observations, and results from Year 1 operation of the air sparging groundwater interim measure (IM) for high-concentration and low-concentration plumes within the perimeter fence line at Launch Complex 39A (LC39A). The objective of the LC39A groundwater IM is to actively decrease concentrations of TCE, cDCE, and VC in groundwater within the pad perimeter fence line via to levels less than Florida Department of Environmental Protection Groundwater Cleanup Target Levels. O&M information from system startup in February 2015 through December 31, 2015, is provided, plus performance monitoring results for quarterly groundwater sampling events through January 2016. From startup through the January 2016 groundwater sampling event, the air sparging system has met the performance criteria, achieving an overall 77% mass reduction of chemicals of concern. <https://clu-in.org/download/techfocus/air-sparging/Sparqing-ksc-2016.pdf>

#### ORCHARD SUPPLY COMPANY FACILITY GROUNDWATER REMEDIATION, 1731 17TH STREET, SACRAMENTO, SACRAMENTO COUNTY

Central Valley Regional Water Quality Control Board, GeoTracker website, 2017

The in situ groundwater remediation project consisted of injecting a slurry solution of EHC into the source area shallow and deep groundwater to treat concentrations of 1,2-DCA, 1,2-DCE, and carbon tetrachloride. EHC is a mixture of controlled-release carbon, zero-valent iron, and nutrients for stimulating in situ chemical reduction of otherwise persistent chemicals in groundwater. A total volume of 24,525 gal of injection substrate containing 68,000 lb of EHC (30% EHC solids mixed with water) was injected using direct push tooling in the source area groundwater. The injections were completed between July 2015 and September 2015. No further injections are planned for the site. Additional groundwater monitoring is being conducted under a separate agreement. See more technical information in the site documents at [http://geotracker.waterboards.ca.gov/profile\\_report?global\\_id=SLT5S2063245](http://geotracker.waterboards.ca.gov/profile_report?global_id=SLT5S2063245).

#### FORMER JOHN TAYLOR FERTILIZER CO, 1819 SOUTH ARGONAUT STREET, STOCKTON, SAN JOAQUIN COUNTY

Central Valley Regional Water Quality Control Board, 16 pp, 2016

Operations at the site ended in 2008, and it is currently vacant. Groundwater chemicals of concern (COCs) include the fumigants 1,2,3-TCP and 1,2-DCE. Groundwater is ~15 ft bgs. A lab microcosm biotreatability study to assess the potential for natural and anaerobic in situ biodegradation of the chlorinated propanes was conducted in 2014. Results indicated that reduction of the site COCs is achievable using an emulsified vegetable oil/sodium lactate mixture (Newman Zone®) as electron donor, combined with bioaugmentation using KB-1® Plus. The June 2015 Remedial Action Workplan presented remedial alternatives and recommended enhanced in situ bioremediation (EISB) for the implementation at the site. The shallow groundwater EISB approach involves a shallow horizontal injection well spanning across the shallow target area and positioned perpendicular to groundwater flow. Amendment injections via the horizontal injection well are anticipated to create a biologically active zone that transects the shallow groundwater plume and treats impacted groundwater through advection and diffusion processes. The deeper groundwater EISB approach involves delivery of electron donor to the deeper target area via

temporarily and intermittently operated groundwater recirculation system. Anticipated operation of the amendment delivery system is ~8-9 months over the course of 2-4 years with operations conducted in 2 to 4 month-long events per year.  
[http://www.waterboards.ca.gov/rwqcb5/board\\_decisions/adopted\\_orders/general\\_orders/r5-2015-0012\\_noas/r5-2015-0012-015\\_noa.pdf](http://www.waterboards.ca.gov/rwqcb5/board_decisions/adopted_orders/general_orders/r5-2015-0012_noas/r5-2015-0012-015_noa.pdf) See more information in the technical documents at [http://geotracker.waterboards.ca.gov/profile\\_report?global\\_id=SL186192977](http://geotracker.waterboards.ca.gov/profile_report?global_id=SL186192977).

#### **FORMER CHROME CRAFT FACILITY, 1819 23RD STREET, SACRAMENTO** Central Valley Regional Water Quality Control Board, GeoTracker website, 2017

A release of chrome plating compound to the subsurface during historical operations at the former Chrome Craft facility introduced Cr(VI) to the site's soil and groundwater. In 2004, the source area was excavated and subsurface treated using MRC-X, which facilitated biological reduction to Cr(III). In 2006, injections of cheese whey to groundwater successfully converted Cr(VI) in downgradient groundwater to Cr(III). In 2017, additional remediation using cheese whey will begin under the State's General Order for in situ remediation. See details in the technical site documents at [http://geotracker.waterboards.ca.gov/profile\\_report?global\\_id=SL0606709398](http://geotracker.waterboards.ca.gov/profile_report?global_id=SL0606709398).

#### **FULL SCALE IN SITU GROUNDWATER REMEDIATION, LINCOLN VILLAGE SHOPPING CENTER, STOCKTON, SAN JOAQUIN COUNTY** Central Valley Regional Water Quality Control Board, 16 pp, 2016

The primary project objective is to provide in situ treatment of VOCs in groundwater, including PCE, TCE, and cis-1,2-DCE. The project consists of injecting dilute, liquid potassium permanganate over a 3-year period across two transects, while simultaneously extracting and treating groundwater from the downgradient area. Following the permanganate injection period, groundwater will continue to be extracted, treated, and injected for an additional 5 years. Before, during, and after this remediation program, the groundwater will be monitored to determine remediation efficacy and to monitor for secondary reaction by-products. The Phase 1 ISCO system was installed during the spring/summer of 2016.  
[http://www.waterboards.ca.gov/rwqcb5/board\\_decisions/adopted\\_orders/general\\_orders/r5-2015-0012\\_noas/r5-2015-0012-013\\_noa.pdf](http://www.waterboards.ca.gov/rwqcb5/board_decisions/adopted_orders/general_orders/r5-2015-0012_noas/r5-2015-0012-013_noa.pdf) See additional information in the site reports at [http://geotracker.waterboards.ca.gov/profile\\_report?global\\_id=SL205132997](http://geotracker.waterboards.ca.gov/profile_report?global_id=SL205132997).

### **Demonstrations / Feasibility Studies**

#### **TECHNICAL MEMORANDUM: ISB PHASE I AND ISCO PHASE II RESULTS AND DOWNGRADE AREA PILOT STUDY WORK PLAN, GEORGETOWN FACILITY, SEATTLE, WASHINGTON** Washington State Department of Ecology, 87 pp, 2016

This memorandum for the closed Stericycle facility located in the Georgetown area of Seattle addresses the next steps in Stericycle's obligations to implement a contingent remedy for 1,4-dioxane in groundwater downgradient of the site. Results are summarized from the in situ bioremediation (ISB) Phase I bench-scale study, which showed that ISB via bioaugmentation with 1,4-dioxane degraders is feasible for this site; therefore, ISB will proceed to Phase II for an in situ pilot study. The objective of the in situ chemical oxidation (ISCO) pilot was to provide data to optimize a full-scale ISCO design and indicate the effect of persulfate injection on the downgradient area. Based on the results of the ISB bench-scale study and the ISCO pilot, ISB and additional ISCO remediation piloting will be performed concurrently as described in the included work plan. This technical report and other site documents are available toward the bottom of the page at <https://fortress.wa.gov/ecy/gsp/CleanupSiteDocuments.aspx?csid=2622>.

#### **THE RADIUS OF INFLUENCE OF A COMBINED METHOD OF IN SITU AIR SPARGING AND SOIL VAPOR EXTRACTION IN THE INTERTIDAL SEDIMENTS OF GOMSO BAY ON THE WEST COAST OF SOUTH KOREA**

Lee, J.H., H.J. Woo, K.S. Jeong, and K.S. Park.  
Springerplus 5(1):1388(2016)

A study was undertaken in the tidal flats of Mandol (mostly sand) and Hajeon (sand/silt) in Gomso Bay on the west coast of Korea where various types of natural sediment are distributed under the influence of the tide. By assuming a scenario in which the bay was contaminated by an oil slick, researchers aimed to estimate the applicability of in situ air sparging techniques at pilot scale to the physical, chemical, and biological remediation of coastal sediments together with a determination of the site-specific elements that influence the efficiency of the technique, including variations in the radius of influence. At each site, the setup consisted of one monitoring well, one sparging well, and four soil vapor extraction wells. This paper is **Open Access** at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4993732/>.

