# Technology Innovation News Survey

## *Entries for October 16-31, 2017*

### Market/Commercialization Information

#### ADVANCED PLANT TECHNOLOGIES (APT)
DoD, Defense Advanced Research Projects Agency (DARPA), Biological Technologies Office, Funding Opportunity HR001118S0005, 2017

The goal of DARPA's APT program is to control and direct plant physiology to detect chemical, biological, radiological, and/or nuclear threats, as well as electromagnetic signals. Plant sensors developed under the program will sense specific stimuli and report these signals with a remotely recognized phenotype (e.g., modified reflectance, morphology, phenology, etc.). Modern plant biotechnology holds significant promise for addressing a range of DoD needs; plants are easily deployed, self-powering, and ubiquitous in the environment, and the combination of these native abilities with specifically engineered sense-and-report traits will produce sensors occupying new and unique operational spaces. The long-term success of engineered plant sensors requires the ability to ensure plant survivability for months or years in a natural environment subject to stresses not present in a lab environment. Meeting both the sensor and survivability technical goals of the APT program will require a combination of plant genomics emerging technologies, precision gene editing tools, and novel methods for engineering new sensing capabilities and physiological responses. Proposing teams should include experts in diverse fields, including plant physiology, gene editing, biochemistry, modeling, phenotyping, remote sensing, and plant ecology. Engineered plant responses must be distinguishable from background plant phenotypes. Additional information is posted at FedBizOpps: https://www.fbo.gov/spg/ODA/DARPA/CMO/HR001118S0005/listing.html. Multiple awards are anticipated. The closing date for applications is February 21, 2018.
http://www.grants.gov/web/grants/view-opportunity.html?oppId=298953

#### BROAD AGENCY ANNOUNCEMENT (BAA)
Air Force Civil Engineer Center, Environmental Management Directorate.
Federal Business Opportunities, FBO-5853, Solicitation AFCECBAA-18-001, 2017

This BAA seeks out proposals that demonstrate and validate innovative, sustainable, and cost-effective technologies and/or methodologies that will lead to more efficient and effective solutions for environmental restoration and compliance concerns across the Air Force. Three attachments to the FedBizOpps notice contain detailed statements of need, summarized here as follows: (1) Selecting and implementing high-resolution site characterization technologies at complex sites; (2) Field-scale demonstration and validation of activated carbon for in situ sequestration and degradation of chlorinated organic contaminants in groundwater; and (3) In situ remediation technology demonstration/validation for Pb and PAHs in wetlands. This requirement is restricted to U.S. companies, academic institutions, non-profit institutions, and/or government agencies. The AFCEC BAA is a two-step process: in Phase I, submit a BAA PDF form via email; in Phase II, if invited, submit a full proposal that details the technology, the demonstration and validation approach, and the costs for the proposed effort. Each electronic submission may address only one area of need. Phase I submittals are due by 1:00 PM CT on December 21, 2017. https://www.fbo.gov/notices/5f44d77ed54e263f88c7b11f59df71b0.

#### A-E FIRMS FOR SOUTH CAROLINA: REGISTRATION IN SHORT SELECTION DATABASE
USDA, Forest Service, SRS Eastern Administrative Zone - Savannah River Site, SC.
Federal Business Opportunities, FBO-5831, Solicitation 12467018R0015, 2017

The purpose of this announcement is to request new AE qualification information for the USDA Forest Service across the State of South Carolina for future projects. No specific project is planned at this time. The Forest Service utilizes the short-selection database to award AE contracts below $150,000 throughout the state. The database contains all of the qualified, interested AE firms that respond to this notice for consideration for future approved projects falling within a wide range of NAICS codes, including those for environmental (RCRA, CERCLA, CWA) investigations, reviews, inventories, and audits and for coordination of RCRA and other waste disposal. Although large businesses may submit SF330s, all acquisitions utilizing the short-selection database are set aside for small business concerns unless requirements cannot be met and the Contracting Officer obtains a proper waiver. Interested firms may submit their SF330 packages by 12:00 PM ET on December 21, 2017. https://www.fbo.gov/notices/9849402b001fada7b2eabf160863abcf

### Cleanup News

#### $CO_2$ SPARGING: PHASE 3 FULL-SCALE IMPLEMENTATION AND MONITORING REPORT, LCP CHEMICALS SITE, BRUNSWICK, GA
U.S. Environmental Protection Agency, 469 pp, 2016

