Technology Innovation News Survey

Entries for November 16-30, 2019

Market/Commercialization Information

RARE EARTH ELEMENT RECOVERY: INL TECHNOLOGIES FOR LICENSING

Battelle Energy Alliance LLC for U.S. DOE, Idaho National Laboratory.
Contract Opportunities from Beta.Sam.gov, Solicitations BA-947 & BA-975, 2019

Idaho National Laboratory is offering the opportunity to enter into a license and/or collaborative research agreement to commercialize two new rare earth element (REE) recovery technologies [NAICS code: 56292 - Materials Recovery].
•BA-947. Engineered Microbes for Rare Earth Element Adsorption: This process is a novel bioengineering strategy in Caulobacter crescentus to achieve one-step separation of REEs from other co-contaminated ions in solution. The process can be applied to the geothermal and mining industries and to metal recycling. Expressions of interest are due by 11:00 AM ET on March 4, 2020.https://beta.sam.gov/opp/0d85cba527de48f3b2a121a8b525afff/view
•BA-975. Rare Earth Metal Recovery: Researchers at INL have developed a new ionic liquid-based REE recovery process that overcomes the limitations of poor metal solubility and high viscosity associated with current technologies. The applications of this technology include rare earth metal production, recovering rare earth metals from mine tailings, and the recycling of magnets. Expressions of interest are due by 11:00 AM ET on March 5, 2020.
https://beta.sam.gov/opp/5d96cd1693914ccb97ca9109bdae3660/view

RILEY PASS URANIUM MINES CERCLA PROJECT BLUFF: A RESPONSE ACTION

Department of Agriculture, Forest Service, R-1 Northern Region, SD.
Contract Opportunities from Beta.Sam.gov, Solicitation 12035520R0001, 2019

The Custer Gallatin National Forest is conducting a removal action as part of the Riley Pass Uranium Mines CERCLA response action in Harding County, South Dakota. The Riley Pass site comprises several abandoned uranium mines with elevated levels of heavy metals and radioactive isotopes. The work involves excavating and moving ~20,000 CY of contaminated mine waste to a designated consolidation area, regrading excavated areas, and placing 15,000 CY of soil cover over the consolidated waste and removal areas. Erosion control, dust control, soil amendments, and revegetation are part of the contract requirements. The work will be performed under the Forest Service's CERCLA authority, and all personnel must have current 40-hr HAZWOPER certification. https://beta.sam.gov/opp/6ba4e58d50e5fb726be8883c13e9418/view

STRATEGIC ENVIRONMENTAL ENTERPRISE RESOURCES (SEER)

U.S. Army Corps of Engineers, W2V6 USA Engineering Support Center, Huntsville, AL.
Contract Opportunities from Beta.Sam.gov, Solicitation W912DY-20-R-0016, 2019

The Government is conducting market research to identify qualified sources under NAICS code 562910 (Environmental Remediation, small business size standard 750 employees) to support work assigned to the U.S. Army Corps of Engineers for DERP, FUDS, and MMR work for various DoD customers, including conventional munitions, chemical warfare materiel, biological warfare materiel, and other munitions-related services; DoD Environmental Compliance and Environmental Support for Others; support to U.S. EPA, including Superfund and Brownfield Programs; FUSRAP; environmental cleanup for other military and interagency customers; environmental stewardship; and other environmental related regulatory programs. The program capacity shared by all awarded contracts will be about $249M for a 2-year base and three one-year options. The Government will host an Industry Day from 1:00 to 4:00 PM CT on January 15, 2020, via Facebook Live/teleconference at https://www.facebook.com/HuntsvilleCenter. To take part, register by 1:00 PM CT on January 9, 2020 at https://www.eventbrite.com/e/strategic-environmental-enterprise-resources-seer-industry-day-tickets-85995439675?aff=ehdsshdestsearch. Interested are invited to respond to the Capability Questionnaire attached to the sources sought notice. Responses must be received by 2:00 PM CT on Thursday, January 30, 2020. https://beta.sam.gov/opp/ae37520aa9da48194f2d6394e5e02ee/view