#### **POTENTIAL FOR PHYTOREMEDIATION OF PCDD/PCDF-CONTAMINATED SLUDGE AND SEDIMENTS USING CUCURBITACEAE PLANTS: A PILOT STUDY**

Urbanik, M., A. Wyrwicka, M. Zielinski, and J. Mankiewicz-Boczek.  
Bulletin of Environmental Contamination and Toxicology 97(3):401-406(2016)

An evaluation of the impact of sewage sludge and urban reservoir sediment on changes in total and toxic equivalency (TEQ) PCDD/PCDF concentration in soil and in phytotoxicity was measured using three test plant species—*Lepidium sativum*, *Sinapis alba*, and *Sorghum saccharatum*—during 5 weeks of *Cucurbita pepo* L. cv "Atena Polka" (zucchini) cultivation. The presence of zucchini was found to reduce total PCDD/PCDF concentration by 37% in soil amended with sludge and 32% in soil treated with sediment from an urban reservoir. The TEQ reduction was almost twofold greater: 68% in soil amended with sludge and 52% with urban sediment. Effects on the test species are described. <https://pdfs.semanticscholar.org/63c1/935a8f4c9bcca9898e8c4f4d45f4b1d475b.pdf>

#### **BIOREMEDIATION OF A TRICHLOROETHENE DNAPL SOURCE ZONE UTILIZING A PARTITIONING ELECTRON DONOR: FIELD IMPLEMENTATION**

Bartlett, Joseph Kingsbery III, Master's thesis, University of Central Florida, 276 pp, 2016

Based on lab studies, n-butyl acetate (nBA) was selected as the partitioning electron donor (PED) for application in Hot Spot 1, a zone of high-concentration TCE in a low permeability clay layer ~40 ft bgs at Cape Canaveral Air Force Station's Launch Complex 34. Implementation included groundwater recirculation above and below the clay layer without PED injection for comparative analysis (baseline flux), and then with PED injection in, above, and below the clay layer (system operation phase). The solar-powered recirculation system was operated without PED addition for ~4 weeks to establish the baseline flux condition. Recirculation was suspended while 34,000 gal of a solution containing nBA (3,000 mg/L) and conservative tracers (bromide and/or iodide) was injected via direct push at 20 locations from 23 to 62 ft bgs. After waiting 4 more weeks to allow the PED to partition into the DNAPL, the recirculation system was restarted and operated for a year. Although effective, nBA was utilized and depleted within 12 months, more quickly than the 2-3 years expected from an industry electron donor. Based on this finding alone, it appears that nBA would not be a good candidate for full-scale implementation at this or other sites, although to provide a true comparative analysis, results from side-by-side electron donor test plots at the site is recommended.  
<http://stars.library.ucf.edu/etd/5255>

#### **NOTICE OF APPLICABILITY OF GENERAL ORDER NO. RS-2015-0012-022: GLADDING MCBEAN COMPANY COAL TAR LANDFILL, 601 7TH STREET, LINCOLN, PLACER COUNTY**

Central Valley Regional Water Quality Control Board, 13 pp, 2016

Operations at the Gladding McBean Coal Tar Landfill introduced 1,1,1-TCA, TCE, and their breakdown products into the site's groundwater and soil. In an evaluation of the effectiveness of enhanced in situ bioremediation for treating the contaminants of concern, a field pilot study yielded favorable results using sucrose (table sugar) as a source of organic carbon and molecular hydrogen to promote anaerobic reductive dechlorination of contaminant constituents.  
[http://www.waterboards.ca.gov/rwqcb5/board\\_decisions/adopted\\_orders/general\\_orders/r5-2015-0012\\_noas/r5-2015-0012-022\\_noa.pdf](http://www.waterboards.ca.gov/rwqcb5/board_decisions/adopted_orders/general_orders/r5-2015-0012_noas/r5-2015-0012-022_noa.pdf)  
For expansion of the pilot to full-scale treatment, the Discharger proposes to continue the sucrose injections as described in the 2014 *Work Plan for Expansion of In-Situ Groundwater Remediation Program* at [http://geotracker.waterboards.ca.gov/esi/uploads/geo\\_report/5887758374/SL185462917.PDF](http://geotracker.waterboards.ca.gov/esi/uploads/geo_report/5887758374/SL185462917.PDF).

#### **NOTICE OF APPLICABILITY OF GENERAL ORDER NO. R5-2015-0012-029, EXPANDED PILOT TEST, FORMER MERCURY CLEANERS, 1419 16TH STREET, SACRAMENTO, SACRAMENTO COUNTY**

Central Valley Regional Water Quality Control Board, 12 pp, 2017

Mercury Cleaners operated as a dry cleaner from 1947 through August 2014. The facility used a variety of dry cleaning solvents, including PCE and petroleum-based Stoddard solvent. Soil, soil vapor, and groundwater are affected by former operations and chemical releases, with PCE, TCE, and cis-1,2-DCE of primary concern. Soil vapor remediation began in 2015 with a soil vapor extraction (SVE) system pilot test, which continues to operate. Source area groundwater remediation began in November 2016 using electrical resistive heating to vaporize VOCs in groundwater for capture by the SVE system. To evaluate the effectiveness of in situ bioremediation in cleaning up areas of elevated PCE and its breakdown products, a field pilot test was conducted in June 2016 in two locations outside the primary source area. 3-D Microemulsion® (electron donor) and Bio-Decchlor Inoculum® Plus (a *Dehalococcoides* consortium) were introduced via 5 injection bores at each test location. The pilot with closer injection spacing has shown significant decreases in PCE and increases in breakdown products, including VC. Expansion of the pilot has been approved to allow additional evaluation.  
[http://www.waterboards.ca.gov/rwqcb5/board\\_decisions/adopted\\_orders/general\\_orders/r5-2015-0012\\_noas/r5-2015-0012-029\\_noa.pdf](http://www.waterboards.ca.gov/rwqcb5/board_decisions/adopted_orders/general_orders/r5-2015-0012_noas/r5-2015-0012-029_noa.pdf)

#### **GOLDER ASSOCIATES EVALUATING INNOVATIVE REMEDIATION TECHNOLOGY**

Kennedy Space Center Tech Transfer News 8(1):4(2016)

NASA's Sorbent Polymer Extraction and Remediation System (SPEARS) is a unique spiked system designed to remove PCBs from sediment. SPEARS comprises ethanol-filled plastic spikes fitted into square or rectangular plates that fit together to form a blanket for covering targeted sections of a PCB-contaminated sediment site. The passive system works by attracting PCBs out of the sediment and trapping them in the plastic spikes. This process can take months to complete, and spikes can be removed and replaced as they become saturated with PCBs. Under a nonexclusive evaluation license agreement with Kennedy Space Center, Golder has constructed a prototype variation of the SPEARS technology that uses individually sealed ethanol-filled spikes attached to a corrosion-resistant frame. In September of 2015, the prototype was deployed at a site in Canada to evaluate its effectiveness in reducing low-level PCB concentrations in sediment over time. The prototype will remain in place for one year, after which time the equipment will be retrieved, and post-treatment sediment samples will be analyzed for comparison to baseline concentrations. See page 4 at [https://technology-ksc.nasa.gov/documents/2016\\_TechTransferNews\\_Summer.pdf](https://technology-ksc.nasa.gov/documents/2016_TechTransferNews_Summer.pdf)

See also the report, *Initial Field Deployment Results of Green PCB Removal from Sediment Systems*, for a description of the somewhat different design of early SPEARS demonstration units and their deployment in 2014 at a site in Altavista, Virginia. <https://ntrs.nasa.gov/search.jsp?R=20140008997> [It might be necessary to copy and paste this URL for access.]