In situ carbon dioxide ($CO_2$) sparging was designed and implemented to address a subsurface caustic brine pool (CBP) formed as a result of releases from historical chlor-alkali manufacturing operations at the LCP Chemicals Site. The remedial action objectives included reducing the pH of the CBP to between 10 and 10.5. Prior to the start of $CO_2$ sparging, the total mercury concentration in the CBP ranged from 35.7 to 2,530 µg/L (mean: 270 µg/L; median: 128 µg/L). By the end of Phase 3, almost every monitoring point (28 out of 30) in the deep Satilla aquifer had lower total Hg compared to pre-sparge levels. Most of the monitoring points (23 out of 30) had total Hg concentrations $\geq$2 sparging was extremely effective in lowering the mean pH in the deep Satilla aquifer from 11.32 (2011-2012) to 7.11. The median pH decreased from 11.44 to 6.57. https://www.epa.gov/frontpage/co2-sparging-phase-3-full-scale-implementation-and-monitoring-report-0.

#### USING SURFACTANTS TO DECONTAMINATE THE AST SUBFLOOR PRIOR TO REPAIR
Edgerly, J.B. and K.D. Loos.
IPEC 2017: 24th Annual International Petroleum Environmental Conference, 23 slides, 2017

This presentation illustrates details of NAPL mobilization and emulsification during remediation and offers a case study in which free product in the subsurface had to be removed to enable the repair of a 120 ft diameter aboveground storage tank at a Gulf Coast refinery. BioSolve Pinkwater, a specialty surfactant formulation, was used to bring >1,000 gal of weathered gasoline from the subsurface after 30 years of efforts to remediate that area through excavation and dual-phase extraction. **Slides:** https://cese.utulsa.edu/wp-content/uploads/2017/11/IPEC-2017-Decontaminating-Subfloor-Space-Prior-to-Hotwork.pdf

#### THE UNEXPECTED NATURE AND EXTENT OF ARSENIC IN SOIL, BASED ON THE RCRA FACILITY INVESTIGATION AT THE ELK HILLS OILFIELD, FORMER NAVAL PETROLEUM RESERVE NO. 1, KERN COUNTY, CALIFORNIA
Snow, M., C. Smith, A. Blake, E. Shiroma, N. Unangst, T. O'Carroll, M. Hurt, and W. Elias.
IPEC 2017: 24th Annual International Petroleum Environmental Conference, 63 slides, 2017

The California Department of Toxic Substances Control (DTSC) prepared a RCRA Facilities Assessment that identified 131 areas of concern (AOCs) at the former Naval Petroleum Reserve No. 1 and resulted in a corrective action consent agreement between DTSC and U.S. DOE to evaluate potential releases of hazardous constituents and implement corrective measures. PAHs and VOCs were the anticipated chemicals of potential concern driving the need for corrective action. A study conducted to determine the site-specific background concentrations of metals included arsenic due to historical use of an arsenic-containing corrosion inhibitor, W-41. Innovative sampling and analytical techniques, such as a field-based X-ray fluorescence analyzer, were used to move efficiently through the investigation phase. To date, a greater number of AOCs than initially anticipated show arsenic in soil exceeding the established background concentration, resulting in a greater number of AOCs requiring corrective measures for arsenic. **Slides:**
https://cese.utulsa.edu/wp-content/uploads/2017/11/IPEC-2017-Former-Naval-Petroleum-Reserve-No.-1-Environmental-Restoration-Project-RCRA-Facility-Investigation-at-the-Elk-Hills-Oil-Field.pdf

#### IN SITU BIOREACTORS (ISBRs) FOR IN-WELL GROUNDWATER REMEDIATION
Fisher, J.B., K.L. Sublette, E. Raes, K. Clark, D. Taggart, B. Baldwin, and A. Biernacki.
IPEC 2017: 24th Annual International Petroleum Environmental Conference, 26 slides, 2017

An in-well bioreactor has been developed to stimulate microbial growth and enhance contaminant degradation to achieve site remediation goals. This approach builds on existing Bio-Sep bead technology, which currently is used commercially as a forensic tool (Bio-Trap) for characterizing subsurface microbial ecology. Bio-Sep beads provide a substrate that can be colonized rapidly by the active members of the microbial community and serve to concentrate indigenous degraders. Air (or $N_2$) and nutrients are also delivered to the bioreactor to maintain conditions favorable for growth and reproduction. Contaminated groundwater is treated as it circulates through the bed of beads. Groundwater moving through the system also transports degraders away from the bioreactor, increasing biodegradation rates in the aquifer. Two case studies are presented in which the ISBR was used at a residential site to treat groundwater contaminated with low concentrations of fuel oil components and at an industrial site contaminated with chlorinated hydrocarbons. **Slides:** https://cese.utulsa.edu/wp-content/uploads/2017/11/IPEC-2017-In-Situ-Bioreactors-for-In-Well-Groundwater-Remediation.pdf

