



## Research

### HEXAVALENT CHROMIUM BIOREDUCTION AND CHEMICAL PRECIPITATION OF SULPHATE AS A TREATMENT OF SITE-SPECIFIC FLY ASH LEACHATES

Cason, E.D., P.J. Williams, E. Ojo, J. Castillo, M.F. DeFaua, and E. van Heerden.  
World Journal of Microbiology and Biotechnology 33(5):88(2017)

Researchers demonstrated an efficient and sustainable dual treatment remediation strategy for removal of high levels of Cr(VI) and sulfate introduced by fly ash leachate generated by a coal-fired power station in South Africa. The treatment consisted of a primary fixed-bed bioreactor kept at a reduction potential for Cr(VI) reduction. Metagenome sequencing clearly indicated a diverse bacterial community containing various bacteria, predominantly of the phylum Proteobacteria, which includes numerous species known for their ability to detoxify metals such as Cr(VI). The bioreactor treatment was followed by a secondary barium carbonate/dispersed alkaline substrate column for sulfate removal. The combination of these biological and chemical systems achieved removal of 99% Cr(VI) and 90% sulfate present in fly ash leachate.

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

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

Scientists examined data collected from U.S. public water systems (PWSs) in support of the recently-completed third round of the Unregulated Contaminant Monitoring Rule (UCMR3) to gain a better understanding of the nature and occurrence of 1,4-dioxane and the basis for establishing drinking water standards. The study confirmed that 21% of the public water supplies detected this compound, a rate that ranks relatively high when compared to the other UCMR3 contaminants. Dioxane detections and exceedances were primarily associated with large systems, and there was a slightly greater likelihood of dioxane presence in groundwater than in surface water; however, the comparable detection rates and concentrations in surface water and groundwater source run counter to the assumptions that dioxane in drinking water is largely related to contaminated groundwater sites. Furthermore, dioxane showed evidence of a decreasing trend in concentration and detection frequency over time based on aggregated nationwide data. The collected UCMR3 occurrence data are posted at <https://www.epa.gov/ucmr/occurrence-data-unregulated-contaminant-monitoring-rule>.

### ASSOCIATING POTENTIAL 1,4-DIOXANE BIODEGRADATION ACTIVITY WITH GROUNDWATER GEOCHEMICAL PARAMETERS AT FOUR DIFFERENT CONTAMINATED SITES

da Silva, M.L.B., C. Worszyllo, N.F. Castillo, D.T. Adamson, and P.J.J. Alvarez.  
Journal of Environmental Management 206:60-64(2017) doi: 10.1016/j.jenvman.2017.10.031

Pearson's and Spearman's correlation and linear regression analyses were conducted to discern associations between 1,4-dioxane biodegradation activity measured in aerobic microcosms and groundwater geochemical parameters at four different contaminated sites. Dissolved oxygen, which is known to limit dioxane biodegradation, was excluded as a limiting factor. Biodegradation activity was positively associated with dioxane concentrations as well as the number of catabolic *trnA* gene copies encoding dioxane monooxygenase. While environmental factors such as pH, temperature, and nutrients might influence dioxane biodegradation, the in situ concentration of substrate dioxane at the time of sampling had the greatest influence in that the analysis infers that aerobic sites with higher dioxane concentrations are more likely to select and sustain a thriving population of dioxane degraders. Under low dioxane concentrations, the contaminant likely would have greater difficulty attenuating naturally.