USACE SACRAMENTO DISTRICT MEGA MATOC

U.S. Army Engineer District, Sacramento, CA.
Contract Opportunities on Beta.Sam.gov, Solicitation W91238-20-S-2078, 2019

This pre-solicitation notice regarding the upcoming Multiple Environmental Government Acquisition (MEGA) Multiple-Award Task Order Contracts (MATOC) by the USACE Sacramento District (SPK) is issued to provide DRAFT performance work statements as background to the forthcoming procurement. SPK invites comments and questions about these documents to be submitted through ProjNet by or before January 31, 2020, under ProjNet posting number:bidder inquiry key W91238-20-S-2078: HRRHB4-QCKNXT. The solicitation will be issued on an unrestricted basis. FUDS Fort Douglas will be the seed task order at time of MEGA award. https://beta.sam.gov/opp/e7e66afa1b7945c39151ac015fa845a9/view

Cleanup News

EVALUATION AND REDESIGN OF WETLAND/ALD PASSIVE SYSTEM IN NORTH FORK OF THE BLACKWATER RIVER, WV

Hedin, B., K. Linnell, G. Watzlaf, N. Anderson, and J. Skousen. | 2019 West Virginia Mine Drainage Task Force Symposium, 26-27 March, Morgantown, WV, 67 slides, 2019

The North Fork of the Blackwater River near Thomas, West Virginia is impacted by acid mine water flowing from the M29 portal out of the Coketon Mine Pool. In 1993, a portion of the flow was diverted to a passive treatment system that consisted of a series of wetland cells followed by an anoxic limestone drain (ALD) that was covered with a constructed wetland. In 1995, the performance declined substantially. Sampling since 2011 showed little difference between the influent and effluent chemistry of the system. The 2018 redesign of the passive treatment system considered current concentrations, which were 75% lower than in 1993. The condition of the limestone aggregate was investigated by excavating a pit into the ALD. Most of the limestone was clean, suggesting that the failure of the passive system was due to plugged flow paths, not armoring of the stone. A passive treatment plan was developed that includes drainable limestone beds, arranged in parallel, that discharge to a settling/polishing pond. The presentation describes the original treatment system, presents sampling data generated over the last 25 years, shows the results of the limestone investigation, and presents the current passive treatment redesign concept. https://wvmdtaskforce.files.wordpress.com/2019/03/2019-0800-hedin-skousen-wald-douglas-task-force-2019.pdf

DESIGNING FOR SUCCESS: APPLYING ECOLOGICAL CRITERIA TO RESTORATION AT BHP BEENUP, AUSTRALIA

Meney, K. and L. Pantelic. | Proceedings of the 13th International Conference on Mine Closure Volume 1:185-198(2019)

Operations at the former BHP Beenup titanium minerals operation significantly modified the landscape. This, combined with limited knowledge of the recruitment biology of many of the plant species, created uncertainty about the feasibility of restoring the site to near-natural communities. The closure process consisted of a novel planning approach using a designed-based philosophy informed by risk assessment and assessment of restoration success using ecological completion criteria. Regional ecosystems were surveyed in detail to characterize the soils, hydrology, and vegetation of each major feature. Deep pools created by dredging were modified into lakes via void infilling, and extensive shallow shorelines were created to generate a more naturalistic final shape. The focus on ecosystem design enabled revegetation to be tailored to the specific vegetation communities that best matched the reconstructed landforms to reduce seed wastage and increase the probability of success. A detailed and prescriptive set of restoration and completion criteria were developed to enable a greater certainty of outcomes and enabled quantitative measurements of restoration success. The incorporation of sustainability and resilience were applied to guide both the approach to restoration and to the measurement of success. Fifteen years after restoration, 15 ecological communities and more than 251 plant species have been successfully restored, including many conservation-listed species. The project achieved regulatory sign-off against rehabilitation completion criteria in 2018 and is one of the few ecologically designed post-mining landscapes globally. *This article is* ***Open Access*** *at*https://papers.acg.uwa.edu.au/p/1915_16_Meney/

