Technology Innovation News Survey

Entries for July 16-31, 2018

Market/Commercialization Information

PRACTICAL METHODS TO ANALYZE AND TREAT EMERGING CONTAMINANTS (PFAS) IN SOLID WASTE, LANDFILLS, WASTEWATER/LEACHATES, SOILS, AND GROUNDWATER

U.S. EPA, Funding Opportunities EPA-G2018-STAR-B1 & EPA-G2018-STAR-B2, 2018

As part of its Science to Achieve Results (STAR) program, U.S. EPA seeks applications proposing research that will lead to (1) better understanding and characterization of the types and quantities of current and historical per- and poly-fluoroalkyl substances (PFAS) and PFAS-containing waste associated with waste disposal (e.g., landfills), as well as media containing PFAS released from leachate collected by landfills or leaching to subsurface soils and groundwater; (2) increased knowledge of the fate, transport, potential for degradation, or other changes to PFAS and their mobility during materials management (e.g., under different landfill conditions such as pH, temperature, moisture content) that facilitate or retard such transformation or movement; and (3) new or improved methods that are more effective, efficient (in cost and energy), and practical in controlling, treating, destroying, or removing PFAS from waste and wastewater, landfill leachates, biosolids, or environmental media. The main goal is to promote innovation in evaluating and managing PFAS in solid waste, landfills, and environmental media that will lead to improved decision-making, management practices, and technical methods to minimize the risks to humans and ecosystems. The closing date for applications is October 2, 2018. Out of the estimated total program funding of $6M, 5 awards are anticipated for EPA-G2018-STAR-B1 with award ceilings of $900,000, and 3 awards are anticipated for EPA-G2018-STAR-B2 (Early Career), with award ceilings of $500,000.
EPA-G2018-STAR-B1: http://www.grants.gov/web/grants/view-opportunity.html?oppId=308378
EPA-G2018-STAR-B2 (Early Career): http://www.grants.gov/web/grants/view-opportunity.html?oppId=308379

FY2019 PHASE I RELEASE 1 SBIR/STTR

Department of Energy, Office of Science, Funding Opportunity DE-FOA-0001940, 2018

DOE supports high-quality R&D on innovative concepts concerning important mission-related scientific or engineering problems and opportunities that have high potential for commercialization. DOE's listed areas of interest include the following environmental topics: **(1) Increasing adoption of high performance computing (HPC) for energy and environment:** a. Turnkey HPC applications are needed that address challenges in subsurface science, technology, engineering, and environmental cleanup. b. Tools are needed in the areas of modeling and simulation, including software for managing, analyzing, and visualizing scientific data. Grant applications are specifically sought that will take a component or components of codes and "shrink wrap" them into tools that require a lower level of user expertise. **(2) Technologies for characterizing and monitoring complex subsurface systems, including the rhizosphere:** a. Greater understanding of plant-microbe-mineral interactions within the rhizosphere is needed to better understand and optimally manage vegetative systems, including biofuel crops. Innovative sensing technologies are desired. b. For real-time, in situ measurements of hydrobiogeochemical processes in complex subsurface systems, innovative fieldable technologies are needed for capturing the in situ functioning of complex subsurface systems from bedrock to the vegetative canopy. Important applications also include characterization and monitoring of contaminated soils and groundwater. The closing date for applications is October 15, 2018. For the complete list of interest areas for this funding round, look for "Phase I Release 1 Topics" on the DOE SBIR/STTR website at http://science.energy.gov/sbir/funding-opportunities/. ** http://www.grants.gov/web/grants/view-opportunity.html?oppId=308297

Cleanup News

CCP DEWATERING USING A HORIZONTAL WELL

Baeten, R.J., J.A. Zimdars, L. Tolokken, M. Lubrecht, and D. Christensen.
2017 World of Coal Ash (WOCA) Conference, May 9-11, Lexington, KY. 13 pp, 2017

A closed coal combustion product (CCP) landfill was constructed with a clay cap and a basal liner of clay and solidified CCP but with no provision for a leachate collection system. Over time, leachate accumulated over the basal liner and reached the top of the landfill embankment, allowing leachate to exit the landfill. To reduce the leachate head, a 643-ft horizontal well was installed by directionally drilling a pilot bore, followed by back-reaming the borehole and pulling in a pipe with a longitudinally slotted well screen. Design challenges included identifying a screen opening compatible with the CCP formation and pipe material compatible with the caustic leachate, and then designing a system with the strength to withstand installation forces and long-term compressive stress. Construction challenges included well screen fabrication, steep pipe entry and exit angles, tight pipe installation tolerances to maximize well depth and prevent damage to the basal liner, drilling to advance the bore through layers of varied CCP cementation, and extraction well development to maximize leachate extraction. The installed well drew down the leachate head level ~18 ft in < 4 months, and CCP-related constituents in groundwater adjacent to the landfill declined sharply to levels lower than those observed in the previous 3 years. http://www.flyash.info/2017/064-Baeten-woca2017p.pdf

