Entries for April 16-30, 2016

Technology Innovation News Survey

Clean-up News

THERMAL DNAPL SOURCE ZONE TREATMENT IMPACT ON A CVOC PLUME
Heron, G., J. Bierschenk, R. Swift, R. Watson, and M. Kominik.
Groundwater Monitoring & Remediation, Vol 36 No 1, 2016

The dissolved-phase PCE plume emanating from the source zone at a site in Endicott, New York, was commingled with a petroleum hydrocarbon plume from an upgradient source of fuel oil. Extraction wells located about 360 m downgradient of the source provided hydraulic containment for the plume. Implementation of in situ thermal desorption (ISTD) in the source area removed ~1,406 kg of PCE in addition to 4,082 kg of commingled petroleum-related compounds. The ISTD treatment reduced the PCE mass discharge into the plume from an estimated 57 kg/yr to 0.07 kg/yr, essentially removing the source term. In the five years following thermal treatment completion in early 2010, the PCE plume has disappeared, and the concentration of degradation products in the PCE-series plume area has declined by two to three orders of magnitude. Anaerobic dechlorination is the suspected dominant mechanism, assisted by the presence of a fuel oil smear zone and a petroleum hydrocarbon plume from a separate source area upgradient of the PCE source. Based on the post-thermal treatment groundwater monitoring data, the hydraulic containment system was downsized in 2014 and discontinued in early 2015.

HOW EFFECTIVE IS THERMAL REMEDIATION OF DNAPL SOURCE ZONES IN REDUCING GROUNDWATER CONCENTRATIONS?
Baker, R.S., G. Nielsen, G. Heron, and N. Pfeifer.
Groundwater Monitoring & Remediation, Vol 36 No 1, 2016

The authors conducted DNAPL source removal using situ thermal remediation (ISTR) at dozens of sites. This paper presents a compilation of cases—10 separate DNAPL source areas at five project sites—where data indicate that a thorough implementation of ISTR in a DNAPL source area can result in the attenuation of the associated dissolved plume, such that in several cases long-standing pump-and-treat systems could be turned off. These findings contrast with assertions that aggressive source remediation may not be justifiable because dissolved plume concentrations will not decline sufficiently. This paper is Open Access at http://onlinelibrary.wiley.com/doi/10.1111/jwrm.12149/pdf.

INDEPENDENT REVIEW OF ELEMENTAL PHOSPHORUS REMEDIATION AT THE EASTERN MICHAUD FLATS FMC OPERABLE UNIT NEAR POCATELLO, IDAHO

Elemental phosphorus (P4) was manufactured from phosphoric ore at FMC’s Pocatello, Idaho, facility, located on privately owned land within the Shoshone-Bannock Tribes’ Fort Hall Indian Reservation. The now-closed facility includes disposal sites regulated under RCRA and CERCLA. The Tribes favor permanent removal and/or treatment of P4. EPA and the Tribes agreed to have Argonne National Laboratory perform an independent review of potential permanent treatment and technologies for the site. This report documents how the independent review was conducted and presents the results. Technologies that could be ready for use in the near term (within 1 yr) include mechanical excavation, containment technologies, off-site incineration, and drying and mechanical mixing under a tent structure. Technologies that could be ready for use in the mid-term (1 to 2 yr) include cutters suction dredging, thermal-hydraulic dredging, and underground pipeline cleaning. Technologies requiring a longer lead time (2 to 5 yr) include on-site incineration, a land disposal restriction waste treatment system, an Albright & Wilson batch mud still, post-treatment on-site disposal, and post-treatment off-site disposal.

http://www.odt.gov/site/index/biblio/1238045

TREATMENT OF CHLORINATED SOLVENTS IN GROUNDWATER BENEATH AN OCCUPIED BUILDING AT THE YOUNG-RAINEY STAR CENTER, PINELLAS, FL
Daniel, J. S. Surovikov, and C. Tabor.