BELT-THE CREEK THAT COAL KILLED. BELT WATER TREATMENT PLANT

Snoddy, B. and C. McCoy. | Mine Design, Operations, and Closure Conference, 7-9 May, Butte, MT, 36 slides, 2019

Abandoned coal mines that operated from 1877-1963 discharge approximately 250 acre-ft of contaminated water to Belt Creek each year. The discharges account for much of the flow in Belt Creek during base flow conditions from the late summer through early spring each year. On average, ~700 lbs of iron and 500 lbs of aluminum are discharged each day. Lower Belt Creek was identified as an impaired water body not fully supporting its beneficial uses. The coal mines around Belt were identified as the top priority for treatment due to the proximity of the community and the resource value of Belt Creek. A 2016 technology evaluation led to the decision to construct a collection system to capture the mine water at the individual discharge points and convey the water to a water treatment facility east of the Belt Anaconda Mine near South 5th Street. This presentation covers an overview of the Belt mines and explains the process design for the treatment plant, which included pumping test evaluation, slug testing, geotechnical studies, risk elimination in the water treatment plant, and equipment sizing. https://www.mtech.edu/mwtp/2019_presentations/tuesday/Bill-Snoddy-Colin-McCoy.pdf
More information on the Belt Water Treatment Project: https://deq.mt.gov/Land/abandonedmines/currentprojects/belt

RECOVERY OF RARE EARTH ELEMENTS FROM ACID MINE DRAINAGE USING GEOTEXTILE TUBE CONTAINMENT AND DEWATERING TECHNOLOGY

Stephens, T. | 10th International Conference on the Remediation and Management of Contaminated Sediments, 11-14 February, New Orleans, Louisiana, 25 slides, 2019

A multi-year pilot study was conducted using geotextile tubes to contain and dewater acid mine drainage (AMD) high-water content slurry so that rare earth elements (REEs) could be recovered. A total of 814 AMD samples were collected from 140 sites in four states. Both untreated raw AMD and solid precipitated AMD sludge were analyzed. A full-scale geotextile tube dewatering and containment operation was installed at one site to facilitate capture of 100% of the sludge generated that contained high concentrations of REEs. The methodologies incorporated and phases of the pilot project are presented to create the proof-of-concept. The presentation details how the pilot project was scaled to a production facility for economical capture of REE at an abandoned mine site. It also covers the cost of the operation, the economic feasibility, and the long-term positive economic opportunity for the Appalachia region that is offered by the application of the REE recovery. https://www.battelle.org/docs/default-source/conference-proceedings/2019-sediments-conference-proceedings/h2_beneficial-use-of-contaminated-sediments/h7_1415_-8_stephens.pdf?sfvrsn=63842dfe_2 *More Information:* https://geosyntheticsmagazine.com/2019/10/01/recovery-of-rare-earth-elements-from-acid-mine-drainage-using-geotextile-tubes/ *To read more on West Virginia University's Rare Earth Extraction Facility:* https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=AC6480D2-9A7E-4160-BE77-086CC84C7489

Demonstrations / Feasibility Studies

TREATMENT AND REHABILITATION OF ACIDIC WASTE ROCK AND TAILINGS - A 14 YEAR CASE STUDY

Castro, J.M. | Mine Design, Operations, and Closure Conference, 7-9 May, Butte, MT, 41 slides, 2019