#### REMEDIATION OF LARGE GROUNDWATER PLUMES THROUGH OPTIMIZED EXTRACTION SYSTEM AND MONITORED NATURAL ATTENUATION
Ahsanuzzaman, N.
Groundwater Solutions: Innovating to Address Emerging Issues for Groundwater Resources, 8-9 August 2017, Arlington, VA. Presentation 11530, 2017

A site-wide groundwater extraction and optimization process has been ongoing at a former large munitions manufacturing facility in the United States. The site contains five large RDX plumes with combined surface area of 4,500 acres. The other smaller commingled plumes are largely covered within the footprint of the RDX plumes. An adaptive groundwater extraction system has been implemented to contain the plumes and reduce the mass of RDX. The final Record of Decision (ROD) directs the relocation of extraction wells over time to maximize mass reduction of RDX. According to the ROD, the optimized groundwater extraction phase will continue for 15 years or more until a specific target concentration is reached. Once reached, the extraction system will be discontinued and the progress of natural attenuation will be monitored for another 45 years. Based on the preliminary remedial goal of 2 µg/L RDX and the site-specific half-life of 8 years, the ideal target concentration at the end of the extraction phase is estimated to be 100 µg/L. The optimization process of the extraction phase is limited to the maximum treatment capacity of 2,400 gpm from the two on-site treatment plants. An extensive groundwater model has been utilized to optimize the relocation of the extraction wells annually. An additional challenge of the remedial action is to obtain the desired attenuation rate throughout the plumes at the end of the extraction phase. Following remedial completion in 60 years, the groundwater should be restored to drinking water standard and allow unrestricted use. The total cost of groundwater extraction to date is ~$70M, including capital and O&M costs.

### Demonstrations / Feasibility Studies

#### SUSTAINABLE AND COST-EFFECTIVE DESTRUCTION OF CHLORINATED ALKANE AND ALKENE CONTAMINANTS VIA BIOSTIMULATION AND ENHANCED REDUCTIVE DECHLORINATION
Armstrong, K. and G. Bell.
IPEC 2017: 24th Annual International Petroleum Environmental Conference, 73 slides, 2017

Owing to past site uses at an industrial/office building in Burlington, Ontario, Canada, the presence of chlorinated VOCs was documented in the site's subslab soils and groundwater. Total CVOCs ranged 10-500 µg/L: 240 µg/L TCA, 11 µg/L DCA, and 170 µg/L DCE at maximum. An in situ treatability program was initiated in May 2013 to evaluate biostimulation using ERDENHANCED™ to address the CVOCs. Secondary data regarding distribution capabilities was also evaluated. In each of two deployment events—May 29 and June 28, 2013—each of five injection nodes was amended with about 40 L additive slurry for a total 294 lb additive/100 gal water deployed via gravity. Groundwater monitoring points were located within, laterally, and downgradient of the treatment zone. The groundwater was sampled annually over a period of 3+ years. Total CVOCs pre-deployment within the treatment zone ranged 97.5 to 911.1 µg/L, whereas total CVOCs post-deployment ranged 4.4 µg/L to 193.2 µg/L. Three years post-deployment, total moles CVOCs fell an average 85.2%. Performance data show that passive amendment of the treatment zone with minimal amounts of ERDENHANCED™ facilitated enhanced reductive dechlorination by native microbials throughout the treatment zone.
**Longer abstract:** https://cese.utulsa.edu/sustainable-cost-effective-destruction-chlorinated-alkane-alkene-contaminants-via-biostimulation-enhanced-reductive-dechlorination/
**Slides:** https://cese.utulsa.edu/wp-content/uploads/2017/11/IPEC-2017-Cost-Effective-In-Situ-Remediation-Biostimulation-as-a-Residual-Source-Mass-Remediation-Strategy.pdf

#### MARINE CORPS BASE (MCB) CAMP PENDLETON FEDERAL FACILITIES AGREEMENT (FFA) MEETING (NO. 118)
Project Note No. 68, 7 Jun 2016