Groundwater contamination from two dissolved-phase plumes originating from chlorinated solvent source areas in the southeastern portion of the Young-Rainey Star Center,Pinellas County, Florida, has migrated off site, beneath the roads and properties by 300 m to the south and east. The origin of the contamination appears to be multiple long-term point sources beneath Building 100, an 11-acre building that housed manufacturing facilities during former DOE operations. The site is now owned by Pinellas County. The technical approach consisted of installing horizontal wells outside the building footprint that extend through and around the identified subsurface treatment areas and terminate under the building. Following installation of two wells 350 ft long, two wells 400 ft long, and four wells 450 ft long to intercept the inferred source areas and confirm contaminant plumes beneath the building, DOE injected emulsified vegetable oil and a microbial culture into the horizontal wells at each of several target areas. This culture describes the details of bioremediation treatment plant installation beneath a large, occupied industrial production facility, including lessons learned; technical, logistical, and environmental challenges; community relations; and regulatory relations. http://www.odt.gov/site/index/biblio/1245981-treatment-chlorinated-solvents-groundwater-beneath-occupied-building-young-rainey-star-center-pinellas-fl

VAPOR EXTRACTION WELL PERFORMANCE AND RECOMMENDATIONS FOR FUTURE SOIL VAPOR EXTRACTION ACTIVITIES AT THE A-014 OUTFALL
Jackson, D., W. Hyde, R. Walker, B. Riha, J. Ross, and M. Kramer.

The vadose zone near the A-014 Outfall contains residual VOCs that serve as a potential source for groundwater contamination. Since 1995 active soil vapor extraction (SVE) has been an integral part of the site corrective actions. Two separate SVE systems currently are removing contamination in the vadose zone from the subsurface. This report describes performance evaluation of individual wells associated with the systems and provides optimization recommendations.

http://clu-in.org/newsletters
DEPARTMENT OF ENERGY SITES
determine the long-term concentration trend in the well. HydraSleeve were more variable compared to monitoring records obtained using purge sampling methods, a characteristic that would make it more difficult to monitor wells with >10 ft of water above the screened interval. In addition to lower VOC concentrations, the monitoring records obtained using the HydraSleeve sampler versus other monitoring well sampling methods, lower VOC concentration results were observed at all three collecting water from an incorrect depth interval, possibly above the screened interval of the well. In a comparative evaluation of VOC results from groundwater
The HydraSleeve is a sampling device for collecting groundwater from the screened interval of a monitoring well without purging. The device uses a check valve

Soils contaminated with per- and polyfluoroalkyl substances (PFASs) at two airport fire training grounds in Australia were used in an independent validation of the commercial immobilization product RemBind™, which contains mainly activated carbon and aluminum hydroxide and clay materials. The trials were independently supervised by an external party to ensure a high level of scrutiny. Soils were mixed with 5-20% RemBind (standard grade) or RemBind Plus (high grade), fixed for 48 hours, and then analyzed for 20 PFASs at a commercial laboratory using the Toxicity Characterization Leaching Procedure. Selected samples were further analyzed using U.S. EPA Method 1312 (multiple extraction procedure) as an indication of long-term binding stability. Results showed that RemBind treatment reduced the soil leachability of PFOS from 37 µg/L (site 1) and 341 µg/L (site 2) below 0.3 µg/L. For PFASs in aqueous media, PerfluoroAd introduction followed by RemBind polishing provides an innovative treatment process. In pretreatment, liquid PerfluoroAd active compound is metered into the precipitation PFASs. Precipitation products are separated from the water as micro-flocs by processes such as sedimentation and filtration. The precipitants can be concentrated to a very high degree, which allows for economical disposal. A downstream RemBind filter treats the residual contaminants. Owing to the significant reduction in the PFAS contaminant load in the PerfluoroAd stage (up to 90%) the absorbent filter lifetime is extended significantly.

A thixotropic gel suitable for use in subsurface bioremediation is described along with a process for using the gel. The thixotropic gel serves as a non-migrating thixotropic gel for vadose zone remediation
This paper is Open Access

Electrical resistance heating (ERH) experiments performed in a 2-D water-saturated porous medium comprising an electrically conductive, low-permeability clay layer embedded within less electrically conductive, higher permeability silica sand were compared to experiments performed in homogeneous silica sand. All experiments were performed in the absence of a NAPL or dissolved VOC. Temperature monitoring showed preferential heating in the clay layer and higher overall heating rates throughout the test cell compared to the homogeneous sand. Gas production was localized around the sand-clay interface due to high temperature and low capillary displacement pressure. Above the clay layer, unexpected temperature plateaus were observed. Results show that the use of conductive ERH as a co-boiling application of ERH at sites containing electrically conductive, low-permeability clay layers embedded within less electrically conductive, higher-permeability sandsThis paper is Open Access