A three-part treatment and revegetation program was implemented at the Mount Carrington mine site in Australia from 2000-2013. Program #1 involved the rehabilitation of acidic waste rock in three treatment areas by amendment with lime and biosolids, capping with clay and topsoil, and the addition of Bauxsol (Terra B) reagent. Each area was planted with native trees, and tree growth was monitored. Program #2 evaluated variations of Terra B treatment. Program #3 treated exposed tailings beach with Terra B. Results suggesting the effectiveness of Terra B in promoting reclamation of acidic waste rock are presented. https://www.mtech.edu/mwtp/2019_presentations/wednesday/Jim-Castro.pdf

BIOLOGICAL MANGANESE REMOVAL FROM MINE DRAINAGE IN A FIXED-BED BIOREACTOR AT PILOT SCALE

Jacob, J., I. Raignault, F. Battaglia-Brunet, C. Mailhan-Muxi, J. Engevin, and M. Djemil.
Proceedings of the 13th International Conference on Mine Closure Volume 1:911-920(2019)

The closed underground fluorspar Burg mine produces mine drainage with a pH of 6.3 and high concentrations of iron (14 mg/L) and manganese (12 mg/L) at an average flow rate of 27 m^3/h. A passive water treatment is being developed to replace the current lime treatment with a technology that is more environmentally friendly and economical and produces less sludge. The pilot consists of a 1 m 3 settling tank to precipitate iron followed by an up-flow, 1 m3 fixed-bed bioreactor. The bioreactor is filled with a mixture of limestone and pyrolusite and supplied with air to precipitate manganese. Residence time ranged from 20-50 h. Results indicated that maximum removal rates were 99% for both iron and manganese and concentrations were below the 1 mg/L standard. Iron removal rate in the settling tank ranged from 80-160 µg/L/h. Manganese removal rate in the bioreactor ranged from 130-350 µg/L/h. Surprisingly, up to 38% of the manganese was removed in the settling tank at low residence time. Residence time and aeration rate are still being optimized, and clogging is being assessed. The pilot has been operating for 6 months and will continue to operate for another 6 months. https://hal-brgm.archives-ouvertes.fr/hal-02146705/document

REMOVAL OF EXCESS GASEOUS AND AQUEOUS SULFIDE FROM VERTICAL FLOW BIOREACTOR EFFLUENT USING ACTIVATED CARBON AND SOLAR-POWERED BLOWERS

Nairn, R.W., and T. Wall | 2019 West Virginia Mine Drainage Task Force Symposium, 26-27 March, Morgantown, WV, 49 slides, 2019

A sulfide removal approach using a custom-designed solar-driven system with activated carbon filter (ACF) was evaluated at the Southeast Commerce passive treatment system (SECPTS) at the Tar Creek Superfund site. SECPTS addresses 380 L/min of net alkaline mine waters using an oxidation pond, surface flow wetland, vertical flow bioreactors (VFBRs), and final polishing unit (FPU). VFBR effluent enters a closed odor-control structure (OCS) from which the sulfide-rich atmosphere is pulled into the ACF using a solar-powered vacuum blower. Solar-powered pressure blowers reaerate the water column through float-mix aerators in the post-VFBR FPU. Aqueous sulfide concentrations were determined by laboratory analyses of surface water grab samples, and gaseous sulfide concentrations were field-measured using a handheld gas detector and Draeger hydrogen sulfide gas detection tubes. Throughout the sampling period (December 2017-October 2018) the maximum aqueous sulfide concentration in the VFBR effluent was 84 mg/L, and the maximum gaseous sulfide concentration in the OCS atmosphere was 950 parts per million by volume (ppmv). FPU effluent aqueous sulfide concentrations measured 0.13-0.28 mg/L. ACF exhaust gaseous sulfide concentrations measured 41-56 ppmv. Over the study period, approximately 14,000 kg S were retained by SECPTS, presumably by bacterial sulfate reduction in the VFBR. Additionally, 100 kg gaseous S entered the ACF with 30 kg retained in the ACF media, 20 kg exhausted to the atmosphere, and 40 kg leaving the ACF as sulfuric acid. Evaluation of the systems indicates they enhanced water quality improvement effectiveness, efficiently removed gaseous sulfide, and may be used in remote locations and at sites where operation and maintenance budgets are limited.
https://wvmdtaskforce.files.wordpress.com/2019/03/2019-1030-nairn-_wvmdtfs_03272019.pdf