## Research

### PLASMA-BASED WATER TREATMENT: EFFICIENT TRANSFORMATION OF PERFLUOROALKYL SUBSTANCES IN PREPARED SOLUTIONS AND CONTAMINATED GROUNDWATER

Stratton, G.R., F. Dai, C.L. Bellona, T.M. Holsen, E.R.V. Dickenson, and S.M. Thagard.  
Environmental Science & Technology 51(3):1643-1648(2017)

A process based on electrical discharge plasma was tested for the transformation of PFOA. The plasma-based process was adapted for two cases, high removal rate and high removal efficiency. With the high-rate process (76.5 W input power) the PFOA concentration in 1.4 L of aqueous solutions fell by 90%, and by 25% with the high-efficiency process (4.1 W input power) during 30 minutes of treatment. The high-efficiency process was also used to treat groundwater containing PFOA and several co-contaminants, including PFOS, demonstrating that co-contaminants did not affect the process significantly and that the process was capable of rapidly degrading PFOS. Preliminary investigation into the byproducts showed that only about 10% of PFOA and PFOS was converted to shorter-chain perfluoroalkyl acids. Investigation into the types of reactive species involved in primary reactions with PFOA showed that hydroxyl and superoxide radicals, typically the primary plasma-derived reactive species, played no significant role. Instead, scavenger experiments indicated that aqueous electrons account for a sizable fraction of the transformation, with free electrons and/or argon ions proposed to account for the remainder.

### SCREENING OF PFAS IN GROUNDWATER AND SURFACE WATER

Ahrens, L., J. Hedlund, W. Duerig, R. Troeger, and K. Wiberg.  
Swedish Environmental Protection Agency, SLU, Rapport 2016:2, 82 pp, 2016

Levels of 26 PFASs were measured in 502 water samples originating from Swedish groundwater, surface water, sewage treatment plant (STP) effluents, and landfill leachates. In drinking water source areas, the average sum of a 26-PFAS concentration was 8.4 ng/L. The national drinking water guideline value of 90 ng/L for the average sum of 7 PFASs was exceeded in 2% of these samples. In water not used for drinking water, the average sum of the 26 PFASs average concentration was 142 ng/L. PFOS concentrations exceeded the Annual Average Environmental Quality Standard (AA-EQS) of the EU Water Framework Directive in 42% of the surface water samples. Among the different water categories, landfill leachates had the highest average concentration of the 26 PFAS with 487 ng/L, followed by surface water (average 112 ng/L), groundwater (49 ng/L), STP effluents (35 ng/L), and background screening lakes (3.4 ng/L). The composition profile of the PFASs differed between the types of waters, showing an even distribution of the sums of PFCAs, PFSAs, and PFAS precursors in groundwater, whereas in all other water categories the sums of PFCAs were dominant. FOSA, PFNA, PFDA, and 6:2 FTSA were frequently detected in drinking water source areas. <http://naturvardsverket.diva-portal.org/smash/get/diva2:915446/FULLTEXT01.pdf>

### SORPTION OF PERFLUOROCTANE SULFONATE AND PERFLUOROCTANOATE ON POLYACRYLONITRILE FIBER-DERIVED ACTIVATED CARBON FIBERS: IN COMPARISON WITH ACTIVATED CARBON

Chen, W., X. Zhang, M. Mamadiev, and Z. Wang.  
RSC Advances 7:927-938(2017)

Polyacrylonitrile fiber (PANF)-derived activated carbon fibers (PACFs) were successfully prepared using one-step carbonation/activation and then used for the sorption of PFOS and PFOA. High specific surface areas (SSAs) of 1782 m<sup>2</sup>/g and micro/mesoporous structures of the PACFs were obtained by optimizing the preparation conditions of the PANF-based pre-oxidized fibers (PANOFs)/KOH ratio of 1:2 and an activation temperature of 800°C. The prepared PACFs exhibited flexibility, endless forms, and sorption capacities of 1.52 mmol/g for PFOS and 0.73 mmol/g for PFOA, much higher than commercially available coal-based powdered activated carbon and granular activated carbon. It was assumed that the multilayer sorption most probably occurs through electrostatic attraction and hydrophobic interaction, and some micelles and hemi-micelles form on the ACF surfaces. The PACFs showed good reusability over five sorption-desorption cycles. This paper is **Open Access** at <http://pubs.rsc.org/en/content/articlelanding/2017/ra/c6ra25230c>.

### RESIDUAL ORGANIC FLUORINATED COMPOUNDS FROM THERMAL TREATMENT OF PFOA, PFHXA AND PFOS ADSORBED ONTO GRANULAR ACTIVATED CARBON (GAC)

Watanabe, N., S. Takemine, K. Yamamoto, Y. Haga, and M. Takata.  
Journal of Material Cycles and Waste Management 18(4):625-630(2016)

PFOA, PFOS, and perfluorohexanoic acid (PFHxA) adsorbed onto GAC were thermally treated in an N<sub>2</sub> gas stream to assess the fate of PFASs during thermal GAC regeneration. Mineralized F, residual PFASs (including short-chained species), and volatile organic fluorine (VOF) were determined. At 700°C, VOF was 13.2, 5.9, and 4.8% as for PFOA, PFOS, and PFHxA; however, VOF decreased to 0.1% when the GAC and off-gas were kept at 1000°C. No PFASs remained in GAC at 700-1000°C; at the same time, short-chained PFASs were slightly detected in the aqueous trapping of off-gas at 800 and 900°C. The destruction of PFASs on GAC might be perfect if the temperature is >700°C, although the process is competitive against volatile escape from GAC. Destruction in the gaseous phase needs a temperature as high as 1000°C. Destruction of PFASs on the surface of GAC, volatile escape from the site, and thermolysis in the gas phase should be considered for thermal regeneration of GAC.

### ISOLATION, IDENTIFICATION, AND DEGRADATION PERFORMANCE OF A PFOA-DEGRADING STRAIN

Yi, L.B., L.Y. Chai, Y. Xie, Q.J. Peng, and Q.Z. Peng.  
Genetics and Molecular Research 15(2):gmr.15028043(2016)

The PFOA-degrading strain YAB1 was isolated from soil near a perfluorinated compound production plant through acclimation and enrichment culture, using PFOA as the sole carbon source. The strain was preliminarily identified as *Pseudomonas parafulva* based on colony morphology, physiological and biochemical features, and 16S rRNA gene sequencing. Using shaking flask fermentation, the maximum tolerable concentration of YAB1 on PFOA was found to be 1000 mg/L. The optimal conditions for bacterial growth and PFOA degradation were 30°C, pH 7, 2% inoculum, and an initial PFOA concentration of 500 mg/L. After 96 h of culture, the PFOA degradation rate determined by GC-MS analysis was 32.4%. When 1 g/L glucose was added to the inorganic salt culture medium, the degradation rate increased to 48.1%. Glucose was the most effective exogenous carbon source for PFOA degradation.

### GLOWING CRYSTALS CAN DETECT, CLEANSE CONTAMINATED DRINKING WATER

Roberts, G. Jr.  
Lawrence Berkeley National Laboratory, News Release, 29 Nov 2016

Tiny, glowing crystals designed to detect and capture heavy-metal toxins such as lead and mercury could prove to be a new tool for locating and cleaning up contaminated water sources. A team led by researchers at Rutgers University used intense X-rays at Lawrence Berkeley National Laboratory to probe the structure of the crystals they developed and study how they bind to heavy metals. The crystals, which function like miniature, reusable sensors and traps, are known as luminescent metal-organic frameworks, or LMOFs. The researchers found that the LMOFs bind strongly to mercury and lead but bind weakly to lighter metals, such as magnesium and calcium. The LMOFs can be collected, cleaned, and reused for three cycles of toxic cleansing before their performance begins to degrade. Researchers from the University of Texas at Dallas and Rider University also participated in this research, which was supported by DOE's Office of Science. <http://newscenter.lbl.gov/2016/11/29/glowing-crystals-cleanup-water/>

### TECHNOLOGY PLAN TO ADDRESS THE EM MERCURY CHALLENGE

Oak Ridge National Laboratory, 32 pp, 2016

This plan identifies mercury-related research and technology development to resolve key technical uncertainties in three DOE EM mission areas: environmental remediation, facility deactivation and decommissioning (D&D), and tank waste processing. Recommendations for the first two areas include developing rapid screening methods as well as sensitive, quantitative analyses for mercury in environmental and infrastructure samples; assessing decontamination approaches for D&D; developing in situ stabilization for mercury-contaminated soil; refining site-specific environmental mercury models; and mitigating mercury in creek ecosystems through source-zone stabilization, water chemistry modification, and ecological management. Crosscutting research topics are also recommended: grout formulation for mercury-bearing wastes and alternative assessments of waste form leachability.