RECENT EPA FACT SHEETS ON MINE SITE REVITALIZATION

- Reuse Alternatives for the Cochiti Gravel Mine: Cochiti Pueblo, New Mexico, EPA Region 6 - EPA 560-F-17-199 - https://www.epa.gov/land-revitalization/fact-sheet-reuse-alternatives-cochiti-gravel-mine
- Brownfields Success Story: A Former Coal Mine Springs to Life - Weirton, West Virginia - EPA 560-F-17-222 - https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100T6NV.txt
- Brownfields Success Story: The Past Is Prologue for Taylor Colliery, Taylor Borough, Pennsylvania - EPA 560-F-17-224 - https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100T6NW.txt

Demonstrations / Feasibility Studies

SAND COULEE ACID MINE DRAINAGE SOURCE CONTROL: ABANDONED MINE RECLAMATION PROJECT, CASCADE COUNTY, MONTANA

Montana Department of Environmental Quality (DEQ), Abandoned Mines Section, 144 pp, 2018

The abandoned mine workings in and around Sand Coulee act as groundwater drains that dewater the overlying Kootenai sandstone and discharge contaminated water to tributaries of Sand Coulee Creek. The acid mine drainage (AMD) is extremely acidic and contains numerous metals, including As, Cd, Cr, Fe, Mn, Ni, Tl, and Zn, at concentrations exceeding Montana DEQ standards. Pilot tests are planned of two methods of reducing flow into the abandoned coal mines: (1) drill horizontally to dewater the Kootenai upstream of the mine workings and discharge clean water to surface water bodies, and (2) drill vertically into the Kootenai aquifer and drain clean water into the lower Madison aquifer, thus reducing the drainage into the abandoned coal mines. The proposed mitigation is source control implemented by intercepting the groundwater in the Kootenai sandstone before it enters the mine workings. This report describes the investigation conducted to identify a location to pilot test a horizontal drainage well and assess the productivity of interception wells and potential reduction in the volume of AMD discharging from nearby mines. The recommendation is for installation of a single horizontal drainage well up to ~2,000 ft long and then installation and testing of one to three vertical drainage wells in a subsequent phase of work.
Slides: https://www.mtech.edu/mwtp/2018_presentations/thursday/David-Donohue-and-Tom-Henderson.pdf
Final Report: http://deq.mt.gov/Portals/112/Land/AbandonedMines/documents/ProjectDocuments/SandCoulee/SourceControlReportFinal.pdf
Appendices: http://deq.mt.gov/Portals/112/Land/AbandonedMines/documents/ProjectDocuments/SandCoulee/SourceControlReportAppendices.pdf

PREVENTING ACID ROCK DRAINAGE: CAN SOURCE CONTROL REALLY BE SUCCESSFUL?

Eger, P.
2017 National Meeting of the American Society of Mining and Reclamation, Morgantown, WV, 9-13 April. ASMR, Champaign, IL. 33 slides, 2017

While adding alkaline material to adjust neutralization potential has been demonstrated in the lab, large-scale implementation at mining sites generally has been ineffective. Borrowing an addition technique from the gold industry, a small pilot study was conducted at the Minnesota Department of Natural Resources Test Facility in Hibbing with an acid-producing Archean greenstone that had a sulfur content of 0.63% and an NP/AP ratio of 0.4. Magnesium-rich limestone (dolostone) was added to increase the NP/AP ratio. Two addition rates were used, which increased the NP/AP ratio to 1.4 and 3.4. After about 3 years the pH in the control tank dropped precipitously from ~7 to < 5.5 over the course of the summer. The pH continued to drop and currently appears relatively stable at ~4.0. In contrast, both treated tanks continue to have pH > 7 after 15 years of treatment.
https://www.asmr.us/Portals/0/Documents/Meetings/2017/04-17-Eger-Slides.pdf

FIELD INVESTIGATION OF IN SITU LIME NEUTRALIZATION OF ACIDIC SEDIMENT

Villinski, J.
Technical Program: The 12th International Symposium on Mining with Backfill, 19-22 February 2018, Denver, CO. 22 slides, 2018

Groundwater remediation using technologies such as pump-and-treat can lead to protracted remediation of aquifers impacted by acid mine drainage because solid-phase reactions impose kinetic limitations on the release of stored acidity and metals to groundwater. Estimates of the time required to remediate AMD-impacted aquifers can be many decades or longer. In situ alkali application is a potential alternative treatment to neutralize sediment acidity and sequester metals. A field-scale infiltration test was performed with a lime solution to evaluate the feasibility and ease of implementation of in situ neutralization of alluvial sediment affected by AMD. Implementation issues included efficiently mixing solutions near solubility limits, controlling solids formed when mixing lime with makeup water containing bicarbonate alkalinity, delivering the lime solution to the impacted sediment without clogging the application facility or affecting the aquifer formation, and transporting the lime alkalinity throughout the treatment volume. http://clearcreekassociates.com/wp-content/uploads/2017/03/Villinski-SME-2017-Presentation.pptx