Meeting no. 118 included an overview and discussion of the planned scope for the pilot study for remediation of pesticide-contaminated soils removed from the tree-line area of the Stuart Mesa East Agricultural Field. Following the removal of ~1,500 eucalyptus trees, about 10,000 $yd^3$ of soil from the tree-line berm area was excavated, and soils were staged on the treatment pad and segregated by concentration level (i.e., non-hazardous, California hazardous, and RCRA hazardous). Unfavorable results from bench-scale testing of in situ chemical oxidation and in situ chemical reduction prompted re-evaluation of the Vapor Energy Generator (VEG) technology. The bench test of VEG was very effective at reducing pesticide concentrations in the RCRA-level stockpile. VEG technology involves thermal treatment with a patented filtration technology for air discharges. Following treatment using the VEG system, about 1.5 drums of waste material is generated for every 15,000 $yd^3$ of treated soil. Cleanup rate is ~3,000 yd of soil in 7 to 10 days per treatment unit. About 300 $yd^3$ would be treated per day, with a target cost reduction of 50-60% compared to a landfill option. The system has been tested at multiple sites, and results tend to be better with soils of lower moisture content. *See* **PDF pages 22-44** *for slides illustrating the Ag Field pilot study update and an overview of the VEG technology*.
http://www.pendleton.marines.mil/Portals/98/Docs/InstallationRestor/118th_FFA_Meeting_Minutes.pdf

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

This memorandum addresses the next steps in the closed Stericycle facility's obligations to implement a contingent remedy for 1,4-dioxane in groundwater for the area downgradient of the site. This report contains the following information:

- A summary of the Phase I in situ bioremediation (ISB) bench-scale results and their effect on implementation of ISB for the downgradient area; bioaugmented microcosms showed statistically significant declines in 1,4-dioxane concentrations to well below the proposed cleanup level of 78 ppb.
- Results and findings from the Phase II in situ chemical oxidation (ISCO) pilot study using persulfate (which differed considerably from bench results) and their effect on implementation of ISCO for the downgradient area.
- A work plan for further pilot testing of both ISB and ISCO technologies in the downgradient area.

Once the pilot tests are complete, Stericycle will summarize the findings and present them to Ecology for review with recommendations on how to proceed for full-scale remediation in the downgradient area.
https://fortress.wa.gov/ecy/gsp/DocViewer.aspx?did=60105 *See follow-on project reports at* https://fortress.wa.gov/ecy/gsp/CleanupSiteDocuments.aspx?csid=2622.

#### NOTICE OF APPLICABILITY OF GENERAL ORDER NO. R5-2015-0012, WASTE DISCHARGE REQUIREMENTS GENERAL ORDER FOR IN-SITU REMEDIATION AND DISCHARGE OF TREATED GROUNDWATER TO LAND, FORMER APACHE PLASTICS, 2050 EAST FREMONT STREET, STOCKTON, SAN JOAQUIN COUNTY
Central Valley Regional Water Quality Control Board, California. 38 pp, 2017

Operation of an underground tank system at the former Apache Plastics facility in Stockton, San Joaquin County, Calif., released pollutants to the soil and groundwater, primarily petroleum hydrocarbons, including gasoline, BTEX, 1,2-DCA, 1,2-DBA, TBA, and TAME. The site is currently occupied by a large warehouse building used as a hardware retail store and storage facility. In August and September 2013, the site contractor conducted a pilot test using a mixture of stabilized $H_2O_2$ and chelated iron for in-well injections. Petroleum constituent concentrations were reduced in all injection wells, and San Joaquin County then approved the proposed Corrective Action Plan in August 2014. The original and revised Notices of Applicability (NOAs) allowed for injection of 5% to 8% $H_2O_2$ solution into eight wells during four tri-weekly events. After completion of the injection events, groundwater monitoring data indicated arsenic exceeding action levels in both of the shallow compliance zone wells, plus Mn in one of the three deep zone compliance wells. Confirmation samples collected during the next monitoring event showed a decrease to pre-injection levels for both As and Mn concentrations. Additional injection events are planned. http://geotracker.waterboards.ca.gov/view_documents?global_id=T0607700244&enforcement_id=6319451.

### Research

#### THERMAL TREATMENT OF HYDROCARBON-IMPACTED SOILS: A REVIEW OF TECHNOLOGY INNOVATION FOR SUSTAINABLE REMEDIATION
Vidonish, J.E., K. Zygourakis, C.A. Masiello, G. Sabadell, and P.J.J. Alvarez.
Engineering 2(4):426-437(2016)

The authors review several common thermal treatment technologies for hydrocarbon-contaminated soils, assess their potential environmental impacts, and propose frameworks for sustainable and low-impact deployment based on a holistic consideration of energy and water requirements, ecosystem ecology, and soil science. The review covers thermal desorption in situ and ex situ, smoldering, incineration, pyrolysis, vitrification, radio-frequency heating/microwave heating, hot air injection, and steam injection. Selecting an appropriate thermal treatment depends on the contamination scenario (including the type of hydrocarbons present) and on site-specific considerations such as soil properties, water availability, and the heat sensitivity of contaminated soils. *This paper is* ***Open Access*** *at* http://www.sciencedirect.com/science/article/pii/S2095809917300796.