#### **REMEDIATION OF CD(II)-CONTAMINATED SOIL VIA HUMIN-ENHANCED ELECTROKINETIC TECHNOLOGY**

Ding, L., W. Lv, K. Yao, L. Li, M. Wang, and G. Liu.  
Environmental Science and Pollution Research 24(4): 3430-3436(2017)

In an investigation of the efficacy of a remediation strategy under the effects of humin-enhanced electrokinetics, humin in the form of a package was placed in close proximity to the cathode. Cations gravitate toward the cathode and anions are transferred to the anode. The humin was removed after the experiments to determine whether a target pollutant (cadmium) had been removed completely from soil. Acetic acid-sodium acetate was selected as the electrolyte for these experiments, which was circulated between the two electrode chambers via a peristaltic pump to control soil pH. When remediation duration was extended to 240 h, the removal of acid extractable Cd(II) went up to 43.86% efficiency, and heavy metal adsorption within the humin was 86.15 mg/kg. Further, the recycling of the electrolyte exhibited good control of the pH of the soil. When comparing the pH of the soil with the circulating electrolyte during remediation, in contrast to when it was not being recycled, the pH of the soil at the anode increased from 3.89 to 5.63, whereas the soil at the cathode decreased from 8.06 to 7.10, which indicated that electrolyte recycling had the capacity to stabilize the soil pH.

#### **EVALUATION OF 1,4-DIOXANE BIODEGRADATION UNDER AEROBIC AND ANAEROBIC CONDITIONS**

Rodriguez, Francisco J. Barajas, Ph.D. dissertation, Clemson University, 243 pp, 2016

This study was conducted to evaluate (1) the kinetic parameters for 1,4-dioxane metabolism and for cometabolism by propane-oxidizing bacteria; (2) the potential for in situ bioremediation of a dioxane plume using metabolic and cometabolic bioparging and bioaugmentation, based on simulations using a subsurface transport model; and (3) the potential for anaerobic biodegradation of dioxane. No significant evidence was found to support biodegradation of dioxane under anaerobic conditions, although partial mineralization in aerobic microcosms was observed. [http://tigerprints.clemson.edu/all\\_dissertations/1856/](http://tigerprints.clemson.edu/all_dissertations/1856/)

#### **REMOVAL OF CR(VI) FROM WATER USING A NEW REACTIVE MATERIAL: MAGNESIUM OXIDE SUPPORTED NANOSCALE ZERO-VALENT IRON**

Siciliano, A.  
Materials 9(8):19(2016)

NZVI was supported on MgO grains to facilitate the treatment of chromium-contaminated waters. The performances and mechanisms of the developed composite in Cr(VI) removal were investigated in batch and continuous tests. Kinetic studies under different operating conditions showed that Cr(VI) reduction could be expressed by a pseudo second-order reaction kinetic. The reaction rate increased with the square of Fe(0) amount, whereas it was inversely proportional to the initial chromium concentration. Performance was satisfactory under uncontrolled pH, and a limited influence of temperature was observed. The reactive material was efficiently reusable for many cycles without regeneration. Performance in continuous tests was close to 97% for about 80 pore volumes of reactive material. <http://www.mdpi.com/1996-1944/9/8/666/pdf>

#### **REMEDIATION OF HEXAVALENT CHROMIUM SPIKED SOIL BY USING SYNTHESIZED IRON SULFIDE PARTICLES**

Li, Y., W. Wang, L. Zhou, Y. Liu, Z.A. Mirza, and X. Lin.  
Chemosphere 169:131-138(2017)

Carboxymethyl cellulose (CMC)-stabilized microscale iron sulfide (FeS) particles were synthesized and applied to remediate hexavalent chromium (Cr(VI)) spiked soil. The effects of parameters, including dosage of FeS particles, soil moisture, and natural organic matter (NOM) in soil, were investigated with comparison to iron sulfate (FeSO<sub>4</sub>). Results show that the stabilized FeS particles can reduce Cr(VI) and immobilize Cr in soil quickly and efficiently. The soil moisture (ranging from 40–70%) and NOM in soil had no significant effects on Cr(VI) remediation by FeS particles. When molar ratio of FeS to Cr(VI) was 1.5:1, about 98% of Cr(VI) in soil was reduced by FeS particles in 3 d and Cr(VI) concentration decreased from 1407 mg/kg to 16 mg/kg. The total Cr and Cr(VI) in TCLP leachate were reduced by 98.4% and 99.4%, respectively. In FeS particles-treated soil, the exchangeable Cr fraction was mainly converted to Fe-Mn oxides bound fraction because of the precipitation of Cr(III)-Fe(III) hydroxides. The physiologically based extraction test bioaccessibility of Cr decreased from 58.67% to 6.98%. Compared to FeSO<sub>4</sub>, the high Cr(VI) removal and Cr immobilization efficiency indicates the potential for field application of synthesized FeS particles for remediation of Cr(VI)-contaminated soil.

#### **REMOVAL OF PHOSPHATE AND HEXAVALENT CHROMIUM FROM AQUEOUS SOLUTIONS BY ENGINEERED WASTE EGGSHELL**

Chen, D., X. Xiao, and K. Yang.  
RSC Advances, Issue 42, 2016

A novel adsorbent derived from waste eggshell was used for phosphate and Cr(VI) adsorption. EDS, XRD, and FTIR analyses demonstrated that alpha-FeOOH was successfully loaded onto the eggshell, thus increasing the available sorption sites and facilitating phosphate and Cr(VI) adsorption. The maximum phosphate and Cr(VI) adsorption capacities on alpha-FeOOH-modified eggshell (F-ES) were 248.73 and 41.57 mg/g, respectively, which were much greater than that of the original eggshell 89.74 and 11.81 mg/g. The kinetics data fit well with pseudo-first-order, pseudo-second-order, and Ritchie kinetics models, which proved that the adsorption process onto the eggshell was controlled by multiple mechanisms. In addition, the removal rates of phosphate and Cr increased with increasing adsorbent dosage, although removal rates showed downward trends when pH increased from 3 to 9 and ionic strength increased from 0 to 0.1 M.

#### **APPLICATIONS OF EGG SHELL AND EGG SHELL MEMBRANE AS ADSORBENTS: A REVIEW**

Mittal, A., M. Teotia, R.K. Soni, and J. Mittal.  
Journal of Molecular Liquids 223:376-387(2016)

In the hunt for waste materials as potential scavengers of hazardous chemicals, eggshells and eggshell membranes have emerged as nontoxic, versatile, and efficient adsorbents. A survey of the literature reveals that these materials in their natural as well as chemically modified forms have provided excellent results for the removal of various classes of dyes, oxalic acid, phenol, pesticides, humic acid, pharmaceuticals, surfactants, PAHs, actinides, fluorides, and heavy, precious and light metals. In recent years powdered eggshell membranes have been modified to nanoparticles and used as adsorbent in a variety of applications. Reports are also available on the use of nanostructured carbonate hydroxylapatite (CHAP), which is derived from eggshells for the removal of cadmium and lead ions from wastewater. This review summarizes research carried out on the above-mentioned applications as discussed in 108 articles.