MONTING IN SITU BIODEGRADATION OF MTBE USING MULTIPLE ROUNDS OF COMPOUND-SPECIFIC STABLE CARBON ISOTOPE ANALYSIS
At a large industrial facility, MTBE released to the subsurface dispersed into existing LNAPL in the first aquifer, where the LNAPL served as a continuous source of MTBE in groundwater. Results from compound-specific isotope analysis conducted on MTBE and TBA in groundwater samples collected in 2008, 2011, and 2013 demonstrated the onset and progress of MTBE biodegradation between 2008 and 2013. The TBA observed in 2008 appears to be derived in part only from MTBE transformation while a significant portion of TBA might be contributed directly from LNAPL sources. In 2011 to 2013, the dominant source of TBA in the mid-gradient plume was MTBE transformation. Contribution from an offsite LNAPL source, the downgradient and downgradient plume, is possible but could not be unequivocally confirmed. The time series provided direct evidence for MTBE biodegradation and valuable insight on TBA source This paper is Open Access

A practical field method uses applied tracers to determine how much pumping is required to collect representative groundwater samples after the introduction of drilling water during borehole advancement. In general, the approach involves adding a tracer of known concentration to the drilling water and then measuring the tracer in the purge water until the tracer concentration declines to a defined target level. If necessary, the dilution effects of residual drilling water can be quantified, and the measured contaminant concentration can be corrected based on the measured tracer concentration. A project example demonstrates that this method is straightforward and reliable and that applied tracers can be used to quantify the influence of residual drilling water on formation water quality while also ensuring that purge times and volumes are not unnecessarily large.
This paper is Open Access

THIXOTROPIC GEL FOR VADOSE ZONE REMEDIATION
Riha, B.D. and B.B. Looney; Assigned to Savannah River Nuclear Solutions, LLC, Aiken, SC.
A thixotropic gel suitable for use in subsurface bioremediation is described along with a process for using the gel. The thixotropic gel serves as a non-migrating thixotropic gel for vadose zone remediation

NEGATIVE BIAS AND INCREASED VARIABILITY IN VOC CONCENTRATIONS USING THE HYDRASSLEEVE IN MONITORING WELLS
The HydraSleeve is a sampling device for collecting groundwater from the screened interval of a monitoring well without purging. The device uses a check valve to collect water from the well over the first 3-5 ft of an upward pulling motion. If the check-valve does not perform as expected, then the HydraSleeve has the potential to collect water from an incorrect depth interval, possibly above the screened interval of the well. In a comparative evaluation of VOC results from groundwater samples collected with the HydraSleeve sampler versus other monitoring well sampling methods, lower VOC concentration results were observed at all three test sites for trichloroethylene and tetrachloroethylene. At two of the three sites, the low concentration sample results were associated most strongly with monitoring wells with >10 ft of water above the screened interval. In addition to lower VOC concentrations, the monitoring records obtained using the HydraSleeve were more variable compared to monitoring records obtained using purge sampling methods, a characteristic that would make it more difficult to determine the long-term concentration trend in the well.
This paper is Open Access

MICROBIOLOGICAL-ENHANCED MIXING ACROSS SCALES DURING IN-SITU BIODEGRADATION OF METALS AND RADIONUCLIDES AT

Technology Innovation News Survey
Entries for April 16-30, 2016
2 of 4
cju-in/newsletters
SORPTION OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) ON FILTER MEDIA: IMPLICATIONS FOR PHASE PARTITIONING STUDIES


Environmental Toxicology and Chemistry, Vol 34 No 1, 30-36, 2015

Sorption of aqueous-phase PFASs on filtration media may lead to underestimation of PFAS concentrations in the aqueous phase. Researchers investigated the sorption of different PFASs on filtration media at 3 concentration levels, on 4 types of filter media, and in 4 matrices. Glass fiber filter showed the least sorption, while polypropylene and polyethylene filters had the most similar efficiency. Sorption was found to be consistent across matrix types except for samples affected by aqueous film-forming foam deployment, which displayed high sorption of PFOS on nylon filters. Overall, glass fiber filters are recommended over nylon filters in environmental samples when PFASs are required. The use of phase partitioning testing is also recommended to account for unpredictable effects prior to selecting filtration media for PFAS removal. http://adamcbowen.com/axyscorp/documents/2015/07/chandramouli-et-al-etc-2015-pfas-filtration.pdf

