



A computer program was developed to optimize in situ chemical oxidation (ISCO) design to meet specified source zone remediation objectives at DNAPL sites. In addition to the remediation objectives, the program determined optimal design parameters to meet remediation cost and took uncertainty in site characterization data and model predictions into consideration. The ISCO model was implemented in the Stochastic Cost Optimization Toolkit. ISCO design parameters considered for optimization include oxidant concentration and injection rate, frequency and number of soil or groundwater samples, and cleanup criteria for termination of subregion injection. Sensitivity studies and example applications are presented to demonstrate the benefits of the proposed stochastic optimization methodology. The Stochastic Cost Optimization Toolkit can be accessed via <http://ecotoolkit.csuohio.edu/>. See more on this SERDP-sponsored project at <https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-2319/>.

#### A PORE-SCALE INVESTIGATION OF HEAVY CRUDE OIL TRAPPING AND REMOVAL DURING SURFACTANT-ENHANCED REMEDIATION

Ghosh, J., G.R. Tick, N.H. Akylol, and Y. Zhang  
Journal of Contaminant Hydrology 223:103471(2019)

A pore-scale study was conducted to understand and quantify the trapping and mobilization mechanisms and in situ emulsification processes of heavy crude oil distributed within increasing complexity unconsolidated sands during surfactant-enhanced remediation. Pore-scale imaging analyses quantified the changes in oil blob morphology before and after surfactant flushing events to assess the primary factors that control the recovery. Results showed relatively low (10%) net recovery from the homogeneous sand after 5 pore volumes (PVs) of surfactant flushing. Negligible net oil recovery was achieved from the mildly heterogeneous sand, likely due to the medium's lower associated permeability. The oil-phase distribution within sand medium primarily consisted of small disconnected blobs more readily exposed than the surfactant solution. For the highly heterogeneous sand experiments, an average of 20% heavy-oil recovery resulted after each flushing event (total of ~37% after 5 PVs) and was attributed to a more efficient reduction of interfacial tension associated with the increased surfactant-oil contact. The associated higher pH sand/fine-carbonate system may have aided in maintaining a water-wet porous medium, a condition more conducive to higher oil recovery and displacement efficiency.

#### APPLICATION OF AN EMULSIFIED POLYCOLLOID SUBSTRATE BIOBARRIER TO REMEDIATE PETROLEUM-HYDROCARBON CONTAMINATED GROUNDWATER

Lee, T.-H., D.C.W. Tsang, W.H. Chen, F. Verpoort, Y.T. Sheu, and C.M. Kao.  
Chemosphere 219:444-455(2019)

An emulsified polycolloid substrate (EPS) was developed and applied to form a biobarrier for the containment and enhanced bioremediation of a toluene-contaminated groundwater plume. EPS had a negative zeta potential (-35.7 mV), which promoted its even distribution after injection. Batch and column experiments conducted to evaluate the effectiveness of EPS on toluene containment and biodegradation resulted in a partition coefficient of 94.3. Groundwater containing toluene (18 mg/L) was pumped into the three-column system at a flow rate of 0.28 mL/min, while EPS was injected into the second column to form a biobarrier. A significant reduction of toluene concentration to 0.1 mg/L was observed immediately after EPS injection, indicating its effectiveness to contain the toluene plume and prevent migration further downgradient. About 99% of toluene was removed after 296 pore volumes of operation via sorption, natural attenuation, and EPS-enhanced biodegradation. An increase in total organic carbon and bacteria was also observed after EPS supplement. Supplement of EPS resulted in a growth of petroleum-hydrocarbon degrading bacteria, which enhanced the toluene biodegradation.