#### **VARYING CONDITIONS FOR HEXANOIC ACID DEGRADATION WITH BIOTIGER™**

SRNL-STI-2016-00427, Poster, 2016

BioTiger™ (BT) is a consortium of 12 bacteria designed for petroleum waste biodegradation. BT is currently being studied for bioremediation use at the Athabasca oil sands refineries in Canada. The runoff ponds from the petroleum extraction processes (i.e., tailings ponds) contain a mixture of PAHs, naphthenic acids, hydrocarbons, heavy metals, water, and sand. BT at 30°C is able to degrade 10 mM hexanoic acid (HA) cometabolically with 0.2% yeast extract (w/v) in 48 hours when starting at 0.4 OD 600 nm. Given this stable degradation capability, variations were tested to explore the wider parameters of BT activity in temperature, pH, intermediate degradation, cometabolic dependence, and transfer stability. Due to the vast differences in temperature at various points in the refineries, a wide range of temperatures was assessed. Results indicate that BT retains the ability to degrade HA, a model surrogate for tailings pond contaminants, at temperatures ranging from 15–35°C. <https://www.osti.gov/scitech/biblio/1281780-varying-conditions-hexanoic-acid-degradation-biotiger>

#### **REMOVAL OF HYDROPHOBIC ORGANIC POLLUTANTS FROM SOIL WASHING/FLUSHING SOLUTIONS: A CRITICAL REVIEW**

Trellu, C., E. Mousset, Y. Pechaud, D. Huguenot, E.D. van Hullebusch, G. Esposito, and M.A. Oturan.  
Journal of Hazardous Materials 306:149-174(2016)

Soil washing and soil flushing processes enhanced by the use of extracting agents (surfactants, biosurfactants, cyclodextrins, etc.) are conceivable and efficient approaches for remediation of PAHs, petroleum hydrocarbons, or polychlorobiphenyls, although these processes generate high-strength effluents containing large amounts of extracting agent. The goal in treating the effluents is to remove target pollutants and recover extracting agents for further treatment use. Techniques investigated for this purpose include heterogeneous photocatalysis, technologies based on Fenton reaction chemistry (including homogeneous photocatalysis such as photo-Fenton), ozonation, electrochemical processes, and biological treatments. This paper reviews and compares the main advantages and drawbacks as well as target pollutant removal mechanisms. Promising integrated treatments, such as a selective adsorption step for target pollutants and advanced oxidation processes combined with biological treatments, are also discussed.

#### **COSOLUBILIZATION SYNERGISM OCCURRENCE IN CODESORPTION OF PAH MIXTURES DURING SURFACTANT-ENHANCED REMEDIATION OF CONTAMINATED SOIL**

Liang, X., C. Guo, Y. Wei, W. Lin, X. Yi, G. Lu, and Z. Dang.  
Chemosphere 144:583-590(2016)

The co-solubilization effect between phenanthrene (Phe) and pyrene (Pyr) in nonionic surfactant Triton X-100 (TX100) solution was investigated with respect to their co-desorption performance from soil. Co-solubilization experiments showed that, when cosolubilized, Phe and Pyr solubility in TX100 increased by 15.38 and 18.19%, respectively, potentially due to the enlarged micelle volume caused by PAHs solubilized in the shell region of the micelle. The co-solubilization effect was further observed in the soil washing process. The strengthened TX100 solubilization capacity toward Phe and Pyr increased the two PAHs

co-desorption efficiency from soil, accompanied by synergistic extent of 6-15%; however, synergism in co-desorption was weaker than that observed in the co-solubilization system, which may be related to surfactant loss to soil and PAH partition into soil organic matter and the sorbed surfactants.

#### **ELECTROKINETIC FLUSHING WITH SURROUNDING ELECTRODE ARRANGEMENTS FOR THE REMEDIATION OF SOILS THAT ARE POLLUTED WITH 2,4-D: A CASE STUDY IN A PILOT PLANT**

Risco, C., S. Rodrigo, R. Lopez-Vizcaino, C. Saez, P. Canizares, V. Navarro, and M.A. Rodrigo.  
Science of the Total Environment 545-546:256-265(2016)

Electrokinetic soil flushing was evaluated for the removal of 2,4-dichlorophenoxyacetic acid (2,4-D) from spiked soils using an electrode configuration consisting of one cathode surrounded by six anodes and one anode surrounded by 6 cathodes. Experiments were conducted for >1 month in a bench-scale set-up (175 dm<sup>3</sup> capacity) that was completely automated and operated at a constant electric field (1.0V/cm).

#### **PERFORMANCE OF ELECTROREMEDIATION IN REAL CONTAMINATED SEDIMENTS USING A BIG CELL, PERIODIC VOLTAGE AND INNOVATIVE SURFACTANTS**

Hahladakis, J.N., A. Latsos, and E. Gidarakos.  
Journal of Hazardous Materials 320:376-385(2016)

An evaluation of electrokinetic (EK) treatment of sediments contaminated with toxic metals and PAHs was conducted in a big laboratory EK cell using non-ionic surfactants and periodic voltage "day on-night off" application. The periodic voltage mode, in conjunction with selected surfactants, favored overall EK process results. Arsenic (83%), nickel (67%), and chromium (63%) exhibited the highest removal percentages, while zinc and lead attained at most 54% and 41%, respectively. Where the non-ionic surfactants were introduced in the electrolyte chambers, a major uniform removal of PAHs from sediment across the EK cell occurred, indicating the high solubilization capacity of the enhancing agents. In the unenhanced EK run, transport and in some cases removal of PAHs (particularly from sections adjacent to the electrolyte compartments) also occurred, mainly due to the negative PAHs charge, their potential weak bonds to the soil matrix, and the periodic voltage application. Maximum removal was obtained by the use of Nonidet P40.

#### **THE BIODIVERSITY SECURITY INDEX: A NEW METRIC FOR BENEFITS FROM USACE ECOSYSTEM RESTORATION PROJECTS**

Cole, R.A.  
ERDC/EL TR-16-5, 34 pp, 2016

This technical report summarizes progress made in the development of the Biodiversity Security Index (BSI), a new nonmonetary metric designed for use by the U.S. Army Corps of Engineers (USACE) to indicate the environmental benefit from planned or implemented ecosystem restoration projects. The BSI was designed to compare ecosystem restoration benefits across plans during project planning and across projects during annual ranking of projects for budget recommendations. It also might be used to compare monitored actual project performance with planned performance. This report synthesizes unpublished research and previously published and draft technical information. Included are the main metric elements; how the main metric elements are calculated and assembled into a metric unit; and the advantages the BSI offers in comparison to other metrics. It is not intended to serve as an implementation manual (which is under separate development). <https://erdc-library.ercd.dren.mil/xmlui/handle/11681/20257>

#### **THE BIOLOGY OF BIOAVAILABILITY: THE ROLE OF FUNCTIONAL ECOLOGY IN EXPOSURE PROCESSES**

Bridges, T.S., A.J. Kennedy, G.R. Lotufo, J.G. Coleman, C.E. Ruiz, J.H. Lindsay, A.H. Wooley, et al.  
ERDC/EL TR-17-2, SERDP Project ER-1750, 248 pp, 2017

The research objective was to improve the accuracy of sediment exposure assessments by considering the functional ecology of benthic organisms and different exposure routes (sediment particles, pore water, overlying water). Lab experiments were conducted using four marine invertebrates (a worm, two amphipods, and a clam) exposed to two different contaminated sediments within mesocosms designed to assess PCB exposure from overlying water and whole sediment using pathway isolation chambers. The impacts of two sediment remediation methods were also tested: (1) a 2-cm sand cap; and (2) activated carbon (AC) that was not aggressively mixed with sediment prior to organism testing. Porewater concentrations assessed using polyethylene devices provided a reasonable indicator of organism exposure but did not account for organisms with connections to the overlying water and direct particle ingestion. The sand cap significantly reduced PCB exposure for all the species except the clam, while non-equilibrated AC did not result in significant reductions in bioaccumulation. Data were used to enhance the capability and predictive reliability of an existing modeling framework (RECOVERY). <https://erdc-library.ercd.dren.mil/xmlui/handle/11681/21083>

#### **AQUATIC CONTAMINANT AND MERCURY SIMULATION MODULES DEVELOPED FOR HYDROLOGIC AND HYDRAULIC MODELS**

Zhang, Z. and B.E. Johnson.  
ERDC/EL TR-16-8, 139 pp, 2016

This report offers details regarding the theory and mathematical formulations implemented in the newly developed general constituent simulation module (GC), contaminant simulation module (CSM), and mercury simulation module (HgSM). The GC models simple kinetics for multiple size classes of solids and user-defined constituents in the water column. The CSM models the kinetics of user-defined contaminants in aquatic systems. The kinetic processes modeled in CSM include ionization, multi-phase partitioning, degradation, photolysis, hydrolysis, volatilization, generalized second-order reaction, and transformations where one chemical species undergoes a reaction and is transformed to a daughter product. The HgSM models mercury species (elemental mercury, inorganic mercury, and methyl mercury) and their cycling in aquatic systems. The three water quality modules only compute internal sources and sinks of each state variable for both water column and an underlying sediment layer. The GC, CSM, and HgSM modules are written as "plug-in" dynamic link libraries and compiled as GC.dll, CSM.dll, and HgSM.dll, respectively. The modules have been integrated into the HEC-RAS model and will also be integrated into other hydrologic and hydraulic models (e.g., AdH and SRH-2D). <https://erdc-library.ercd.dren.mil/xmlui/handle/11681/20249>