ARSENIC, ANTIMONY AND SELENIUM REMOVAL FROM MINE WATER BY ANAEROBIC BIOREACTORS AT LABORATORY SCALE


A field test was combined with numerical modeling to examine nano-scale zero-valent iron (NZVI) reactivity and transport properties in variably saturated soils. The field test consisted of 142 L of carboxymethyl cellulose (CMC)-stabilized monometallic NZVI synthesized on-site and injected into a variably saturated zone. Sample analysis showed that CMC-stabilized monometallic NZVI was able to decrease DOC concentrations in groundwater by more than 99% from historical concentrations. A 3-D, 3-phase, finite-difference numerical simulator (SimComp) was used to further investigate NZVI and polymer transport at the vanadium contaminated site. The model accurately predicted the field-observed head data without parameter fitting, estimated the mass of NZVI delivered to the saturated and unsaturated zones, and distinguished the NZVI phase (i.e., aqueous or attached). In simulations, the injected slurry migrated radially outward from the injection well, indicating NZVI transport was governed by injection velocity and viscosity of the injected solution. In different injection scenarios, simulations showed that injection of a higher NZVI volume delivered more Fe particles at a given distance, although travel distance was not proportional to increase in volume.

HORIZONTAL ARRANGEMENT OF ANODES OF MICROBIAL FUEL CELLS ENHANCES REMEDIATION OF PETROLEUM HYDROCARBON-CONTAMINATED SOIL


Environmental Science and Pollution Research, Vol 22 No 3, 2335-2341, 2015

In a study of in situ bioremediation of hydrocarbon-contaminated soil, anodes arranged two different ways (horizontal or vertical) were compared in microbial fuel cells (MFCs). Charge outputs as high as 833 and 762 mC/m3 were achieved in reactors with horizontal or vertical anodes at 30°C, which was 50.6% higher than in the VA system (8.3%) and 95.3% higher than in the disconnected control (6.4%). Hydrocarbon fingerprint analysis showed that the degradation rates of both alkanes and PAHs in the VA were higher than those in the control, possibly owing to lower mass transport resistance in the VA. Metal bioreduction strategies require manipulation of the subsurface, usually through injection of electron donor, which mixes at varying scales with the contaminant to stimulate metal-reducing bacteria. Mixing limitations of substrates at all scales can affect biological growth and activity or U(VI) reduction. A growing body of literature suggests that reaction could be enhanced or cell-to-cell interaction could be exploited to enhance metal reduction over length scales extending tens to thousands of microns. This project investigated two potential mechanisms of enhanced electron transfer: (i) the formation of single- or multispecies biofilms that transport electron (rather than nutrients) between as conditions as when electron transfer is not limited (nanowires) through bioloids to where the electron acceptor is available, and (ii) through diffusion of electron carriers from syntrophic bacteria to dissimilatory metal-reducing bacteria. The specific objectives were to (i) quantify the extent and rates of metal attenuation and (ii) determine if attenuation rates are positively correlated with rates for 1,1-DCE and TCE but not TCA. This set of sites gave little evidence that chlorinated solvent remedial efforts (e.g., chemical oxidation, enhanced bioremediation) affected dioxane attenuation. Attenuation rates based on specific activity from the Air Force data set confirmed significant dioxane attenuation (131 of 441 wells) at a similar frequency and extent (mean life of 48 months) as observed at the Dornbluth site. The contaminant analysis established a positive correlation between dioxane attenuation and increasing concentrations of dissolved oxygen, while the same analysis found a negative correlation with metals and CVOC concentrations. The evidence of dioxane attenuation documented here suggests that natural attenuation might be used to manage some but not necessarily all dioxane-aFFECTED sites.

IMPLICATIONS OF MATRIX DIFFUSION ON 1,4-DIOXANE PERSISTENCE AT CONTAMINATED GROUNDWATER SITES


In a study of the extent to which 1,4-dioxane's persistence was subject to diffusion of mass into and out of lower-permeability zones relative to co-released
chlorinated solvents, two release scenarios were evaluated within a 2-layer aquifer system using an analytical modeling approach. The first scenario simulated a dioxane and 1,1,1-TCA source zone where spent solvent was released. The period when dioxane was actively loading the low-permeability layer within the source zone was estimated to be presentation slides: http://www.contaminantssummit.com/images/presentations/3_DavidAdamson.pdf

COMPARISON OF PHYTOSCREENING AND DIRECT-PUSH-BASED SITE INVESTIGATION AT A RURAL MEGASITE CONTAMINATED WITH CHLORINATED ETHENES
Groundwater Monitoring & Remediation, Vol 35 No 4, 45-56, 2015

The relative effectiveness of rapid, reasonably priced screening techniques—direct push (DP)-based groundwater sampling and tree-core sampling—was compared at a rural megasite contaminated with chlorinated hydrocarbons. Unexpected pollution hot spots were identified using both of these methods. Tree coring even delineated the contaminant plume flowing into an adjacent wetland, which was inaccessible to DP units. Both methods agreed well in revealing the spatial pattern of contamination. The correlation between groundwater concentrations and equivalent concentrations in wood was linear and highly significant for TCE, whereas correlation was less obvious for its metabolite cis-DCE, but still significant. Tree coring is recommended for initial screening in combination with DP sampling to retrieve quantitative data on groundwater pollutants for early assessment of contamination, with subsequent placement of monitoring wells for long-term monitoring.