CONSTRUCTED WETLAND DESIGN AND OPTIMIZATION FOR METAL AND METALLOID TREATMENT AT THE MINTO MINE IN THE YUKON, CANADA

Haakensen, M., V. Friesen, and R. Herbert.
Technical Program: The 12th International Symposium on Mining with Backfill, 19-22 February 2018, Denver, CO.

A 2-year site-specific demonstration of a constructed wetland treatment system was conducted for Capstone Mining Corporation's Minto Mine (Yukon). Biogeochemical technologies such as microbial community profiling were used to guide system design in a site-specific context. Pilot-scale tests enabled selection of the optimal full-scale demonstration design from several options and tested different predicted closure water chemistries. The selected design treats the water for Cd, Cu, and Se, with polishing achieved for several additional metals. Removal rate coefficients were developed for modeling and sizing of full-scale systems. *The Government of Yukon recognized the project with the 2017 Robert E. Leckie Award for responsible and innovative exploration and mining practices to Capstone subsidiary Minto Explorations Ltd. See the details of this demonstration project in the report,* Minto Mine Constructed Wetland Treatment Research Program: Demonstration-Scale 2017, *at* http://www.emr.gov.yk.ca/mining/pdf/mml-minto-rcp-v2018-01-appendix-a6.pdf.

RECLAMATION OF OHIO COAL MINE SITES USING FGD BYPRODUCTS: PHASE III DEMONSTRATION PROJECTS

Wolfe, W., T. Butalia, and C.-M. Cheng.
Ohio Coal Development Office, OOE-CDO-D-13-03, 288 pp + 384 pp Appendix, 2017

This study encompassed three full-scale demonstration projects: the Gavin Acid Mine Drainage (AMD) Remediation, Conesville Five Points, and Cardinal Star Ridge projects, conducted 2012-2016. The main objective was to demonstrate the potential of using high-volume flue gas desulfurization (FGD) materials and fly ash to improve the environmental quality, land use, and safety of disturbed mine lands. The Gavin project evaluated the effectiveness of mitigating AMD using fixated FGD material (a mixture of calcium sulfite FGD by-product, fly ash, and lime). The Conesville and Cardinal projects evaluated the environmental responses of using coal combustion residues, including FGD gypsum, fixated FGD material, and fly ash, in the reclamation of two

highwall pit complexes near the Conesville and Cardinal power plants. The high-volume beneficial uses of FGD materials in the three mine reclamation applications demonstrated in this study provide an economically feasible and environmentally viable alternative to landfill disposal.
Main report: https://ccp.osu.edu/sites/ccp.osu.edu/files/uploads/oge-cdo-d-13-03_final_report_ocdo_rev_0129.pdf
Appendices: https://ccp.osu.edu/sites/ccp.osu.edu/files/uploads/oge-cdo-d-13-03_final_report_appendices.pdf

Research

EFFECTS OF COMPOSTED BIOSOLIDS AND MANURE APPLICATIONS FOR PRAIRIE AND WETLAND RESTORATION ON REMEDIATED MINE LANDS: ORONOGO-DUENWEG MINING BELT SITE, WEBB CITY, MO

Nichols, J., S. Hamilton, D.E. Mosby, and E. Gramlich.
Missouri Dept. of Natural Resources/U.S. Fish and Wildlife Service, 136 pp, 2017

In a 2-year pilot study conducted to evaluate the potential environmental benefits and impacts of using composted manure products as a soil amendment on lead and zinc mine lands, different compost mixtures composed of cattle manure, poultry litter, municipal biosolids, wood chips, and conventional fertilizers were tested in both upland and wetland soils. Test plots established using the different compost mixtures were sampled to evaluate potential contaminants in stormwater runoff, changes in bioavailability and plant uptake of soil metals, and plant growth and diversity. Overall results of this study indicate that cattle manure-based composted soil amendments tended to perform better than the other amendments in terms of providing the best growth medium for the seeded native vegetation and producing relatively low levels of excess nutrients and metals in surface runoff. Few differences were observed in effects between the high (80 tons/acre) and low (40 tons/acre) application rates. The researchers concluded that application rates, within the range tested, could be scaled according to site-specific soil conditions without a significant increase in potential negative environmental impacts. https://dnr.mo.gov/env/hwp/sfund/docs/compostpilotstudyfinalreport.pdf

DEVELOPING TREES TOLERANT TO DEGRADED MINE SOILS IN AN UNDERGROUND GREENHOUSE

Opoku-Ware, C., P. Conrad, and M. Kukay.
Abstracts of the 2018 Society for Mining, Metallurgy & Exploration Annual Conference & Expo, 25-28 February, Minneapolis, MN.