#### **FEATURED R&D 100 AWARD WINNER: U-GRABBER**

R&D Magazine, 9 Feb 2017

U-Grabber, created at Oak Ridge National Laboratory, is a novel adsorbent material for remediation of water and extraction of commodities from traditionally difficult-to-mine sources, such as oceans, fly ash, mine-tailings ponds, and geothermal brines, including fracking water. The innovative product was the winner of a 2016 R&D 100 Award. The prototype material is made from polyethylene fibers, similar to PVC, woven into braids and grafted with chains of a uranium-attractive chemical called amidoxine. Uranium in contaminated water binds with the fibers and can be extracted and purified for reuse. The fibers can be reconstituted and reused and are cheap to produce at scale. They can also be customized to bind with other toxic or valuable aqueous metals, thus presenting an environmentally sound method of cleaning bodies of water. The adsorbent works by immobilizing (i.e., coordinating) metals on the highly grafted polymer. The use of metal coordination (i.e., grabbing the metal out of solution) allows U-Grabber to extract metals of interest from solutions where traditional adsorbents are cost prohibitive, such as geothermal brines or high sulfate streams. The available material formats (e.g., braided fibers, nonwoven fabric, and powder) allow optimal deployment. <http://www.rdmaq.com/article/2017/02/featured-r-d-100-award-winner-u-grabber>

#### **BIOREMEDIATION OF INDUSTRIAL AND MUNICIPAL WASTE PONDS CONTAMINATED WITH POLYCHLORINATED BIPHENYLS (PCBS)**

Lowman, J.S. and C. Mei.  
Austin Environmental Sciences 1(3):id1013(2016)

This brief communication focuses on strategies for PCB bioremediation in wastewater treatment ponds under different conditions, highlighting efforts to remediate PCBs in a pond at a small town in Central Virginia using a combination of switch grass and bacteria. <http://austinpublishinggroup.com/environmental-sciences/download.php?file=fulltext/aes-v1-id1013.pdf>

#### **PERCHLORATE BIOREMEDIATION: CONTROLLING MEDIA LOSS IN EX-SITU FLUIDIZED BED REACTORS AND IN-SITU BIOLOGICAL REDUCTION BY SLOW-RELEASE ELECTRON DONOR**

Shrestha, Sichu, Ph.D. dissertation, University of Nevada, Las Vegas. UNLV Theses, Dissertations, Professional Papers, and Capstones, no. 2744, 270 pp, 2016

Two issues related to ex situ and in situ perchlorate biodegradation were examined: (a) Use of digital image as a tool to determine appropriate backwashing frequency for fluidized bed reactor (FBR) used to treat perchlorate-contaminated waters, and (b) Feasibility of using a slow-release electron donor, emulsified oil, to support in situ degradation of perchlorate in groundwater with slow and fast hydraulic conductivities. Column FBRs were constructed to contain activated carbon and perchlorate solutions at different concentrations (100 ppb, 100 ppm and 10 ppm). A high-resolution camera was mounted to target the operating zone of the FBR, pictures were taken every 1.5 hr, and the digital pictures were analyzed using the ImageJ processing tool. These analyses were compared with backwash simulations from a biofilm model and backwash time forecast using biomass growth. Images processed with ImageJ closely represented the height of the expanded media in the FBR and proved useful for deciding backwashing frequency. Emulsified oil provided effective slow-release electron donor to degrade nitrate and perchlorate in saturated groundwater zones. Perchlorate removal required acclimation time, whereas nitrate degraded almost immediately. Perchlorate degradation was highly affected by high hydraulic conductivities (i.e., smaller contact time). Degradation extent depended upon the relative amounts of perchlorate and nitrate present, the amount of electron donor present, and the residence time. <http://digitalscholarship.unlv.edu/thesesdissertations/2744>

#### **BIOLOGICAL 1,4-DIOXANE WASTEWATER TREATMENT BY IMMOBILIZED PSEUDONOCARDIA SP. D17 ON LOWER 1,4-DIOXANE**

## CONCENTRATION

Isaka, K., M. Udagawa, Y. Kimura, K. Sei, and M. Ike.  
Journal of Water and Environment Technology 14(4):289-301(2016)

In an evaluation of biological 1,4-dioxane removal performance using newly isolated *Pseudonocardia* sp. D17, which can utilize 1,4-dioxane as the sole carbon source, a low level of influent dioxane (5-50 mg/L) was treated to meet the Japanese effluent standard of 0.5 mg/L. The gel entrapment technique was used to immobilize *Pseudonocardia* sp. D17 so that it did not wash out of the bioreactor. An average effluent dioxane concentration of 0.49 mg/L was achieved at a loading rate of 0.096 kg dioxane/m<sup>3</sup>/d with an influent dioxane concentration of 50 mg/L. Bioreactor startup was observed at 25°C within 2 weeks. Effluent dioxane concentration of 0.38 mg/L on average was confirmed at a loading rate of 0.060 kg dioxane/m<sup>3</sup>/d, even when the operating temperature was 15°C. The effect of temperature on dioxane removal activity was characterized in the batch experiment, with maximum dioxane removal observed at 33.9°C. Dioxane removal activity was observed even at 7.4°C, although that declined to 27% compared with removal at 25°C. The activation energy for dioxane removal by *Pseudonocardia* sp. D17 (representing the temperature dependency) was calculated as 51.9 kJ/mol.  
[https://www.istage.jst.go.jp/article/jwet/14/4/14\\_15-084/pdf](https://www.istage.jst.go.jp/article/jwet/14/4/14_15-084/pdf)

## RESEARCHERS DEVELOP GENETIC TOOL TO IMPROVE ARSENIC STUDIES

Utah State University News Release, 2017

A team of Utah State University College of Engineering researchers developed a new primer—a tool used in DNA amplification—that simplifies the process of identifying bacteria found in soil and groundwater samples. Various bacteria transform or reduce As(V), or arsenate, into As(III), or arsenite. Arsenite is more toxic to humans and is more mobile. Gaining a better understanding of the microbial ecosystems that release arsenite is an important first step in reducing the prevalence of arsenic contamination in groundwater. The new primer—a short strand of DNA that targets the arsenate reductase gene—helps researchers identify which bacteria in a sample have the gene. Without this primer, researchers had to first grow the bacterial cells in a lab before extracting their DNA and amplifying the gene. Now researchers can simply add the primer into the reaction and get quantifiable copies of the reductase gene. The copied genes show which bacteria species are in the sample and provide new information about the diversity of arsenate-reducing microorganisms. The team pulled groundwater samples from 20 privately owned wells located in Northern Utah's Cache County; 20% of the wells surveyed had arsenate and arsenite concentrations above the drinking water limit of 10µg/L. The samples containing high arsenite concentrations also had an abundance of the arsenate reductase genetic material. <https://engineering.usu.edu/news/arsenic> The team's findings were published in *Applied and Environmental Microbiology* [abstract: <http://aem.asm.org/content/83/4/e02725-16.abstract>].

## REMOVAL OF OXYFLUORFEN FROM EX-SITU SOIL WASHING FLUIDS USING ELECTROLYSIS WITH DIAMOND ANODES

dos Santos, E.V., V. Saez, C.A. Martinez-Huitle, P. Canizares, and M.A. Rodrigo.  
Journal of Environmental Management 171:260-266(2016)

Treatment of soil spiked with oxyfluorfen was studied using a surfactant-aided soil-washing (SASW) process followed by electrochemical treatment of the washing liquid using boron-doped diamond (BDD) anodes. Results demonstrated the efficiency of SASW for soil treatment; the pesticide was removed completely using dosages below 5 g of sodium dodecyl sulfate (SDS) per kg of soil. After that, complete mineralization of organic matter (oxyfluorfen, SDS, and by-products) was attained when the washing liquids were electrolyzed using BDD anodes. Electrolysis of soil-washing fluids occurs via the reduction in size of micelles until their complete depletion. The removal rate depends on the size of the particles in solution. Lower concentrations of intermediates are produced (sulfate, chlorine, 4-(trifluoromethyl)-phenol and ortho-nitrophenol) during BDD-electrolyzes. Sulfate (from SDS) and chlorine (from oxyfluorfen) ions play an important role during electrochemical organic matter removal.