### USING AEROBIC COMETABOLIC BIODEGRADATION AND GROUNDWATER RECIRCULATION TO TREAT 1,4-DIOXANE AND CO-CONTAMINANTS IN A DILUTE PLUME

Chiu, M.-Y.J., P. Bennett, M. Dolan, M. Hyman, Anderson, A. Boudour, and A. Peacock.  
The 10th International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Palm Springs, CA; May 2016). Battelle, Columbus, OH. Poster F-010, 2016

Although numerous studies on aerobic cometabolic biodegradation (ACB) of 1,4-dioxane (1,4-D) have been published, most of them have been lab studies at high 1,4-D concentrations, not the low levels typically found at cleanup sites. A field test is underway at the former McClellan AFB to evaluate the potential of ACB to treat 1,4-D and co-contaminants in a dilute plume using groundwater recirculation to deliver substrates along with bioaugmentation. Groundwater in the test area is aerobic and contains 1,4-D (~50 mg/L), 1,1-DCA (~10 mg/L), and TCE (~5 mg/L), and an injection/extraction well pair, a monitoring network, and an above-ground substrate delivery system were constructed to facilitate groundwater recirculation and propane and oxygen addition. A conservative tracer test was conducted to characterize the travel times from the injection well to individual monitoring wells. The lab study phase revealed that a strain of *Mycobacterium* sp. capable of degrading 1,4-D had substantial 1,4-D transformation activity when using propane as the primary substrate. Following the biostimulation phase, the recirculation zone will be bioaugmented. <http://www.halsvadrich.com/Downloads/battelle-chlorinated/aerobic-cometabolic-biodegradation-groundwater-14dioxane-halsvadrich-battelle.pdf>

### SIMULTANEOUS DETERMINATION OF THE POTENTIAL CARCINOGEN 1,4-DIOXANE AND MALODOUROUS ALKYL-1,3-DIOXANES AND ALKYL-1,3-DIOXANOLANES IN ENVIRONMENTAL WATERS BY SOLID-PHASE EXTRACTION AND GAS CHROMATOGRAPHY

TANDEM MASS SPECTROMETRY  
Carrera, G., L. Vegue, M.R. Boleda, and F. Ventura.  
Journal of Chromatography A 1487:1-13(2017)

The suitability of a solid-phase extraction method and further analysis by GC/MS-MS for simultaneous determination of 1,4-dioxane, alkyl-1,3-dioxanes, and dioxolanols has been demonstrated. Recoveries in surface waters spiked at 25 ng/L ranged from 76-105%, whereas method quantification limits varied from 0.7 to 26 ng/L for dioxanes and dioxolanols, and 50 ng/L for 1,4-dioxane. Uncertainties were evaluated at two different concentrations, 0.02 µg/L and 0.4 µg/L, with values of 25% for 1,4-dioxane and of 16-28% for alkyl-1,3-dioxanes and alkyl-1,3-dioxolanols. The methodology was applied successfully to samples from the aquifer of the Llobregat River in Northeast Spain.

### HIGH-RESOLUTION SITE CHARACTERIZATION OF 1,4-DIOXANE SITES USING NEW ON-SITE, REAL-TIME ANALYSIS

Davis, W.M., C.P. Antworth, C.A. Horrell, J. Wright, and P. Curry.  
The 10th International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Palm Springs, CA; May 2016). Battelle, Columbus, OH. Presentation F-001, 22 slides, 2016

Current lab methods for 1,4-dioxane use either purge and trap (EPA Methods 524.2 or 8260b) or solid-phase extraction (EPA Method 522). Due to the high water solubility of 1,4-dioxane, purging methods show high limits of detection and require special method adjustments, including heating the sample and/or addition of salt. Solid-phase extraction methods are time consuming with multiple steps, including concentration of the final extract to obtain the desired sensitivity. These factors make the use of these methods impractical for rapid, on-site analysis of 1,4-dioxane. A new 1,4-dioxane analysis method is based on solid-phase microextraction (SPME) followed by mass spectrometric analysis using the direct sampling on trap mass spectrometer (DSITMS). This method has been demonstrated to provide quantitative analysis of 1,4-dioxane to limits of detection of 1-2 µg/L for groundwater and 5-8 µg/kg for soil samples. Due to the extremely simple nature of the SPME extraction and the rapid DSITMS analysis (5 minutes), an analyst operating a single DSITMS can provide up to 50 on-site analyses per day. The method has been applied to provide high-resolution site characterization at a number of sites. Case studies are presented. <https://www.epa.gov/ucmr/occurrence-data-unregulated-contaminant-monitoring-rule>

### PREDICTING DNAPL SOURCE ZONE AND PLUME RESPONSE USING SITE-MEASURED CHARACTERISTICS

Annable, M.D., K. Hatfield, J.W. Jawitz, M.C. Brooks, A.L. Wood, and P.S.C. Rao.  
SERDP Project ER-1613, 69 pp, 2017.