Montana Tech is exploring the potential for developing trees that are tolerant of degraded, unreclaimed mine site soils and tailings as a solution for re-establishing long-term tree growth on those sites. The project incorporates growing tree seedlings in underground greenhouse beds containing degraded mine soils from the site to which they will be transplanted. The underground location maintains a constant temperature year-round and insulates the young seedlings from inclement weather. It is believed that the project will lead to a successful solution for re-establishing tree growth in soils containing high metal concentrations in arid environments with minimal human intervention. The project is being conducted in the Underground Mine Education Center (the old Orphan Boy Mine), an underground greenhouse/tree farm located 100 ft bgs at the Montana Tech campus. *See more about this project in Opoku-Ware's thesis at* https://digitalcommons.mtech.edu/grad_rsch/162/.

PHYTOREMEDIATION OF INDUSTRIAL MINES WASTEWATER USING WATER HYACINTH

Saha, P., O. Shinde, and S. Sarkar.
International Journal of Phytoremediation 19(1):87-96(2017)

For the Sukinda chromite mines area of Orissa, India, research is underway to develop a suitable phytoremediation technology for effective removal of Cr(VI) from mine wastewater using a water hyacinth species (*Eichhornia crassipes*). This plant was observed to remove 99.5% Cr(VI) of the processed water in 15 days, not only removing Cr(VI) but also reducing total dissolved solids, biological oxygen demand, chemical oxygen demand, and other elements of water. After an initial 5-L study, the same removal efficiency was achieved in a larger experiment performed using 100 L of mine wastewater. *This paper is* ***Open Access*** *at* https://www.tandfonline.com/doi/full/10.1080/15226514.2016.1216078.
Although water hyacinth is a problematic invasive species in the United States and other countries, researchers nonetheless are studying the potential for using its fast-growing, metal hyperaccumulating properties for water remediation under controlled conditions. See more at https://theconversation.com/invasive-tropical-plant-removed-metal-pollutants-from-british-river-new-study-100403.

FLOATING WETLAND TREATMENT OF ACID MINE DRAINAGE USING *EICHHORNIA CRASSIPES* (WATER HYACINTH)

Palihakkara, C.R., S. Dassanayake, C. Jayawardena, and I.P. Senanayake.
Journal of Health and Pollution 8(17):14-19(2018)

The applicability of water hyacinth (*Eichhornia crassipes*), a tropical aquatic plant with reported heavy metal hyperaccumulation, was investigated in microcosm floating wetland treatment systems designed to remediate acid mine drainage with Cu and Cd concentrations exceeding threshold limits. Water hyacinth demonstrated the capability to reduce both Cu and Cd concentrations, except at an initial concentration of 4 mg/L of Cu, which was toxic to the plants; at 4 mg/L the plants had low metals accumulations and rapid dying was evident. *This paper is* ***Open Access*** *at* http://www.journalhealthpollution.org/doi/abs/10.5696/2156-9614-8.17.14?code=hsie-site.

THE RELATIONSHIP BETWEEN SITE CONTAMINATION AND NATIVE PLANT SUCCESS IN BUTTE, MT: IMPLICATIONS FOR FUTURE RESTORATION

Trilling, J., D. Nagy, and R. Pal.
Butte Natural Resource Damage Restoration Council (BNRC), 33 pp, 2018

Plant-contaminant relationships were studied to guide restoration planting decisions in areas around Butte, Montana, affected by decades of mining operations. Many plant species have colonized this contaminated environment spontaneously. Transect sampling showed that pH had the most significant inhibitory effect on plant establishment, followed by Zn, while random sampling indicated Cu and Pb to be most influential in retarding coverage in plant islands. Within vegetation islands, heavy metals were negatively associated with plant community composition. Increasing Cu (and to a lesser extent Pb) concentrations were strongly correlated with increasing invasive species cover, richness, and diversity, and those elements were negatively correlated with native species richness. This paper identifies native species tolerant of a range of contaminants for use in restoration. Direct planting or seeding of these species in metal-contaminated soils could be used as a low-cost way of stabilizing contaminants where full restoration of native plant communities is not feasible. https://digitalcommons.mtech.edu/grad_rsch/150/

URANIUM MINE WASTE PHYTOSTABILIZATION WITH NATIVE PLANTS: A CASE STUDY FROM BRAZIL

Alves, L.J., F.C. Nunes, M.N.V. Prasad, P.A.O. Mangabeira, E. Gross, D.M. Loureiro, H.H.S. Medrado, and P.S.F. Bomfim.
Bio-Geotechnologies for Mine Site Rehabilitation, Elsevier Inc. ISBN: 978-0-12-812986-9, Chapter 17:299-322(2018)

This chapter presents the different techniques applied over the course of 14 years to the rehabilitation of a uranium mine in a semiarid climate with semiarid thorny scrub vegetation (Caatinga biome) in Brazil. The main rehabilitation strategies employed were the use of engineered blankets composed of plant fibers, the prospection of native grass species adapted to long periods of drought, and the use of legume species.