NEUTRALIZATION OF ACID MINE DRAINAGE CONTAMINATED WATER AND ECORESTORATION OF STREAM IN A COAL MINING AREA OF EAST JAINTIA HILLS, MEGHALAYA

Pyrbot, W., L. Shabong, and O.P. Singh.
Mine Water and the Environment 38(3):551-555(2019)

Coal mining in Jaintia Hills, Meghalaya has adversely affected the water resources of the area, leading to streams with a pH of 3-5. The prevailing situation demanded immediate neutralization and eco-restoration. The Moolawar stream in Mukhaialong village, East Jaintia Hills District, Meghalaya, India was neutralized by constructing an open limestone channel (OLC) using locally available limestone. The OLC raised the pH of the stream water from 4.31 to 6.57. The near-neutral pH has promoted the reappearance of many aquatic flora and fauna, including two species of fishes and some insects. The OLC was cost-effective and technically feasible in the rural area and prompted the construction of similar projects for improvement of water quality and ecorestoration of degraded streams. Details of the study and associated improvements in water quality and aquatic ecology are reported.*To read more on the pilot project, see* https://www.hindustantimes.com/india-news/limestone-can-help-to-save-meghalaya-water-bodies-polluted-by-coal-mining/story-z1j3TRxP0BjwqVvGnZY7zH.html

Research

A NOVEL METHOD OF USING IRON NANOPARTICLES FROM COAL FLY ASH OR FERRIC CHLORIDE FOR ACID MINE DRAINAGE REMEDIATION

Gilbert, C., O.S. Ayanda, O.O. Fatoba, G. Madzivire, and L.F. Petrik.
Mine Water and the Environment 38(3):617-631(2019)

Iron nanoparticles (nano Fe) were extracted from coal fly ash (CFA) or ferric chloride ($FeCl_3$) and used to remediate acid mine drainage (AMD). Characterization using various analytical techniques indicated good dispersion of the nano Fe, which was mainly in the zero-valent oxidation state. The Braunaer-Emmet-Teller surface areas of the CFA and FeCl3 were measured at 34.7 and 88.8 m^2/g, respectively. Nano Fe decreased contaminant levels by 17-99%. The pH of the AMD increased from 3.49 to 5.74 (CFA) and 6.01 ($FeCl_3$), the electrical conductivity decreased from 0.57 Ω/m to 0.18 (CFA) and 0.13 Ω/m ($FeCl_3$), while the total dissolved solids decreased from from 1,683 mg/L to 447 (CFA) and 384 mg/L($FeCl_3$).

MICROBIAL COMMUNITIES ASSOCIATED WITH PASSIVE ACIDIC ABANDONED COAL MINE REMEDIATION

Ly T., J.R. Wright, N. Weit, C.J. McLimans, N. Ulrich, V. Tokarev, M.M. Valkanas, et al.
Frontiers in Microbiology 10: 1955(2019)

This study evaluated the microbial community structure and functional capability associated with the Middle Branch passive remediation system in Central PA. Sediment and water samples were collected from areas within the passive remediation system and its receiving stream. Environmental parameters associated with the system explained a significant amount of variation in microbial community structure. The study revealed shifts in microbial community structure from acidophilic bacteria in raw AMD discharge to a more metabolically diverse set of taxa toward the end of the system. Vertical flow ponds and the aerobic wetland showed strong metabolic capability for sulfur redox environments. This study supports previous investigations that demonstrated the effectiveness of sulfur-reducing bacteria in the process of removing sulfate and heavy metals from contaminated water.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6716070/pdf/fmicb-10-01955.pdf