### CONVENTIONAL AND MICROWAVE PYROLYSIS REMEDIATION OF CRUDE OIL CONTAMINATED SOIL
Ogunkeyede, Akinyemi Olufemi, Ph.D. thesis, University of Nottingham, UK. 223 pp, 2016

The performance of two thermal remediation techniques—microwave pyrolysis and traditional pyrolysis—on crude oil-contaminated soil was investigated using a Gray-King retort. The maximum average recovered product from the thermal remediation process with Gray-King pyrolysis was 99.4% TOC and the maximum crude oil was 85.3% TOC, with maximum oil recovery of 70% TOC from all treatment conditions. The shortest treatment time gave the lowest gas yield of 10.2% TOC. Microwave pyrolysis treatment achieved a maximum pollutant removal of 77% TOC. Gray-King pyrolysis removed more of the soil organic carbon than microwave pyrolysis, but the latter had advantages in operability and greater output within a short treatment time. http://eprints.nottingham.ac.uk/35190/1/Ogunkeyede_Akinyemi_thesis%204112918.pdf

### ENVIRONMENTAL ELECTROKINETICS FOR A SUSTAINABLE SUBSURFACE
Lima, A.T., A. Hofmann, D. Reynolds, C.J. Ptacek, P. Van Cappellen, L.M. Ottosen, S. Pamukcu, et al.
Chemosphere 181:122-133(2017)

Many remediation technologies achieve only limited success at sites challenged by low permeability soils, such as silts and clays. Electrokinetics (EK), a soil remediation technique recognized mainly for in situ treatment of low-permeability soils, has been combined with more conventional techniques and can significantly enhance the performance of several remediation technologies, including in situ chemical oxidation, in situ chemical reduction, enhanced in situ bioremediation, and phytoremediation. EK techniques can be used in tandem with conventional remediation techniques to achieve improved remediation performance, and this paper highlights new EK applications that might play a role in sustainable treatment of contaminated sites. http://www.academia.edu/32867192/Environmental_Electrokinetics_for_a_sustainable_subsurface

### SOIL MOISTURE COULD ENHANCE ELECTROKINETIC REMEDIATION OF ARSENIC-CONTAMINATED SOIL
Shin, S.Y., S.M. Park, and K. Baek.
Environmental Science and Pollution Research 24(10):9820-9825(2017)

The primary heavy metal removal mechanisms in electrokinetic (EK) remediation are electromigration and electroosmosis flow under appropriate electric gradients. Few studies have investigated the effect of moisture content. In this study, tap water and NaOH were used as electrolytes to enhance electromigration and electroosmosis flow. The higher moisture content led to greater As removal efficiency with no differences observed between tap water and NaOH.

### RADIO FREQUENCY SYSTEM FOR THERMAL SOIL REMEDIATION
Degiorgi, M., P. Usai, N. Fontana, C. Ciampalini, A. Monorchio, M. Bertoneri, S Tonlorenzi, et al.
2016 USNC-URSI Radio Science Meeting, pp 81-82, 2016

Radiofrequency (RF) heating of contaminated sediments is an effective and flexible method for soils remediation. Proper design of the antennas responsible for radiating into the sediments has a pivotal importance in the performances of those processes, but difficulties arise due to the fact that the radiators are buried in a lossy, time-variant, and temperature-dependent medium. The authors present a novel system for RF soil heating with a particular emphasis on antenna design. Both simulations and measurements of the system are presented to demonstrate system effectiveness and viability.

### ELECTROMAGNETIC INDUCTION OF FOAM-BASED NANOSCALE ZEROVALENT IRON (NZVI) PARTICLES TO THERMALLY ENHANCE NON-AQUEOUS PHASE LIQUID (NAPL) VOLATILIZATION IN UNSATURATED POROUS MEDIA: PROOF OF CONCEPT
Srirattana, S., K. Piaowan, G.V. Lowry, and T. Phenrat.
Chemosphere 183:323-331(2017)

