Technology Innovation News Survey

Entries for February 16-28, 2022

Market/Commercialization Information

PUGET SOUND NAVAL SHIPYARD HAZARDOUS WASTE REMOVAL, TRANSPORTATION, AND DISPOSAL

Defense Logistics Agency (DLA) Disposition Service - EBS, Battle Creek, MI
Contract Opportunities at SAM.gov, Solicitation 22BE003,

This is a sources sought announcement for market research purposes only under NAICS code 562211. The Defense Logistics Agency seeks to identify qualified small businesses, specifically 8(a), HUBZone, woman-owned, and service-disabled veteran-owned small businesses, for the transportation and disposal of RCRA Hazardous wastes, non-RCRA wastes, compressed gas cylinders, state-regulated waste, non-hazardous waste, and PCBs in and around Puget Sound Naval Shipyard in Washington State. All services necessary for the collection, storage, processing, removal, transportation, final treatment, and disposal and/or recycling of waste shall be in accordance with all local, state, Department of Defense, and Federal laws and regulations. The anticipated award is expected to be a Firm Fixed-Priced, Indefinite Delivery Indefinite Quantity Services Contract with one 30-month base period, followed by one 30-month option period. There is no solicitation available at this time. Capability statements are due by 3:30 pm EDT on April 22, 2022.
https://sam.gov/opp/321c39caccf341fbad182247bcda9de8/view

BROAD AGENCY ANNOUNCEMENT FOR INNOVATIVE ENVIRONMENTAL TECHNOLOGIES AND METHODOLOGIES

Naval Facilities Engineering Systems Command, Expeditionary Warfare Center, Port Hueneme, CA
Contract Opportunities at SAM.gov, Solicitation N3943022S2401, 2022

This is a full and open competition under NAICS code 541715. The Naval Facilities Engineering Systems Command Expeditionary Warfare Center issues this broad agency announcement to seek out technologies and methodologies to reduce environmental impacts from current and past Navy operations; it applies to Navy installations worldwide. NEXWC is interested in environmental technologies and methodologies that are either new, innovative, advanced state-of-the art or increase knowledge or understanding of a technology or methodology. The technology or methodology shall address one of the following seven topic areas: 1) Environmental Assessment, Restoration, and Cleanup; 2) Conservation of Natural Resources; 3) Unexploded Ordnance; 4) Technologies and Methodologies Addressing Emerging Chemicals; 5) Environmental Compliance; 6) Resilient Infrastructure Crucial For Enduring Environmental Protection; and 7) Remote Sensing and Web-Based Data Processing, Modeling and Reporting of Environmental Data. This announcement is for abstracts/white papers only. Abstracts shall identify the specific topic area that the submission addresses. Each abstract must be specific to one of the topic areas. Multiple submissions are acceptable. Abstracts will be evaluated on relevance and merit. The abstract may be supplemented by resumes and lists of relevant publications and prior government projects. Abstracts can be submitted any time until 2:00 pm on March 21, 2023.
https://sam.gov/opp/31a0cb3fe2fc4777b2f723ebe37a7d59/view

REGION 8 SUSTAINABLE MATERIALS MANAGEMENT GRANT

Environmental Protection Agency, Funding Opportunity EPA-R8-2022-SMM, 2022

EPA Region 8 is soliciting applications that address the national and regional priority of decreasing the environmental impact of materials, focusing on reducing greenhouse gas emissions (GHGs, EPA Overview of Greenhouse Gases). This funding opportunity is designed to decrease materials generated (source reduction) and increase the diversion of materials through reuse, recycling, and other strategies. Currently, there is inadequate infrastructure in

the Mountains and Plains Region to support these goals. Applications must directly benefit at least one of the EPA Region 8 States (Colorado, North Dakota, Montana, South Dakota, Utah, and Wyoming) or one of the 28 tribal nations in the Region. Three specific EPA Region 8 activities are the focus of this funding opportunity. Applicants must include at least one of these activities in their application (described in Section I.B). These activities may focus on any material within the scope of sustainable materials management and can include (but are not limited to) the built environment, construction and demolition debris, materials commonly collected in materials recovery facilities (MRFs), and food. The total estimated funding for this competitive funding opportunity is ~$40,000. EPA Region 8 anticipates funding up to one to two cooperative agreements from this announcement, 2 ranging in value from $10,000 to $25,000. The number of awards will depend on the quality of applications received and fiscal year program funds available. EPA expressly reserves the right to make no awards under this competitive funding opportunity or to adjust the number of awards originally anticipated under this competitive funding opportunity. The closing date and time for the receipt of applications is May 11, 2022, by 11:59 pm ET.
https://www.grants.gov/web/grants/view-opportunity.html?oppId=339129