ACID ROCK DRAINAGE/METAL LEACHING (ARD/ML) AT COOLEDGE BROOK, MA: FEASIBILITY OF ALTERNATIVE REMEDIAL AND TREATMENT APPROACHES
Locke, J.R. and R.E. Stickles, B.S. Qualifying Project Report, 98 pp, 2019

The feasibility of different options to treat acid rock drainage (ARD) was assessed at the Cooledge Brook site in Northborough, MA. An ex situ active treatment system and an in situ permeable reactive barrier were bench-tested to measure their effectiveness at treating site water. Both tests successfully neutralized the pH of the drainage water from 4.23 to >6, reduced dissolved aluminum concentrations from 40,280 parts per billion (ppb) to
https://digitalcommons.wpi.edu/cgi/viewcontent.cgi?article=7781&context=mqp-all

LIFE CYCLE ASSESSMENT OF A PASSIVE REMEDIATION SYSTEM FOR ACID MINE DRAINAGE: TOWARDS MORE SUSTAINABLE MINING ACTIVITY
Martinez, N.M., M.D. Basallote, A. Meyer, C.R. Canovas, F. Macias, and P. Schneider.
Journal of Cleaner Production 211:1100-1111(2019)

A life cycle assessment was performed for a dispersed alkaline substrate technology in the Iberian Pyrite Belt to determine the environmental impacts generated throughout its life cycle and the factors controlling its environmental performance. Results indicated that although the construction of the plant initially created significant environmental impacts, they became negligible within 4.5 years. Results also showed that the potential impacts of the plant were closely related to the upstream production chain of the materials employed in this technology. Thus, the replacement of certain material sources and circular usage would lead to a significant decrease in impact values. The replacement of wood chips by forestry waste would reduce emissions by 50%-100%. This study also found evidence for the lower carbon footprint of passive treatment in comparison with other wastewater treatment systems analyzed using life cycle analysis. *More information on the Iberian Pyrite Belt project:* http://www.life-etad.com/index.php/en/project.

ENHANCED IMMOBILIZATION OF ARSENIC FROM ACID MINE DRAINAGE BY DETRITAL CLAY MINERALS
Lefticariu, L., S.R. Sutton, A. Lanzirotti, and T.M. Flynn.
ACS Earth and Space Chemistry 3(11):2525-2538(2019)

In this study, detrital clay minerals originating from the partial weathering of coal mining waste substantially increased total As uptake by acid mine drainage (AMD) sediments. The As immobilization mechanisms by the AMD sediments were investigated by the combined use of microbial community structure characterization (16S rRNA), chemical extractions, and synchrotron-based X-ray fluorescence, diffraction, and absorption. The use of an X-ray spot size as small as one micrometer allowed a detailed examination of the heterogeneous AMD sediments. Results suggest that during sustained redox cycling of iron in Fe(III) $_{NP}$-clay mixed-mineral systems, the clays controlled As mobility by (1) enhancing heterogeneous precipitation of Fe(III)) $_{NP}$ under oxic conditions, which then adsorbed or incorporated As; and (2) facilitating the transfer of As from Fe(III))$_{NP}$ to clay during microbially mediated reduction of Fe(III))$_{NP}$ coatings under anoxic conditions.

COMPARISON OF METAL PLAQUE FORMATION AND METAL ACCUMULATION IN REEDS CULTURED IN ACID MINE DRAINAGE SOLUTIONS AND SOILS
Guo, L. and T.J. Cutright.
Soil and Sediment Contamination: An International Journal 28(7):670-683(2019)