### General News

#### BROWNFIELDS FEDERAL PROGRAMS GUIDE, 2019 EDITION

U.S. EPA, Office of Land and Emergency Management, Washington, DC.  
EPA 560-B-19-001, 134 pp, September 2019

This guide updates the 2017 edition to aid in the cleanup and redevelopment of brownfields. Each federal agency or organization involved is summarized with respect to its mission and connection to brownfields. Each summary identifies relevant programs organized according to whether technical or financial assistance is available. Where applicable, a description is provided of eligibility requirements, availability, uses, and applications, as well as any restrictions on use or eligibility. "Snapshots" of brownfield projects that have successfully leveraged funding from these programs are included to illustrate how federal programs have stimulated brownfields cleanup and redevelopment around the country. The section on "Other Support for Brownfields Cleanup and Redevelopment" explains options for using federal tax incentives and bringing state and local partners into the funding mix. Tapping into these additional funding sources often can provide the additional resources that a brownfields project needs. EPA encourages stakeholders to think broadly about a brownfields project and plan early for its success by considering the many options available for technical and financial assistance. This guide provides a useful tool. A quick-reference table gives an overview of brownfields federal programs to help narrow the search for assistance.  
[https://www.epa.gov/sites/production/files/2017-06/documents/final\\_2017\\_bf\\_fed\\_guide\\_5-8-17.pdf](https://www.epa.gov/sites/production/files/2017-06/documents/final_2017_bf_fed_guide_5-8-17.pdf)

#### FUNDAMENTALS OF ENVIRONMENTAL SITE ASSESSMENT AND REMEDIATION

Rong, Y. (ed). CRC Press, Boca Raton, FL. ISBN: 978-1-138-10515-7, 340 pp, 2018

In 12 chapters, this book examines all aspects of environmental site assessment and remediation and outlines the interdisciplinary skills needed for field assessments. Included is a comprehensive overview for students, environmental professionals, and real estate developers, as well as recent information on environmental regulations, environmental site assessment and remediation practices, and industry standards. Topics covered include pollution sources, related impacts on drinking water supplies, and associated health risks; how to protect water resources, surface water, groundwater, and soil monitoring; and vapor intrusion. Practical case studies are also provided. See a preview of the book at <https://content.taylorfrancis.com/books/download/pdf/C0017-0-49302-48ISBN=9781351590438format=googlePreviewPdf>, or examine the chapter abstracts at <https://www.taylorfrancis.com/books/e/9781315101887>.

#### GREENER CLEANUP METRICS

U.S. EPA Engineering Forum Greener Cleanup Workgroup, CLU-IN Website, 2019

EPA's "Principles for Greener Cleanups" (<https://www.epa.gov/greenercleanups>) provide a foundation for planning and implementing cleanups that protect human health and the environment while minimizing the environmental footprint of cleanup activities. EPA has developed 14 greener cleanup metrics to use to quantify specific portions of the footprint, such as the amounts of refined materials, public water, or diesel fuel that are used or the amount of wastewater and hazardous waste that is generated. The metrics provide an optional means for regulators, private industry and other cleanup partners to collect and track site-specific footprint information across multiple sites in a uniform and transparent manner. On a project level, metrics use is anticipated to help the cleanup stakeholders identify best management practices that could be implemented to minimize the footprint. A spreadsheet tool, the Excel-based Greener Cleanup Metrics Workbook, is available to help parties document and report the metrics. <https://clu-in.org/epa-remediation/in/greenercleanupmetrics>

#### ADVANCES IN MANAGING CONTAMINATED GROUNDWATER USING HIGH RESOLUTION SITE CHARACTERIZATION AND CONTAMINANT MASS FLUX REDUCTION

Mok, C.M. and P. Kulkarni. | SERDP & ESTCP Webinar Series, Webinar #101, October 2019

SERDP and ESTCP sponsored two presentations on managing contaminated groundwater. The first presentation featured hydraulic tomography (HT), a cost-effective high-resolution site characterization technique to delineate the spatial distributions of hydraulic conductivity and storativity. A field-scale demonstration confirmed that HT can be readily applied at other DoD sites using existing networks of groundwater extraction/injection and observation wells. The presentation also described further enhancements by integrating HT with geophysical tomography as well as applications for remediation reliability evaluation and optimization. The second presentation described a recently completed ESTCP project on a contaminant flux reduction barrier. The discussion included 1) results from a small-scale field demonstration of the permeation grouting technology, 2) a permeation grouting decision flowchart, and 3) an overview of the ESTCP Source Barrier Toolkit. <https://www.serdp-estcp.org/Tools-and-Training/Webinar-Series/10-24-2019>