## ENHANCED FENTON-LIKE DEGRADATION OF TRICHLOROETHYLENE BY HYDROGEN PEROXIDE ACTIVATED WITH NANOSCALE ZERO VALENT IRON LOADED ON BIOCHAR

Yan, J., L. Qian, W. Gao, Y. Chen, D. Ouyang, and M. Chen.  
Scientific Reports 7:Article 43051(2017)

A composite of nanoscale zero-valent iron (NZVI) loaded on biochar (BC) was prepared and characterized as a hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) activator for TCE degradation. NZVI was homogeneously loaded on BC sheets to form NZVI/BC with specific surface area of 184.91 m<sup>2</sup>/g. Application activated H<sub>2</sub>O<sub>2</sub> to achieve TCE degradation efficiency of 98.9%, with TOC removal of 78.2% within 30 min under the conditions of 010 mmol/L TCE, 1.13 g/L NZVI/BC, and 1.50 mmol/L H<sub>2</sub>O<sub>2</sub>. Test results from electron-spin resonance measurement and coumarin-based fluorescent probe technology indicated that OH radicals were the dominant species responsible for TCE degradation within the NZVI/BC-H<sub>2</sub>O<sub>2</sub> system. *This paper is Open Access at* <http://www.nature.com/articles/srep43051>.

## ULTRASOUND ASSISTED, THERMALLY ACTIVATED PERSULFATE OXIDATION OF COAL TAR DNAPLS

Peng, L., L. Wang, X. Hu, P. Wu, X. Wang, C. Huang, X. Wang, and D. Deng.  
Journal of Hazardous Materials 318:497-506(2016)

The feasibility of ultrasound-assisted thermally activated persulfate for effective oxidation of 20 coal-tar 2-to-6-ringed PAHs in a biphasic tar/water system and a triphasic tar/soil/water system was investigated and established. Ultrasonic assistance, persulfate, and elevated reaction temperature were all required to achieve effective oxidation of coal tar PAHs. The heating needed can be ultrasonically induced. The oxidation of individual PAHs in the biphasic tar/water system followed first-order kinetics, and individual PAH oxidation rate was primarily determined by the mass transfer coefficients, tar/water interfacial areas, the aqueous solubility of the individual PAH, and its concentration in coal tar. Results also indicated that individual PAH degradability is closely related to its reactivity, and the high reactivity of 4-to-6-ringed PAHs substantially improves their degradability.

## REMEDIATION OF HEXAVALENT CHROMIUM CONTAMINATED SOIL BY BIOCHAR-SUPPORTED ZERO-VALENT IRON NANOPARTICLES

Su, H., Z. Fang, P.E. Tsang, L. Zheng, W. Cheng, J. Fang, and D. Zhao.  
Journal of Hazardous Materials 318:533-540(2016)

High-efficiency and low-cost biochar-supported zero-valent iron nanoparticles (NZVI-BC) were synthesized and applied to the remediation of Cr(VI)-contaminated soil. The remediation tests indicated that the immobilization efficiency of Cr(VI) and Cr<sub>total</sub> was 100% and 91.94%, respectively, at 8 g NZVI-BC per kg soil for 15 d of remediation. Further investigation showed that exchangeable Cr was almost completely converted to Fe-Mn oxides and organic matter. NZVI-BC also served to improve soil fertility and reduce Fe leachability. Cabbage mustard growth experiments indicated that the NZVI-BC treatment decreased the phytotoxicity of Cr(VI) and Fe in the seedlings and enhanced plant growth.

## REMEDIATION OF HEXAVALENT CHROMIUM CONTAMINATION IN CHROMITE ORE PROCESSING RESIDUE BY SODIUM DITHIONITE AND SODIUM PHOSPHATE ADDITION AND ITS MECHANISM

Li, Y., A.B. Cundy, J. Feng, H. Fu, X. Wang, and Y. Liu.  
Journal of Environmental Management 192:100-106(2017)

Large amounts of chromite ore-processing residue (COPR) wastes have been deposited worldwide, generating significant Cr(VI) contamination issues. In a 2-step procedure, sodium dithionite (Na<sub>2</sub>S<sub>2</sub>O<sub>4</sub>) was used to reduce Cr(VI) to Cr(III) in COPR containing high available Fe, and then the Cr(III) was further immobilized using sodium phosphate (Na<sub>3</sub>PO<sub>4</sub>). Systematic investigation results showed that Na<sub>2</sub>S<sub>2</sub>O<sub>4</sub> effectively reduced Cr(VI) to Cr(III), catalyzed by Fe(III), with further Cr(III) immobilization upon subsequent addition of Na<sub>3</sub>PO<sub>4</sub>; however, Cr(VI) reduction was impeded by simultaneous addition of Na<sub>3</sub>PO<sub>4</sub> with Na<sub>2</sub>S<sub>2</sub>O<sub>4</sub> due to their competitive reaction with Fe(III). At optimal dosage in the 2-step procedure (i.e., Na<sub>2</sub>S<sub>2</sub>O<sub>4</sub> at a dosage 12 times the stoichiometric requirement for 15 days, and then Na<sub>3</sub>PO<sub>4</sub> in a molar ratio), the total dissolved Cr in the leachate determined via TCLP Cr testing of the samples fell to 3.8 mg/L from an initial TCLP Cr of 112.2 mg/L (>96% efficiency).

## BIOTRANSFORMATION OF HEXAVALENT CHROMIUM INTO EXTRACELLULAR CHROMIUM(III) OXIDE NANOPARTICLES USING SCHWANNIOMYCES OCCIDENTALIS

Mohite, P.T., A.R. Kumar, and S.S. Zinjarde.  
Biotechnology Letters 38(3):441-446(2016)

The biotransformation of toxic Cr(VI) ions into Cr<sub>2</sub>O<sub>3</sub> nanoparticles was studied in reaction mixtures containing the yeast *Schwanniomyces occidentalis* NCIM 3459 and Cr(VI) ions. Initially yellow, the mixtures turned green after 48 h incubation due to the synthesis of Cr(III) oxide nanoparticles. UV-visible spectra of the reaction mixtures showed peaks at 445 and 600 nm, indicating transitions in Cr<sub>2</sub>O<sub>3</sub>. FTIR profiles suggested the involvement of carboxyl and amide groups in nanoparticle synthesis and stabilization. The crystalline nature of the Cr<sub>2</sub>O<sub>3</sub> nanoparticles, ranging between 10 and 60 nm, was evident from the selective area electron diffraction and X-ray diffraction patterns. Energy-dispersive spectra confirmed the chemical composition of the biogenic nanoparticles, which could find applications in different fields. This eco-friendly process could be made cost-effective and scaled up by employing yeast biomass obtained from industrial processes and wastewater containing Cr(VI) ions.