RECLAMATION OF FOREST ECOSYSTEMS IN POSTMINING SITES IN THE CZECH REPUBLIC AND ITS COMPARISON WITH UNASSISTED ECOSYSTEM DEVELOPMENT

Frouz, J.
Bio-Geotechnologies for Mine Site Rehabilitation, Elsevier Inc. ISBN: 978-0-12-812986-9, Chapter 19:335-346(2018)

A case study is presented of ecosystem development in the Sokolov postmining district (Czech Republic) in which a variety of reclamation approaches were compared with spontaneous (natural) succession of the postmining sites. In suitable substrates the succession was driven mainly by site topography. In sites that were leveled, grassy vegetation developed. In sites where original wavelike topography was preserved, the ecosystem developed toward forest. In forest sites the development on most ecosystem parameters in succession sites was a little slower in comparison with those of reclaimed plantations during the first 15-20 years; however, the differences disappeared in older sites.

BIOLOGICAL LEACHING OF METAL CONTAMINATED SUBSTRATES FROM A PASSIVE BIOREACTOR TREATING MINE DRAINAGE

Bailey, M.T.
Environmental Science: Water Research & Technology 4(5):739-749(2018)

In a proof-of-concept study, acid mine drainage (AMD) was used to leach metals (Zn, Cd, Ni, Mn, Fe, Pb, Cu) from a metal-contaminated passive treatment system substrate taken from a sulfate-reducing bioreactor treating AMD at another site. The substrate was too heavily contaminated with metals for landfill disposal under UK regulations. Lab-scale batch leaching experiments were conducted under aerobic conditions to harness microbial sulfur oxidation to generate sulfuric acid and remobilize metals. AMD, normally considered an environmental liability, was used as a microbial inoculum and leach solution for the experiments, with added zero-valent sulfur as a supplementary nutrient source for sulfur-oxidizing bacteria. The initial reactor pH of 4.0 decreased to ≤ 2.8 in inoculated reactors, whereas the final pH of the sterile controls was 4.1. Metals data showed removal efficiencies of 71-100% for Zn, Cd, Ni, and Mn in inoculated reactors upon completion of the 1,600 hour leach period.

ACID ROCK DRAINAGE OR NOT—OXIDATIVE VS. REDUCTIVE BIOFILMS—A MICROBIAL QUESTION

Kalin, M., W.N. Wheeler, and S. Bellenberg.
Minerals 8(5):199(2018)

Measures to counteract acid rock drainage (ARD) generation can start at the mineral surface to inhibit mineral-oxidizing, acidophilic microbes. Lab and long-term field tests with pyrite-containing mining wastes resulted in low acidity and nearly neutral drainage when carbonaceous phosphate mining waste (CPMW) was added. The effect was reproducible and confirmed by several independent research groups. The improved drainage was shown to involve an organic coating, likely a biofilm. The biofilm formation was confirmed when CPMW was added to lignite coal waste with an initial pH of 1. The coal waste was dominated by heterotrophic microorganisms in biofilms at 45 days after CPMW addition. This paper contains a review of scientific literature that provides ample support that CPMW has physical and chemical characteristics that can induce a strong inhibitory effect on sulfide oxidation by triggering the formation of an organic coating, a biofilm, over the mineral surface. *This paper is* ***Open Access*** *at* http://www.mdpi.com/2075-163X/8/5/199/htm.

SURVEYOR IN THE SKY: USING VERY HIGH-RESOLUTION DRONE-COLLECTED DATA TO MONITOR ECOLOGICAL RESTORATION

Koenemann, G.J., T.J. Minnick, A. Langton, and R. Alward.
2018 National Meeting of the American Society of Mining and Reclamation, June 2-7, St. Louis, MO. 30 slides, 2018

Investigators estimated vegetation cover and species composition on seven reclaimed well pads and two reference sites in Rio Blanco County, Colorado, using standard line-point-intercept (LPI) techniques and then compared the results to those obtained using a 5-band multi-spectral camera with sub-meter resolution obtained via drone platform fly-over of the same sites. Pixel-based supervised classification of the resulting multi-spectral imagery allowed for more accurate estimation of the herbaceous, shrub, and tree composition of the well pads compared to the LPI method. Several woody species were reliably identifiable from the imagery. Results indicate that remote sensing techniques can provide land managers with an effective and more cost-efficient alternative to ground-based monitoring with the advantage of easy scale-up to landscape level.
Longer abstract: https://www.asmr.us/Portals/0/Documents/Meetings/2018/Koenemann-CO-Abstract.pdf
Slides: https://www.asmr.us/Portals/0/Documents/Meetings/2018/3A-930-Grayson.pdf