ENVIRONMENTAL JUSTICE SMALL GRANTS PROGRAM

Environmental Protection Agency, Funding Opportunity EPA-OP-OEJ-22-01, 2022

EPA is working to improve the environment and public health conditions of tribal governments, low-income communities, and communities of color through the advancement of racial equity and environmental justice. This funding announcement supports the priorities detailed in President Biden's Executive Order 13985, "Advancing Racial Equity and Support for Underserved Communities Through the Federal Government," and Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad. 2 $1.6 million of American Rescue Plan" funds are now available to fund EJ Small Grants to federally recognized tribal governments to establish or modify public participation programs where fair treatment and meaningful participation priorities have been impacted by the COVID-19 pandemic. To be eligible for ARP funding, public participation programs must specifically address activities authorized by section 103(b) of the Clean Air Act and/or section 1442 of the Safe Drinking Water Act. For this single funding announcement, EPA is limiting eligible applicants to federally recognized tribal governments only. Applicants may request up to $100,000. Approximately 16 to 20 EJ Small Grants will be awarded to federally recognized tribal governments nationwide. Application packages must be submitted by May 20, 2022, at 11:59 pm ET.
https://www.grants.gov/web/grants/view-opportunity.html?oppId=338812

Cleanup News

FULL-SCALE REDUCING AND ALKALINITY PRODUCING SYSTEM (RAPS) FOR THE PASSIVE REMEDIATION OF POLLUTED MINE WATER FROM A FLOODED ABANDONED UNDERGROUND COAL MINE, CAROLINA, SOUTH AFRICA

Dube, G.M., T. Mello, V. Vadapalli, H. Coetzee1, K. Tegegn, R. Lusunzi, S. Moja1, M. Malatji, M.E. Sinthumule, and R. Ramatsekisa.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 7 pp, 2021

A reducing and alkalinity producing system (RAPS) named CaroRap was implemented to remediate coal mine water in South Africa. RAPS combines the mechanisms of anaerobic treatment wetlands and anoxic limestone drains to improve water quality by processes including calcite dissolution and sulfate reduction through sulfate-reducing bacteria (SRB). After four weeks of operation, the system, which included RAPS 1 and an oxidation pond, increased the pH to an average of 5.6 (from an average of 2.9) and increased alkalinity to ~35.8 mg/L. The increases were attributed to bicarbonate ions released from the dissolution of limestone. The system reduced total iron (Fe) by 92% and Al by 58.8%. There are limitations regarding adequate removal of Mn and SO_4, and optimization measures will be explored further. https://www.imwa.info/docs/imwa_2021/IMWA2021_Dube_352.pdf

ASSESSMENT OF THE CHEMICAL AND ECOLOGICAL RECOVERY OF THE FRONGOCH STREAM FOLLOWING REMEDIATION AT FRONGOCH LEAD AND ZINC MINE, MID WALES

Edwards, P., J.F. Murphy, J.I. Jones, C. Morgan, R.P.D. Walsh, and J. Gething.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 6 pp, 2021