Experiments were conducted to compare the effect of citric acid (CA) on metal uptake in *Phragmites australis* cultured in artificial acid mine drainage (AMD) contaminated soil or aqueous solutions. When the chelator CA was present, it appeared to reduce metal plaque formation around the roots systems of reeds, while simultaneously increasing the metal accumulation in both belowground and aboveground tissues of reeds cultured in AMD contaminated soil or solutions. Compared to soils, the effect of CA to decrease Mn and Fe plaque and enhance Mn and Fe uptake in solutions was more pronounced. In general, the more CA that was added, the more Mn and Fe accumulated in the reeds, especially the underground tissues of reeds. However, the effects of CA on Al accumulation in reeds grown in AMD soil and solutions were different. CA decreased Al plaque formation and increased Al uptake in reeds cultured in AMD-contaminated soil but had no influence on Al levels in reeds grown in AMD solutions. CA could be effective at enhancing the phytoremediation of metals from AMD contaminated sites, depending on the metal levels, types of metals and the characteristics of contaminated media.

IMPACTS OF POINT-SOURCE NET ALKALINE MINE DRAINAGE (NAMD) ON STREAM MACROINVERTEBRATE COMMUNITIES
Kimmel, W.G. and D.G. Argent.
Journal of Environmental Management 250:109484(2019)

Ten low-order tributaries of the Ohio and Youghiogheny Rivers in southwestern Pennsylvania impacted by point-source inputs of net alkaline mine drainage were selected for assessment of water quality and benthic macroinvertebrate communities. Levels of pH, total Fe, and sulfate (SO_4) were significantly elevated in the impacted stream reaches when compared with upstream reference sites, while total alkalinity and specific conductance were equivalent. Macroinvertebrate abundance declined by 92% in the impacted stream reaches, but community structure in terms of taxonomic composition and species richness was similar. Total Fe, total SO $_4$, and specific conductance were significantly linked to macroinvertebrate community impairment. The presence of resident macroinvertebrate communities in the unimpacted reaches suggests that remediation would result in a rapid recolonization and establishment of viable downstream ecosystems.

A COMPOSITE TAXONOMICAL AND FUNCTIONAL FRAMEWORK OF MICROBIOMES UNDER ACID MINE DRAINAGE BIOREMEDIATION SYSTEMS
Villegas-Plazas, M., J. Sanabria, and H. Junca.
Journal of Environmental Management 251:109581(2019)

Available sequence information and associated metadata about acid mine drainage-impacted microbial communities were reanalyzed and reexamined in a composite comparative manner to understand composition and functions and propose potential genetic enhancements for improved bioremediation strategies. The 16 S rRNA gene-targeted sequencing data from 9 studies previously published including AMD systems reported and studied around the world were collected and reanalyzed to compare and identify the core and most abundant genera in four distinct AMD ecosystems: surface biofilm, water, impacted soils/sediments and bioreactor microbiomes. Microbial communities of bioreactors were the most diverse in bacterial types detected. The metabolic pathways predicted strongly suggest the key role of syntrophic communities with denitrification, methanogenesis, manganese, sulfate and iron reduction. The perspectives to explore the dynamics of engineering systems by high-throughput sequencing and biochemical techniques are discussed and foreseen application of synthetic biology and omics exploration on improved AMD biotransformation are proposed.

EVALUATION OF ZEOLITE/BACKFILL BLEND FOR ACID MINE DRAINAGE REMEDIATION IN COAL MINE
Fallavena, V.L.V., M. Pires, S.F. Ferrarini, and A.P.B. Silveira.
Energy Fuels 32(2):2019-2027(2018)

Lab-scale leaching experiments were performed to assess remediation of acid mine drainage (AMD) from coal mines and the mobilization of ions in leachates using different zeolite/tailing blends. During the experiment, major and trace elements, pH, and conductivity were monitored over time. Results indicate that the addition of zeolites obtained from coal ash promoted the remediation of metal content in water generated by AMD and was a more beneficial process in the removal of metal ions. The 50:50 backfill/zeolite blend achieved reductions of 100, 98, 39, 55, 94, and 41% in aluminum, iron, calcium, magnesium, zinc, and manganese content, respectively, after 7 days of leaching. The increase in pH caused by zeolite addition promoted the precipitation of both metal ions and sulfate ions. The addition of 50% or 25% of zeolite in the backfill sample increased pH from 2.36 to 8.38 or 4.66, respectively, over a leaching period of 7 days.