WATER QUALITY PREDICTION OF MINING WASTE FACILITIES BASED ON PREDICTIVE MODELS

Muniruzzaman, M., P.M. Kauppila, and T. Karlsson.
Geological Survey of Finland, Open File Research Report 16/2018, 65 pp, 2018

This report reviews major processes that influence drainage quality in mine waste dumps; existing water quality prediction methods based on lab and field scale tests; and available predictive modeling tools. The scope and capability of predictive models is demonstrated in three published case studies focusing on waste rock pile and tailings systems. In addition to a review of

methods from the literature, this report also focuses on potential approaches to enhance prediction accuracy by using integrated methodologies to describe the multifaceted processes occurring in mine wastes. http://tupa.gtk.fi/raportti/arkisto/16_2018.pdf

USE OF PHYTOPRODUCTIVITY DATA IN THE CHOICE OF NATIVE PLANT SPECIES TO RESTORE A DEGRADED COAL MINING SITE AMENDED WITH A STABILIZED INDUSTRIAL ORGANIC SLUDGE

Chiochetta, C.G., H. Toumi, R.F.S. Boehm, F. Engel, G. Poyer-Radetski, L.R. Roerig, F. Adani, and C.M. Radetski.
Environmental Science and Pollution Research 24(31):24624-24633(2017)

The content of P and N nutrients, together with stabilized organic matter, makes stabilized industrial organic sludge an excellent fertilizer and soil conditioner, fostering biota colonization and succession in the degraded site. Choice of native plant species to restore a degraded site, however, must be guided by criteria such as plant survival/adaptation and plant biomass productivity. In a 3-month study under environmental conditions, phytoproductivity tests with five plant species native to Brazil were performed to assess these criteria, and additional biochemical parameters were measured in plant tissues (i.e., protein content and peroxidase activity) exposed to different soil/sludge mixture proportions. Three native plants displayed adequate performance for restoring vegetation on degraded sites: Surinam cherry, *Citharexylum myrianthum*, and Brazilian peppertree. Results demonstrate that phytoproductivity tests associated with biochemical endpoint measurements can help in the selection of native plant species, as well as aid the choice of the most appropriate soil/stabilized sludge proportion to optimize biomass production.

THE EFFECT OF ELECTRO-ACTIVATION AND EGGSHELL POWDER ON THE NEUTRALIZATION OF ACID MINE DRAINAGE

Kastyuchik, A., A. Karam, and M. Aider.
Journal of Sustainable Mining 16(3):73-82(2017)

Acid neutralization and the precipitation of metals present in acid mine drainage (AMD) were carried out by electro-activation with ion-exchange membranes, which is based on the self-generation of necessary conditions for acid neutralization and metal precipitation. The treatment of sulfide mine tailings (SMT) was carried out using an electro-activation cell-generated alkaline solution in the cathode compartment. After 60 min of electro-activation, a catholyte of 7.9-9.6 (depending on the experimental conditions) was obtained. The absence of Fe and other trace metal ions in the catholyte provide evidence that SMT electro-activation promotes the precipitation of insoluble trace metals in the cathode compartment. This approach can be applied to real conditions in combination with a pretreatment of SMT neutralization using biological calcareous amendments, such as eggshell powder. *This paper is* ***Open Access*** *at* https://www.sciencedirect.com/science/article/pii/S2300396017300617.

MEMBRANE TECHNOLOGY APPLIED TO ACID MINE DRAINAGE FROM COPPER MINING

Ambiado, K., C. Bustos, A. Schwarz, and R. Borquez.
Water Science and Technology 75(3):705-715(2017)

The performance of two commercial spiral-wound membranes—NF99 and RO98pHt (Alfa Laval)—was compared in an evaluation of pilot-scale treatment by nanofiltration (NF) and reverse osmosis (RO) of high-strength acid mine drainage (AMD) from copper mining. Results showed high ion removal under optimum pressure conditions, which reached 92% for the NF99 membrane and 98% for the RO98pHt membrane. Sulfate removal reached 97% and 99% for NF99 and RO98pHt, respectively. Removal percentage for Cu, Al, Fe, and Mn surpassed 95% in both membranes. Although concentration polarization limited NF performance at higher pressures, permeate fluxes observed in NF were five times greater than those obtained by RO, with only slightly lower divalent ion rejection rates.