#### RECENT ADVANCES IN SURFACTANT-ENHANCED IN-SITU CHEMICAL OXIDATION FOR THE REMEDIATION OF NON-AQUEOUS PHASE LIQUID CONTAMINATED SOILS AND AQUIFERS

Besha, A.T., D.N. Bekele, R. Naidu, and S. Chadalavada  
Environmental Technology & Innovation 9:303-322(2018)

This review introduces surfactant enhanced in situ chemical oxidation (S-ISCO) technology and compares it to traditional in situ chemical oxidation. An overview of the three most important components of S-ISCO (surfactant/co-solvent mixtures, the catalyst and/or the oxidant and the free radicals) and major factors affecting the application of S-ISCO for the remediation of contaminated sites are included. The review concludes with a detailed explanation of the recent case studies and field applications of S-ISCO and factors affecting its implementation.

#### THE 35TH ANNUAL INTERNATIONAL CONFERENCE ON SOILS, SEDIMENTS, WATER AND ENERGY, 21-14 OCTOBER 2019, UNIVERSITY OF MASSACHUSETTS AT AMHERST: ABSTRACT BOOK

The Association for Environmental Health & Sciences (AEHS) Foundation, 201 pp, 2019

Over the past 35 years this conference has evolved from a meeting about underground storage tanks into one of the premier environmental conferences in the United States, attended annually by 700-800 individuals from a wide variety of disciplines, including state and federal agencies, military, industry, utilities, environmental consulting, and academia. International participation has continued to expand, with some years boasting representation from over 40 different countries. Topics encompass emerging contaminants, advances in site remediation, health risks, vapor intrusion, risk assessment, environmental forensics, sustainable remediation, and site characterization.  
<http://www.aehsfoundation.org/Member/aehsfoundation/Files/Abstracts%20Book%2019-2019.pdf>

#### REMEDICATION OF MERCURY CONTAMINATED SOIL, WATER, AND AIR: A REVIEW OF EMERGING MATERIALS AND INNOVATIVE TECHNOLOGIES

Wang, L., D. Hou, Y. Cao, Y. Ok, F.M.G. Tack, J. Rinklebe, and D. O'Connor  
Environmental International (Published online 11 November 2019 prior to print)

Recent developments in technological approaches for the remediation of Hg-contaminated soil, water, and air with a focus on emerging materials and innovative technologies are covered in this publication. Emerging materials include various nanomaterials graphene, biochar, metal organic frameworks, covalent organic frameworks, layered double hydroxides as well as other materials such as clay minerals and manganese oxides. The performance of innovative technologies, such as adsorption/desorption, oxidation/reduction and stabilization/containment, with the aid of these materials is then evaluated. In addition, the publication reviews technologies involving organisms, such as phytoremediation, algae-based mercury removal, microbial reduction, and constructed wetlands as well as the role of organisms in these techniques.

#### A REVIEW ON DECONTAMINATION OF ARSENIC-CONTAINED WATER BY ELECTROCOAGULATION: REACTOR CONFIGURATIONS AND OPERATING COST ALONG WITH REMOVAL MECHANISMS

Kobya, M., R. Darvishi, C. Soltani, F.I. Omwene, and A. Khataee  
Environmental Technology & Innovation 17:100519(2019)

Electrocoagulation (EC) applications, performance results, drawbacks, and limitations for As removal are the focus of this review. Topics covered include mechanisms and theoretical aspects; effects of operational parameters on the efficiency of the process, including current density, charge loading, and initial pH; reactor configurations and operating cost of the process; the EC sludge production, including characterization and disposal methods; and the simultaneous As removal with other contaminants from water. The publication concludes with examples of pilot and full-scale applications of EC for As removal and the outlook of this field of study with respect to new areas of research.

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.

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