This report focuses on assessing the level of site characterization needed to support quality decisions regarding remedial strategies and long-term stewardship of contaminated sites using a flux and mass balance-based approach. Site characterization efforts were aimed at understanding the link between DNAPL source zones mass discharge under natural hydrological conditions and under conditions modified by source zone treatment. The transition between forward- and back-diffusion was also explored. <https://www.serdp-estm.nri/content/download/45449/424781/file/ER-1613%20Final%20Report.pdf>

### GAS PRODUCTION AND MASS TRANSFER DURING ELECTRICAL RESISTANCE HEATING OF CLAY LENSES

Martin, Eric J., Ph.D. dissertation, Queen's University, Kingston, ON, Canada. 144 pp, 2017

A study was conducted to develop a mechanistic understanding of remediation in clay lenses as well as lensed by electrical resistance heating. Clay lenses are areas of accumulation for DNAPL and are difficult to remediate. Experiments were performed in a 2-D saturated porous medium comprising an electrically conductive, low-permeability clay lens embedded within less electrically conductive, higher permeability silica sand. This study is based on an experimental program and mathematical modeling of experimentally measured data. <https://nrc.ca/science/library/guensis.ca/handle/1974/27044>

### MANAGING THE NEGATIVE IMPACTS OF GROUNDWATER FLOW ON ELECTROTHERMAL REMEDIATION

Hegele, P.R. and B.C.W. McGee.  
Remediation Journal 27(3):29-38(2017)

Rapid groundwater fluxes often influence subsurface temperature distributions during in situ thermal remediation using electrothermal or conduction heating technologies. Researchers used a numerical approach to evaluate the impact of groundwater flow on electrothermal heating, as well as the effectiveness of several upgradient heat loss management strategies, in a hypothetical treatment volume. Evaluation of design alternatives using upgradient (i) hydraulic barriers, (ii) physical barriers, and (iii) increased energy input indicated that target temperatures can be achieved despite the presence of local groundwater flow velocities greater than 0.3 m/day through careful design and implementation of the alternatives. To be effective, however, physical barriers need to be designed to prevent groundwater flow through the heated volume. Field data from an electrothermal application are presented where boiling temperatures were achieved after steam injection and upgradient pumping wells were used.

## General News

### REMEDATION MANAGEMENT OF COMPLEX SITES

Interstate Technology & Regulatory Council (ITRC), RMCS-1, 2017

This web-based ITRC guide explains how to implement adaptive site management as a holistic, comprehensive, flexible, and iterative process for managing complex sites. The process is applicable to sites where remedy performance predictions are significantly uncertain. Adaptive site management includes setting short-term interim objectives and long-term site objectives that reflect both technical and nontechnical challenges. The remedial approach might involve using multiple technologies at one time and changing technologies over time. Comprehensive planning and scheduled evaluations of remedy performance help decision-makers track remedy progress and adjust the remedy as needed to stay on track to achieving short-term interim objectives. Long-term planning can also improve the timeliness of remedy optimization, reevaluations, or transitions to other technologies or contingency actions. The case studies in this guide describe real-world applications of remediation and remediation management at complex sites. <http://rmcs-1.itrcweb.org/>

### INVESTIGATIVE STRATEGIES FOR LEAD-SOURCE ATTRIBUTION AT SUPERFUND SITES ASSOCIATED WITH MINING ACTIVITIES

National Academies of Sciences, Engineering, and Medicine.  
National Academies Press, Washington, DC. ISBN: 978-0-309-46556-4, 112 pp, 2017