MINE TAILING DISPOSAL SITES: CONTAMINATION PROBLEMS, REMEDIAL OPTIONS AND PHYTOCAPS FOR SUSTAINABLE REMEDIATION

Karaca, O., C. Cameselle, and K.R. Reddy.
Reviews in Environmental Science and Bio/Technology 17(1):205-228(2018)

This review examines the use of phytocapping for the remediation of mine tailing deposits and abandoned mine areas. Phytocapping is a cost-effective technique that provides erosion control, landscape rehabilitation, improvement of soil properties for further colonization by more demanding vegetal species, reduction of metals leachability toward groundwater, and metals stabilization or immobilization. The most critical step in phytocapping is development of the initial vegetative cover because of the biotoxicity of the mine soil and mine tailings. Several amendment materials can be used to ameliorate soil conditions, serve as a source of nutrients, and create a favorable environment for plants to take root. Local fast-growing plant species are preferred because their adaptation to the soil and climate conditions favors their self-propagation.

A COMPARATIVE SOIL UTILITY REPORT FOR THE TROY MINE TAILINGS STORAGE FACILITY, MONTANA

Montana Department of Environmental Quality, 14 pp, 2017

An evaluation was conducted of the utility of an 8-inch soil cover versus an 18-inch soil cover in restoring vegetation on the Troy Mine tailings storage facility. The investigators concluded that similarities between the native soil, stockpiled soil, and tailings material are such that 8 inches of soil cover will provide the necessary nutrients and ecologic soil-habitat to facilitate regrowth of the planned revegetation species toward a trend of succession and wildlife habitat similar to the surrounding undisturbed forest conditions.
https://deq.mt.gov/Portals/112/Land/Hardrock/Active%20Amendments/Troy%20Mine%20Amendment%20006/TroyMine_Amend006_ComparativeSoilUtilityReport.pdf

THE MNDRIVE TRANSDISCIPLINARY PROJECT IMPLEMENTATION OF SMART BIOREMEDIATION TECHNOLOGY TO REDUCE SULFATE CONCENTRATIONS IN NE MINNESOTA WATERSHEDS

Hudak, G., L. Estepp, and P. Schoff.
University of Minnesota Duluth, Natural Resources Research Institute. NRRI/TR-2017/17, 155 pp, 2017

This MnDRIVE-supported project continues a long-running set of experiments to address issues associated with mining-impacted waters. Results to date show both promise and challenges for floating sulfate-reducing bacterial bioreactors as currently configured. Functional tests show that the bioremediation process can decrease aqueous sulfate concentrations in water substantially. The potential advantages of this bioremediation system include low power demand that can be satisfied by on-site solar photovoltaic panels, year-round operation with minimal need for human intervention, reasonable capital costs, low operating costs, and minimal waste production. In addition, the bioreactors used in this study are extremely flexible and adaptable; they have been designed as interchangeable modules that can operate in series or in parallel and will accommodate changes in flow rate. The bioreactor platform might be most useful as a preliminary stage to reduce sulfate concentrations in water prior to treatment by conventional energy- and material-intensive methods, such as reverse osmosis or ion exchange, both of which have limited efficiency in high-sulfate environments. The bacterially mediated reduction in sulfate could substantially decrease the burden on those more expensive systems and thus increase the cost-effectiveness of the remediation system as a whole. http://hdl.handle.net/11299/190404 *See more information on the problem of mining-related sulfate generation in Minnesota in a series of reports at*https://www.dnr.state.mn.us/lands_minerals/dnr_so4_research.html.

General News

MAKING ABANDONED MINE LANDS (AML) PROFITABLE: WORKSHOP PROCEEDINGS AND ABSTRACTS

McLemore, V.T. and B. Frey (eds).
New Mexico Bureau of Geology and Mineral Resources Open-File Report 597, 58 pp, 2018

Sponsored by the New Mexico Bureau of Geology and Mineral Resources, the workshop was held March 27-28, 2018, in Socorro, New Mexico. The purpose of the workshop was to examine the feasibility of combining mine reclamation (not limited to uranium mines) with potential recovery of critical minerals and other commodities. Participants included industry and government experts. The goal of the meeting was to identify (1) mine waste features that can be used to extract critical minerals or other material essential to the U.S. economy and security; (2) other potential technologies that can be developed for using mine waste; (3) hazards, especially those that can be removed or mitigated through profitable activities; and (4) funding sources for research in these areas.https://geoinfo.nmt.edu/publications/openfile/downloads/500-599/597/OFR-597.pdf || See the presentations and posters at https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=597.

A PROTOCOL FOR RECLAIMING IN-PIT TAILINGS PONDS TO EXCEED FEDERAL AND STATE REGULATIONS

Seifert, J., P. Conrad, C. Smith, S. Rosenthal, and L. Hunter.
Abstracts of the 2018 Society for Mining, Metallurgy & Exploration Annual Conference & Expo, 25-28 February, Minneapolis, MN.