## SUSTAINABLE REMEDIATION OF ARSENIC AND CHROMIUM IN GROUNDWATER: TASK 3.61.2

Cutt, D., K. Mishkin, H. Young, and R. Wilkin.  
Sustainable and Healthy Communities 3.61, Contaminated Sites Posters, 2016

This work addresses one of EPA Region 2's identified science needs: conducting research to more fully understand natural degradation mechanisms and rates to

aid in developing strategies to remediate sites sustainably and cost-effectively. The research is being conducted at two Superfund sites in New Jersey: the Garfield Chromium Ground Water Superfund Site, a former electroplating facility that contaminated the community's groundwater with Cr(VI) from a tank rupture, and the Vineland Chemical Superfund Site, where a groundwater pump-and-treat remedy has addressed arsenic for over 10 years at an annual cost of ~\$3M/yr. At the Garfield site, spectroscopy and solid-phase extraction studies are being conducted to evaluate natural capacity of subsurface solids to reduce Cr(VI) and form insoluble Fe-Cr hydroxide precipitates. At Vineland, in situ stabilization of arsenic via air sparging is being evaluated. Using this technique, natural reducing conditions that transport ferrous iron and arsenic in groundwater are manipulated using air sparge techniques; this favors the formation of Fe hydroxide precipitates and the sequestration of arsenic.  
[https://www.epa.gov/sites/production/files/2016-11/documents/bosc\\_2016\\_poster\\_as\\_and\\_crvl\\_final.pdf](https://www.epa.gov/sites/production/files/2016-11/documents/bosc_2016_poster_as_and_crvl_final.pdf)

#### VITRIFICATION OF INCINERATED TANNERY SLUDGE IN SILICATE MATRICES FOR CHROMIUM STABILIZATION

Varitis, S., P. Kavouras, E. Pavlidou, E. Pantazopoulou, G. Vourlias, K. Chrissafis, et al.  
Waste Management 59:237-246(2017)

Vitrification was applied to stabilize and solidify a chromium-rich ash by-product of the incineration of tannery sludge. Six different batch compositions were produced, based on silica as the glass former and sodium and calcium oxides as flux agents. As-vitrified products (monoliths) were either composed of silicate matrices with separated-from-the-melt chromium oxide mineral (Cr<sub>2</sub>O<sub>3</sub>) crystallites or were, in one case, homogeneous glass. Leach test results revealed that Cr was successfully stabilized inside the as-vitrified monoliths. All as-vitrified products then were thermally treated to transform them for further study. Devitrification impaired Cr stabilization where the initial as-vitrified product was a homogeneous glass. In all other cases, devitrification did not affect successful chromium stabilization.

#### THE RATE OF CHROMIUM LEACHING FROM SLAG-BASED CEMENT COMPOSITES IN DIFFERENT LEACHANTS

Oravec, J., A. Estokova, and S. Demcak.  
International Journal of Materials 3:56-59(2016)

This experiment evaluated the leachability of chromium from reference concrete samples containing Portland cement as binder against the leachability of concrete samples containing ground blast furnace slag (65% and 95%, respectively, in place of Portland cement). The samples were subjected to long-term leaching for 500 days in three different leachants: distilled water, rainwater, and Britton-Robinson solution. In subsequent analysis of Cr concentration in the various leachates, measured values of dissolved Cr(VI) clearly indicated that the higher the amount of slag in the concrete samples, the more Cr leached out. Distilled water was the most aggressive leachant for Cr. <http://www.naun.org/main/NAUN/materials/2016/a162018-083.pdf>

### General News

#### BEST PRACTICES FOR ENVIRONMENTAL SITE MANAGEMENT: RECOMMENDED CONTENTS OF A GROUNDWATER MONITORING REPORT

EPA 542-F-16-005, 10 pp, 2016

The purpose of this issue paper is to recommend information to include in groundwater monitoring reports that will lead to improved report consistency and a useful, readable format. Incorporation of the recommended information will standardize groundwater monitoring report deliverables, which may in turn inform site characterization strategies, analysis of remedial alternatives, monitoring network optimization, remedy performance evaluation, continual refinement of the conceptual site model, and technical evaluation of groundwater data in five-year reviews. <https://semspub.epa.gov/src/document/11/500024623>

#### CHARACTERIZATION OF CONTAMINATED GROUND WATER DISCHARGE TO SURFACE WATER: TECHNICAL GUIDANCE, VERSION 1.0

New Jersey Department of Environmental Protection, Site Remediation and Waste Management Program, 55 pp, 2016

This guidance is designed to help the person responsible for conducting the remediation to comply with the Department's requirements established by the Technical Requirements for Site Remediation (Technical Rules), N.J.A.C. 7:26E, dated May 2012. This guidance provides tools and methods to characterize the groundwater to surface water pathway to obtain the data necessary to evaluate contaminated groundwater discharges to surface water. The document describes the following:

- An approach for conducting an investigation of contaminated groundwater discharges to surface water.
- Conceptual models of the groundwater migration to surface water pathway.
- Tools to investigate the pathway.
- Remedial action performance monitoring considerations.

[http://www.nj.gov/dep/srp/guidance/srra/gw\\_discharge\\_to\\_sw\\_tech\\_guidance.pdf](http://www.nj.gov/dep/srp/guidance/srra/gw_discharge_to_sw_tech_guidance.pdf)

#### TOOLKIT FOR IDENTIFICATION AND QUANTIFICATION OF MERCURY RELEASES: REFERENCE REPORT AND GUIDELINE FOR INVENTORY LEVEL 2. VERSION 1.4

United Nations Environment Chemicals Branch, Geneva, Switzerland. 339 pp, 2017

Chapter 5 of the Level 2 guide provides detailed descriptions of sources of mercury releases from industrial or other human activity.

<http://web.unep.org/chemicalsandwaste/what-we-do/technology-and-metals/mercury/toolkit-identification-and-quantification-mercury-releases>

#### THE ABCs OF PCBs

Prepared by the Office of Senator Edward J. Markey, 46 pp, 2016

Although U.S. EPA banned polychlorinated biphenyls (PCBs) production and most uses in 1979, people are still exposed to these toxic chemicals from sources such as leaking fluorescent light ballast; old electrical equipment; PCB-containing landfills; and caulk, some oil-based paints, and floor finish in buildings constructed between 1950 and 1979. A 2016 study by the Harvard School of Public Health estimated that between 12,960 and 25,920 schools have PCB-containing caulk. This report focuses on PCBs found in school infrastructure and discusses the costs of appropriate responses to these hazards.  
<https://www.markey.senate.gov/imo/media/doc/2016-10-05-Markey-PCB-Report-ABCsofPCBs.pdf>

#### MILITARY BASE REALIGNMENTS AND CLOSURES: DOD HAS IMPROVED ENVIRONMENTAL CLEANUP REPORTING BUT SHOULD OBTAIN AND SHARE MORE INFORMATION

U.S. Government Accountability Office, GAO-17-151, 41 pp, 19 Jan 2017

This report addresses DoD progress since 2007 in (1) capturing and reporting environmental cleanup costs at installations closed under the Base Realignment and Closure (BRAC) process and (2) transferring excess property and mitigating any challenges. Although DoD estimated as of September 30, 2015, that it will need about \$3.4 billion to complete environmental cleanup for installations closed under all BRAC rounds in addition to the ~\$11.5 billion already spent, its annual report to Congress has not pointed out that the removal of certain emerging contaminants (e.g., PFOS and PFOA) will be cost-significant. With no best estimate of these increased costs, Congress will not have sufficient insight into the significant associated cleanup costs to make more informed funding decisions. Additionally, DoD has no formal mechanism to capture and share information on how to expedite or resolve remediation challenges, such as disposing of radiological contamination or navigating multiple regulatory agencies. Without a mechanism to record and share lessons learned, installation personnel charged with implementing cleanup efforts miss opportunities to share information and could duplicate errors made in the past. GAO recommends that (1) DoD include in future reports to Congress that the cleanup of emerging contaminants will increase cleanup costs, and estimate such costs, and (2) share best practices on mitigating cleanup and property transfer challenges. <http://www.gao.gov/products/GAO-17-151>

#### PERFLUORINATED CHEMICALS (PFCS): CONTAMINANTS OF CONCERN

Cheremisinoff, N.P.  
Scrivener Publishing LLC, Beverly, Mass. ISBN: 978-1-119-36353-8, 2017

The 10 chapters in this book cover the following topics: Chapter 1 provides an overview of fluoropolymers and PFCs; Chapter 2 covers historical uses and evolution of PFCs; Chapter 3 discusses the use of these chemicals in fire-fighting foams; Chapter 4 covers health risk studies; Chapter 5 provides an overview of environmental concerns; Chapter 6 discusses supply chain and pathways of exposure to these chemicals in manufacturing and consumer products; Chapter 7 summarizes drinking water and other standards; Chapter 8 provides an overview of water treatment technology options; Chapter 9 covers adsorption technologies, currently viewed as the preferred water treatment; and Chapter 10 offers four cases of sites where PFCs have been studied.

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.