Under the Superfund program, U.S. EPA attempts to identify parties that are responsible for site contamination and thus financially responsible for remediation. Identification of potentially responsible parties can be complicated at Superfund sites that have a long history of use and involve contaminants from different sources, as is often the case for mining sites that involve metal contamination; metals occur naturally in the environment, they can be contaminants in the wastes generated at or released from the sites, and they can be used in consumer products that degrade and release the metals back to the environment. This report examines the extent to which various sources contribute to environmental lead contamination at Superfund sites near lead-mining areas and focuses primarily on sources that contribute to lead contamination at sites near the Southeast Missouri Lead Mining District. The authors recommend potential improvements in approaches used for assessing sources of lead contamination at or near Superfund sites. <https://doi.org/10.17726/24898>

### FLUX-BASED GROUNDWATER ASSESSMENT AND MANAGEMENT

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, Adelaide, Australia.  
CRC CARE Technical Report no. 37, 103 pp, 2016

Although the assessment and management of groundwater contamination traditionally has been driven by contaminant concentrations, concentration data alone sometimes are insufficient to fully understand plume behavior or impact over time. Mass flux and mass discharge concepts can help fill the gap in understanding and have been applied successfully. This guide was prepared to illustrate how flux concepts, tools, and measurements can be used to assess and manage groundwater contamination. The report includes suggestions for engaging with regulators and other stakeholders. See *CRC CARE Technical Report 37* at <http://www.crccare.com/publications/technical-reports>.

### A REVIEW OF THE ENVIRONMENTAL PROTECTION AGENCY'S SCIENCE TO ACHIEVE RESULTS RESEARCH PROGRAM

National Academies of Sciences, Engineering, and Medicine.  
The National Academies Press, Washington, DC. ISBN: 978-0-309-45857-3, 114 pp, 2017

In 1995, U.S. EPA created a program known as Science to Achieve Results, or STAR. STAR is EPA's primary competitive extramural grants program. This report contains an assessment of the program's scientific merit, public benefits, and overall contributions in the context of other relevant research, and recommends ways to enhance those aspects of the program. <https://doi.org/10.17726/24757>

### LOW-LEVEL RADIOACTIVE WASTE MANAGEMENT AND DISPOSITION: PROCEEDINGS OF A WORKSHOP

National Academies of Sciences, Engineering, and Medicine.  
The National Academies Press, Washington, DC. ISBN: 978-0-309-45678-4, 162 pp, 2017

DOE's Office of Environmental Management is responsible for the safe cleanup of sites used for nuclear weapons development and government-sponsored nuclear energy research. Low-level radioactive waste (LLW) is the most volumetrically significant waste stream generated by the DOE cleanup program. LLW is also generated through commercial activities such as nuclear power plant operations and medical treatments. U.S. laws and regulations related to LLW disposal have evolved over time and across agencies, resulting in a complex regulatory structure. The National Academies of Sciences, Engineering, and Medicine organized a workshop to discuss approaches for LLW management and disposition. Participants explored the key LLW physical, chemical, and radiological characteristics that govern its safe and secure management and disposal in aggregate and in individual waste streams, and how key LLW characteristics are incorporated into standards, orders, and regulations that govern its management and disposal in the United States and in other major waste-producing countries. This publication summarizes presentations and discussions from the workshop. <https://doi.org/10.17726/24715>

### SBIR/STTR AT THE DEPARTMENT OF ENERGY

National Academies of Sciences, Engineering, and Medicine.  
National Academies Press, Washington, DC. ISBN: 978-0-309-43792-9, 434 pp, 2016

The U.S. Congress tasked the National Research Council with undertaking a comprehensive study of how the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs have stimulated technological innovation and used small businesses to meet federal research and development needs. The Council was also charged with recommending further improvements to the programs. Although converting scientific discoveries into innovations for the market involves substantial challenges, the American capacity for innovation can be strengthened by addressing the challenges faced by its entrepreneurs. Appendix E in this report contains 12 case studies of product development by DOE SBIR/STTR recipients, including several companies that developed or promoted technologies with application in environmental monitoring and characterization. <https://doi.org/10.17726/23406>

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