In lab batch reactors, researchers evaluated the possibility of using foam as a carrier to emplace NZVI in unsaturated porous media followed by the application of a low-frequency electromagnetic field (LF-EMF) to enhance VOC volatilization. The optimal condition for generating foam-based NZVI (F-NZVI) was sodium lauryl ether sulfate (SLES) at a concentration of 3% (w/w) and an $N_2$ flow rate of 500 mL/min. The F-NZVI could carry as much as 41.31 g/L of NZVI in the liquid phase of the foam and generate heat to raise the temperature to 77°C in 15 min under an applied LF-EMF (150 kHz and 13 A). Under these conditions, F-NZVI together with LF-EMF enhanced TCE volatilization from TCE DNAPL in unsaturated sand by 39.51 ± 6.59-fold compared to reactors without LF-EMF application. F-NZVI and LF-EMF used together theoretically presents an alternative to radio frequency heating (RFH) as it requires a much lower irradiation frequency (336-fold lower), which should result in significantly lower capital and operating costs compared to RFH. http://web.eng.nu.ac.th/eng2012/enmis/doc/printer/journal/2017_05_29_11_57_29-article.pdf

### A NOVEL FLUOROMETRIC BIO-SENSING-BASED ARSENIC DETECTION SYSTEM FOR GROUNDWATER
Gudlavalleti, R.H., S.C. Bose, S.K. Verma, P. Khatri, J. Scaria, S. Dhewa, and V.K. Chaubey.
IEEE Sensors Journal 17(17):5391-5398(2017)

An arsenic biosensor strain has been constructed by transforming *E. coli* DH5alpha with the plasmid pJSKV51 carrying an in-frame promoter operator region as well as an entire arsR gene, part of an arsD gene, and an enhanced green fluorescent protein (EGFP) gene. This strain was able to induce EGFP in the presence of As(III) ion. A novel EGFP-based bio-electronic sensing methodology also was developed to provide a low-cost battery-operated system to measure the fluorescence emitted by the biosensor strain and display numerical values of As concentrations in water samples. In this method, a blue light of 480 nm excites the EGFP to produce a green fluorescence signal proportionate to As concentration. The device includes a compact embedded system to measure the signal fluorescence using a light sensor, programmable controllers, and a liquid crystal display to show the corresponding As concentration in parts per billion, which in tests ranged from 5 to 100 ppb. After proper incubation, testing time for each sample is around 15 sec. The effective operational time frame of the 9-V battery is 10 hr; thus, ~2500 samples could be tested without replacing/recharging the battery.

### REMEDIATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH)-CONTAMINATED MARINE SEDIMENT WITH SURFACTANTS
Wu, P.-C., C.-F. Chen, and C.-D. Dong.
IEEE Conference: 2016 Techno-Ocean. pp 439-443, 2016

A study of the removal efficiency of PAHs from contaminated sediment used 2 anionic surfactants: Triton X-100 and Simple Green, and 2 nonionic surfactants: sodium dodecyl sulfate and sodium dodecylbenzene sulfonate. The effects of various operating parameters were investigated, such as surfactant concentration, liquid/solid ratio, washing time, and washing frequency. The maximum removal efficiency obtained was 68% with Triton X-100 (100 CMC: 19 mM) at a liquid/solid ratio of 20 with 1 h each washing time and 20 times washing frequency.

### BIOREMEDIATION APPROACHES AND TOOLS FOR BENZENE REMEDIATION UNDER ANAEROBIC CONDITIONS
Dworatzek, S., J. Webb, P. Dollar, E. Edwards, N. Bawa, S. Guo, F. Luo, and K. Bradshaw.
IPEC 2017: 24th Annual International Petroleum Environmental Conference, 27 slides, 2017

Anaerobic cultures capable of complete degradation of benzene, toluene, and xylenes have been developed at the University of Toronto. The cultures have been characterized and key organisms have been identified. SiREM, the University, and Federated Cooperatives Ltd. currently are engaged in a 3-year project to advance anaerobic benzene degradation from the lab to the field, funded in part by Genome Canada and the Province of Ontario. Project objectives include scale-up of an anaerobic benzene culture to field volumes and demonstrating its effectiveness for bioaugmentation in treatability studies and field tests. The culture is currently being assessed using microcosms constructed with materials from hydrocarbon-contaminated sites. Information generated will include inoculum density requirements, degradation rates, and the range of geochemical conditions required for optimal performance, which will be used to design field trials. Molecular genetic tools to quantify and track key microbes and functional genes involved in benzene degradation are also being developed. These tools will allow assessment and monitoring of enhanced bioremediation applications.
**Slides:** https://cese.utulsa.edu/wp-content/uploads/2017/11/IPEC-2017-Bioremediation-Approaches-and-Tools-for-Benzene-Remediation-Under-Anaerobic-Conditions.pdf

### EVALUATION OF SEDIMENT CAPPING USING ZEOLITE, MONTMORILLONITE, AND STEEL SLAG TO IMMOBILIZE HEAVY METALS
Kang, K., B.-W. Gu, and S.-J. Park.
IEEE Conference: OCEANS 2016, 13-16 April, Shanghai. pp 1-5, 2016