ENVIRONMENTALLY SUSTAINABLE ACID MINE DRAINAGE REMEDIATION: RESEARCH DEVELOPMENTS WITH A FOCUS ON WASTE/BY-PRODUCTS
Moodley, I., C.M. Sheridan, U. Kappelmeyer, and A. Akcil.
Minerals Engineering 126:207-220(2018)

This paper presents an overview of acid mine drainage (AMD) and discusses research developments into various waste materials or by-products from other industries that have been successfully applied in remediating AMD.

BIOMASS ASHES FOR ACID MINE DRAINAGE REMEDIATION
Bogush, A.A., C. Dabu, V.D. Tikhova, J.K. Kim, and L.C. Campos.
Waste and Biomass Valorization [Published online 13 September 2019 prior to print]

The potential use of CPK-LA type and PK-LA type biomass ashes (BAs) to remediate acid mine drainage (AMD) was investigated in a lab study that used four BAs from different fuels (straw, meat and bone meal, poultry litter), synthetic AMD, and raw AMDs from Belovo and Ursk, Russia. Batch experiments showed that in 1 hour, biomass ash from straw combustion effectively neutralized synthetic AMD and the Belovo AMD with removal at the liquid-to-solid ratio (L/S) of 100-250 and 10-50, respectively. The biomass ashes from straw and poultry litter combustion effectively removed pollutants from the Ursk AMD at L/S 100 and adjusted pH. The metal concentrations of the treated AMDs met receiving water quality standards. Potential pollutants precipitated as carbonate/hydroxide/sulfate, co-precipitated with Fe oxyhydroxides and Ca phosphates, and appeared as new phases such as Ca, Cu, Zn phosphates and Ca, Fe phosphates.
https://link.springer.com/content/pdf/10.1007/s12649-019-00804-9.pdf

General News

REMOVAL OF MANGANESE(II) FROM ACID MINE WASTEWATER: A REVIEW OF THE CHALLENGES AND OPPORTUNITIES WITH SPECIAL EMPHASIS ON MN-OXIDIZING BACTERIA AND MICROALGAE
Li, Y., Z. Xu, H. Ma, and A.S. Hurthouse. | Water 11(12):2493

This review provides a comprehensive assessment of the main implications and challenges of Mn(II) removal from mine drainage. The review compares several techniques to remove Mn(II) from wastewater, assesses the challenges associated with precipitation, adsorption, and oxidation/filtration, and provides an analysis of remediation options with special emphasis on Mn-oxidizing bacteria (MnOB) and microalgae. The review concludes with alternative treatments for manganese mine drainage that focuses on the synergistic interactions of Mn in wastewater with co-immobilized MnOB/microalgae. https://www.mdpi.com/2073-4441/11/12/2493

THE ROLE OF MEMBRANE TECHNOLOGY IN ACID MINE WATER TREATMENT: A REVIEW
Agboola, O. | Korean Journal of Chemical Engineering 36(9):1389-1400(2019)

This paper reviews the use of membranes in the published literature for the treatment of acid mine waters and for the recovery of valuable metals from acid mine drainage effluents. The paper also discusses the role of membrane technology in acid mine water treatment and the factors that determine membrane performance for AMD treatment. Challenges of membrane technology in acid mine water treatment and some solutions to the challenges are presented.

HOW TO TACKLE THE STRINGENT SULFATE REMOVAL REQUIREMENTS IN MINE WATER TREATMENT-A REVIEW OF POTENTIAL METHODS
Runtti, H., E.-T. Tolonen, S. Tuomikoski, T. Luukkonen, and U. Lassi.
Environmental Research 167:207-222(2018)

Process options to reach low sulfate levels (

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.

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