TREE CORING AS A COMPLEMENT TO SOIL GAS SCREENING TO LOCATE PCE AND TCE SOURCE ZONES AND HOT SPOTS
Algers, M., S. Trapp, P.R. Jensen, and M. Bittens.

Tree coring and soil gas sampling were applied and compared at two forested sites contaminated with PCE or TCE to evaluate their ability to locate source zones and contaminant hot spots. One test site represented a relatively homogeneous sandy soil and aquifer, and the other a more heterogeneous geology with both sandy and less permeable clay till layers overlying a chalk aquifer. Both methods were found useful as screening tools to locate hot spots of PCE and TCE in the shallow subsurface. Tree coring was found to be particularly beneficial as a complement to soil gas sampling at sites with low permeable soils and where contamination was located in the capillary rise or shallow groundwater. The shorter time required for tree coring reduced its costs compared to those of soil gas sampling but with lower sensitivity and precision. Combining the two methods can help to focus subsequent investigations.

General News

SCREENING OF THE BACTERIAL REDUCTIVE DECHLORINATION POTENTIAL OF CHLORINATED ETHENES IN CONTAMINATED AQUIFERS: A TECHNICAL ASSISTANCE MANUAL FOR ASSESSMENT OF NATURAL ATTENUATION OF CHLOROETHENES-CONTAMINATED SITES
Swiss Federal Office for Environment, 86 pp, 2016

The approach proposed in this guide to evaluate dechlorination processes in the saturated zone of contaminated sites examines aquifers as a coherent and dynamic assembly comprising a biotic and an abiotic part. A key contribution of this methodology is the use of statistics derived from numerical ecology tools for analysis of the physicochemistry and bacteriological status of a contaminated aquifer. This guide details the proposed approach. http://infoscience.epfl.ch/record/213613/files/Manual_BioremediationPotentialAssessment_ChlorinatedEthenes_Final_March2016.pdf

MAKING STRIDES IN THE MANAGEMENT OF "EMERGING CONTAMINANTS"
Suthersan, S., J. Quinnan, J. Horst, I. Ross, E. Kalve, C. Bell, and T. Pancras.

1,4-Dioxane and per- and polyfluoroalkyl substances (PFASs) are truly emerging in the United States as EPA works to establish a consensus on toxicology and states begin to prepare to adopt cleanup standards. The better known PFAS compounds, PFOA, has been identified internationally as a persistent organic pollutant (POP) and its production is severely restricted by the Stockholm Convention. PFOA (also known as CB) is currently under consideration to be classed as a POP. Analytical methods, toxicology, and treatment technologies are evolving in parallel for both, but stakeholders face much uncertainty as they prepare to manage their liabilities. The paper summarizes current remediation options for dioxane and PFASs in a table. Commercial technologies for PFASs include RemBind™ and MatCARE™ (both available) and ScisoR® (still at lab scale). http://onlinelibrary.wiley.com/doi/10.1111/gwmr.12143/pdf

AN ANALYSIS OF UST SYSTEM INFRASTRUCTURE IN SELECT STATES
Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Aging Tanks Workgroup, Tanks Subcommittee, 40 pp, 2015

To analyze whether aging UST infrastructure poses a higher risk of leaks, thus creating higher risks for state tank funds and private insurers and ultimately higher costs for tank owners/operators, the Tanks Subcommittee reviewed UST system data from eight participating states, information on potential fuel leak risk factors, state policies and initiatives for mitigating aging tank risks, and state fund and financial insurance considerations. This report also highlights examples of equipment problems observed on UST systems previously storing motor fuels after changing to storing biofuel blends or ultra-low-sulfur diesel, although the roof causes of each problem was not documented. http://www.astswmo.org/files/policies/Tanks/2015-10-ASTSWMOAgingTanks%20Report-Final.pdf

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.