Lab experiments in a flat flow tank were performed to evaluate the effect of capping materials on sediments containing metals. Some of the capping materials were ineffective in interrupting release of arsenic, and higher As concentrations in capped conditions were observed than in uncapped conditions. Zeolite had a negative effect in blocking Cr release, but 5 cm of steel slag capping significantly reduced Cr mobility. In contrast to As and Cr, release of Cd, Ni, and Pb was not observed in all cases, including those of uncapped sediments. Cu and Zn were the heavy metals most significantly influenced by the capping conditions. Cu releases from the marine sediments were effectively blocked by capping materials, whereas Cu concentrations in uncapped conditions were above the Cu criteria concentration during the experimental run. All capping materials were effective in interrupting release of Zn from marine sediments.

### THE ROLE OF NITRITE IN SULFATE RADICAL-BASED DEGRADATION OF PHENOLIC COMPOUNDS: AN UNEXPECTED NITRATION PROCESS RELEVANT TO GROUNDWATER REMEDIATION BY IN-SITU CHEMICAL OXIDATION (ISCO)
Ji, Y., L. Wang, M. Jiang, J. Lu, C. Ferronato, and J.-M. Chovelon.
Water Research 123:249-257(2017)

Thermally activated persulfate oxidation of phenol in the presence of nitrite ($NO_2^-$), an anion widely present in natural waters, has been observed to lead to the formation of nitrated by-products, including 2-NP, 4-NP, 2,4-DNP, and 2,6-DNP. Involvement of nitrogen dioxide radical ($NO_2^•$), arising from $SO_4^{•-}$ scavenging by nitrite, is proposed in the formation of nitrophenols as a nitrating agent. Nitrophenols accounted for ~70% of the phenol transformed under reaction conditions of nitrite = 200 μM and [PS] = 2 mM at 50°C. Increasing the concentration of nitrite markedly enhanced the formation of nitrophenols but did not affect the phenol transformation rate significantly. Phenol degradation and nitrophenols formation were influenced by persulfate dosage, solution pH, and natural organic matter. Studies on the degradation of other phenolic compounds (4-chlorophenol, 4-hydroxybenzoic acid, and acetaminophen) verified the formation of their corresponding nitrated by-products as well. Therefore, formation of nitrated by-products is probably a common but overlooked phenomenon during $SO_4^{•-}$-based oxidation of phenolic compounds in the presence of nitrite. Nitroaromatic compounds are known for their carcinogenicity, mutagenicity, and genotoxicity; hence, the formation of nitrated organic by-products in sulfate radical-based advanced oxidation processes should be carefully scrutinized to assess possible health and ecological impacts.

### EVALUATION OF ONE COMMERCIAL OLEOPHILIC POWDER FOR NAPL-ABSORBING EFFECTIVENESS
Zak, J., T. Blazicek, and L. Matko.
MGP 2017: The 7th International Symposium and Exhibition on the Redevelopment of Manufactured Gas Plant Sites, New Orleans, 16-18 October 2017

New York State Electric and Gas Corporation (NYSEG) is responsible for remediation of MGP-affected sediments in Lake Champlain at the mouth of the Saranac River in Plattsburgh, New York. The sediments are 95% fine sand and coarser, with low total organic content. In an assessment of innovative approaches that could reduce the costs of hydraulic dredging, NYSEG evaluated sediment washing. This technique separates the NAPL, the finest fines, and most PAHs from the sediments. This subset is disposed of, but the washed sediments can be returned to the delta. The engineering and financial aspects of this approach are being evaluated for practicality and cost differences. A second technology that has been on the market for years—a hydrophobic and oleophilic powder that will not sink—is also being evaluated for its ability to absorb NAPL, sheen, and PAHs. After simple bench-scale tests confirmed effective absorption of coal tar DNAPL and sheen, as well as continued floatation and simple removal of the powder, a cooperative trial under laboratory-grade QA/QC conditions was conducted. Results are pending. If lab results are positive, field trials with analytical sampling before and after are planned. Coal tar, sand, and water will be mixed in 250-gal "tote" containers, followed by introduction of the powder and extreme agitation to determine whether the powder effectively removes NAPL, sheen, and PAHs. If the powder works as advertised, is not cost-prohibitive, and can be mated well with other remediation mechanics, it will go to a pilot test in the site sediments.