The protocol for reclaiming in-pit tailings ponds describes a series of steps that can be followed to design, operate, and reclaim a tailings disposal pond in a warm, dry climate. By incorporating a wetland into the reclamation design, post mining land use gives wildlife a source of water while providing for a variety of uses, including but not limited to livestock grazing and other ranching activities. An example design was completed to demonstrate how implementing the protocol can result in a well-designed reclaimed tailings disposal pond. *A copy of the protocol is available at* https://digitalcommons.mtech.edu/grad_rsch/100/.

IN SITU ANALYTICAL CHARACTERIZATION OF CONTAMINATED SITES USING NUCLEAR SPECTROMETRY TECHNIQUES: REVIEW OF METHODOLOGIES AND MEASUREMENTS

International Atomic Energy Agency, Vienna. IAEA Analytical Quality in Nuclear Applications Series No. 49, 206 pp, 2017

This publication presents a comprehensive review of the in situ gamma ray spectrometry and field-portable X-ray fluorescence analysis techniques for the characterization of sites contaminated with metals and radionuclides. Diverse authors from IAEA member states contributed papers on the use of these techniques, which provide useful background information for conducting similar studies. http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/49/023/49023168.pdf

FASTTIMES SPECIAL ISSUE ON MINE-SITE GEOPHYSICS

The June 2018 issue (Vol. 23, No. 2) of FastTIMES was developed as a special issue featuring 10 technical articles on mine site and mining geophysics and one article on archaeological geophysics. The June issue also introduced a regular Mining Geophysics News column to continue to engage with the mining sector. Mine site geophysics applications provide by far the widest range of applications of near-surface geophysics of any sector in which those methods are applied. The June issue is available with other recent issues at http://www.eegs.org/latest-issue.

USE OF PROJECT MANAGEMENT APPROACH FOR PLANNING OF DECOMMISSIONING ACTIVITIES OF A URANIUM MINING SITE

Ribeiro, S.F.Q., R.F. Lage, D.E. Gomes, and I. Ogawa.
INAC 2017: 2017 International Nuclear Atlantic Conference, 22-27 October, Belo Horizonte, MG, Brazil. 16 pp, 2017

This work describes the management plan and strategy adopted for execution of decommissioning and environmental remediation activities for the first uranium mine in Brazil, located in the State of Minas Gerais. All the economically recoverable uranium was extracted during facility operations between 1982 and 1995. Mining is no longer underway; only research and laboratory activities are ongoing at the site. These activities are related to studies of acid drainage, dam safety, adequacy of CAKE II storage conditions, and request for operating licenses and authorization for decommissioning activities. The conceptual plans for decommissioning and remediation for this unit were prepared and emergency activities were recommended.
http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/49/009/49009660.pdf

ASSESSING RISKS OF MINE TAILING DAM FAILURES

Larrauri, P.C. and U. Lall.

Columbia Water Center: An interim report for a research project sponsored by Norges Bank Investment Management, 32 pp, 2017

This paper reviews historical tailings dam failures, failure mechanisms, and current design and risk assessment practices. A methodology for performing a qualitative assessment of tailings dam risk exposure considers dam attributes and characteristics of the area downstream to obtain a hazard rating index (H_R).The calculation of H_R does not need very detailed information and can be estimated for multiple dams simultaneously, providing for a rapid assessment of potential damages that can be updated overtime. H_R can be used as a guide to assess potential risks to downstream communities as part of a strategy for elicitation of potential financial risk information for investors; it is not, however, a substitute for formal inundation analyses. An illustrative test case of H_R calculation is based on 179 tailings dams located in Minas Gerais, Brazil. http://water.columbia.edu/files/2017/12/TSF-paper-CWCrev.pdf

'HARD ROCK' STANDARD REFERENCE MATERIAL MAKES IDENTIFYING CHEMICALS IN MINE WASTE EASIER

National Institute of Science and Technology (NIST), 20 Mar 2018

Scientists generally use standard reference materials (SRMs) to validate the accuracy of results from their analytical methods—typically a spectrometer calibrated to determine chemical composition. An updated SRM released by NIST helps to evaluate the environmental challenges posed by old mining waste piles. SRM 2780a contains powdered waste from three hard rock mine piles near the former mining boom town of Silverton, Colorado. SRM 2780a provides certified values for 35 elements from aluminum to zirconium that are commonly found in the waste rock material—double the number of certified elements that were in its popular predecessor SRM 2780. SRM 2780a also provides values for all but one of the 15 rare earth elements in the lanthanide series. Environmental researchers can use SRM 2780a to learn the contents of hard rock mine waste to determine potential health hazards and prioritize remediation plans.
https://www.nist.gov/news-events/news/2018/03/hard-rock-standard-reference-material-makes-identifying-chemicals-mine

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