### EXPRESSION IN GRASSES OF MULTIPLE TRANSGENES FOR DEGRADATION OF MUNITIONS COMPOUNDS ON LIVE-FIRE TRAINING RANGES
Zhang, L., R. Routsong, Q. Nguyen, E.L. Rylott, N.C. Bruce, and S.E. Strand.
Plant Biotechnology Journal 15(5):624-633(2017)

Two perennial grass species, switchgrass (*Panicum virgatum*) and creeping bentgrass (*Agrostis stolonifera*), have been transformed with the genes for degradation of RDX. These species possess agronomic traits that equip them for effective uptake and removal of RDX from root zone leachates. Transformation vectors were constructed with *xplA* and *xplB*, which confer the ability to degrade RDX, and *nfsI*, which encodes a nitroreductase for the detoxification of the co-contaminating explosive TNT. The vectors were transformed into the grass species using *Agrobacterium tumefaciens* infection. All transformed grass lines showing high transgene expression levels removed significantly more RDX from hydroponic solutions and retained significantly less RDX in their leaf tissues than wild-type plants. Soil columns planted with the best-performing switchgrass line were able to prevent leaching of RDX through a 0.5-m root zone. These plants represent a promising plant biotechnology to sustainably remove RDX from training range soil, thus preventing contamination of groundwater. *This paper is* ***Open Access*** *at* http://onlinelibrary.wiley.com/doi/10.1111/pbi.12651/full.

### PGPR-ASSISTED PHYTOREMEDIATION OF CADMIUM: AN ADVANCEMENT TOWARDS CLEAN ENVIRONMENT
Verma, C., A.J. Das, and R. Kumar.
Current Science 113(4):715-724(2017)

Phytoremediation has been shows to play a beneficial role in removing cadmium contamination from soil, but removal becomes less effective with increasing concentration levels and toxicity. The introduction of plant growth-promoting rhizobacteria (PGPR) to the plant rhizosphere can enhance plant growth and promote bioremediation of soil by accumulation or transformation of contaminants. This paper focuses on the application of PGPR-assisted phytoremediation for Cd-contaminated soils. http://www.currentscience.ac.in/Volumes/113/04/0715.pdf

## General News

### TECHNICAL FACT SHEETS
U.S. EPA, Federal Facilities Restoration and Reuse Office, 2017

In September 2017, EPA released updated technical fact sheets to provide brief summaries of contaminants of concern that present unique issues and challenges at contaminated federal facility sites. Ranging from 6 to 9 pages in length, each fact sheet provides a brief summary of the contaminant's physical and chemical properties, environmental and health impacts, existing federal and state guidelines, and detection and treatment methods. These fact sheets are intended for project managers and field personnel to use when addressing specific contaminants at cleanup sites.

- Perchlorate — EPA 505-F-17-003
- Tungsten — EPA 505-F-17-004
- N-Nitroso-dimethylamine (NDMA) — EPA 505-F-17-005
- 1,2,3-Trichloropropane (TCP) — EPA 505-F-17-007
- Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX) — EPA 505-F-17-008
- 2,4,6-Trinitrotoluene (TNT) — EPA 505-F-17-009
- Dinitrotoluene (DNT) — EPA 505-F-17-010

https://www.epa.gov/fedfac/emerging-contaminants-and-federal-facility-contaminants-concern

### CLEANUP 2017: THE 7TH INTERNATIONAL CONTAMINATED SITE REMEDIATION CONFERENCE

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE), Adelaide, Australia. 634 pp, 2017

The papers and presentations given at this conference encompass pressing issues of contaminated site assessment, management, and remediation. The organizers emphasized an extra focus on the topic of per- and poly-fluorinated alkyl substances, or PFASs, and CleanUp 2017 incorporates the first International PFAS Conference. http://www.cleanupconference.com/wp-content/uploads/2017/09/CleanUp_2017_Proceedings_Low-Res.pdf

### NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION: NOTICE OF RULE PROPOSAL

NJDEP, Water Resource Management, Division of Water Supply & Geoscience, 4 Aug 2017

The New Jersey Department of Environmental Protection is proposing to amend the New Jersey Safe Drinking Water Act (SDWA) rules at **N.J.A.C. 7:10** to establish, as recommended by the New Jersey Drinking Water Quality Institute, a maximum contaminant level (MCL) for perfluorononanoic acid (PFNA) of 0.013 µg/L and an MCL for 1,2,3-TCP of 0.030 µg/L. The proposal includes monitoring requirements and treatment, as necessary, for these contaminants for both public community and public non-transient non-community water systems. The NJDEP is also proposing to amend the SDWA rules to require public non-transient non-community water systems to begin monitoring for radionuclides in 2019. The proposal was published in the New Jersey Register dated August 7, 2017. A copy of the proposal is available at http://www.nj.gov/dep/rules/notices.html.

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 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.