Large waste dumps at the former Frongoch Mine that produced lead, and zinc ore provided a source of metals pollution to Frongoch Stream through surface runoff and shallow groundwater discharges, including a discharge from a culvert of unknown origin. Annual metal discharges to Frongoch Stream were 6.5 and 0.5 tonnes of dissolved Zn and Pb, respectively, while Frongoch Adit discharged ~2 times those amounts. Remediation was completed in four phases. Water that caused Frongoch Stream to overflow into an open stope northeast of the mine was diverted back to its original watercourse via a culvert from a pond, reducing the flow to Frongoch Adit and increasing metal dilution in Frongoch Stream. A drainage channel was constructed around the northern and western perimeter of the site to intercept clean surface water, divert it away from the mine waste into a flood attenuation pond, and discharge it upstream. Mine waste was relocated where it was reprofiled to enhance runoff. A series of ponds were created to convey the drainage to the flood attenuation pond and provide a habitat for wildlife. A continuous section of imperforated pipe was placed in the perimeter channel to carry cleaner water through an area of lead-rich tailings lagoon deposits. The ponds and drainage channels were lined with a geosynthetic clay liner (GCL). Most of the reprofiled area was covered with ≥300 mm of compacted clay plus 100 mm of restoration soils and seeded with common bentgrass. Over 23,000 m^2 of the site was capped, covering ~65% of the contaminated mine waste. Then, 7,600 m^2 of the previously reprofiled but uncapped area was covered with GCL under a minimum 350 mm confining layer and restoration soils. Another 5,000 m^2 was sprayed with experimental mixtures, including commercial hydroseeding products with biochar, mycorrhizae, and plant nutrients. Efforts led to decreases in dissolved Zn (87%), Pb (93%), and Cd (87%). Sediment metal concentrations in 2020 indicated that ecological recovery might be impaired by enduring bed-sediment contamination, including areas where erosion and sediment transport of mine waste has been successfully managed.
https://www.imwa.info/docs/imwa_2021/IMWA2021_Edwards_145.pdf

IN SITU RESTORATION OF SOIL ECOLOGICAL FUNCTION IN A COAL GANGUE RECLAMATION AREA AFTER 10 YEARS OF ELM/POPLAR PHYTOREMEDIATION

Bai, D.-S., X. Yang, J.-L. Lai, Y.-W. Wang, Y. Zhang, and X.-G. Luo.
Journal of Environmental Management 305:114400(2022)

Soil ecological health risks and toxic effects of coal gangue accumulation were examined after 10 years of elm/poplar phytoremediation. Soil enzyme activities, ionome metabolism, and microbial community structure changes were analyzed at shallow (5-15 cm), intermediate (25-35 cm), and deep (45-55 cm) soil depths. Soil acid phosphatase activity in the restoration area increased by 4.36-7.18 fold. Soil concentrations of Cu, Pb, Ni, Co, Bi, U, Th, and the non-metallic element S were reduced. The repair effect was shallow > middle > deep. Redundancy analysis showed that S and Na are important driving forces for the microbial community distributions at shallow soil depths. The Kyoto Encyclopedia of Genes and Genomes (KEGG) function prediction indicated enhancement of the microbial function of the middle-depth soil layers in the restoration area. Phytoremediation enhanced the biotransformation of soil phosphorus in the coal gangue restoration area, reduced the soil content of metals, significantly changed the structure and function of the microbial community, and improved the overall soil ecological environment.

PASSIVE TREATMENT OF AMD USING A FULL-SCALE UP-FLOW MUSSEL SHELL REACTOR, BELLVUE COAL MINE, NEW ZEALAND

Trumm, D., J. Pope, and H. Christenson.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 7 pp, 2021

Results of the first full-scale up-flow mussel shell reactor to treat acid mine drainage (AMD) at the abandoned underground Bellvue Coal Mine are presented. The system consists of five 30,000-L plastic water tanks with associated alkathene piping and plastic valves to convey AMD from the adit and equally distribute it to the base of each tank. The water flows upwards

through treatment media and is discharged into Cannel Creek. Each tank is filled with ~24 m^3 of fresh mussel shells, broken into pieces ~5 cm long. The discharge piping is ~ 22 cm above the top of the shells to maintain a free water surface above the shells and ensure the reactor remains under reducing conditions. The tanks were filled with AMD and left static for 10 weeks before operation to allow reducing conditions to establish and iron-reducing and sulfate-reducing bacteria to populate the tanks. During site visits, field parameters were measured, and water samples were collected from the inlet and the system's outlet and Cannel Creek upstream and downstream of the confluence with the treated AMD. The system increased the pH from a median of 2.74 to a median of 6.94 and lowered metal concentrations by 97.2% (Fe), 99.8% (Al), 98.2% (Zn), and 97.0% (Ni).
https://www.imwa.info/docs/imwa_2021/IMWA2021_Trumm_577.pdf

Demonstrations / Feasibility Studies

FULL-SCALE DEMONSTRATION TESTS OF PASSIVE TREATMENT SYSTEM BY JOGMEC IN JAPAN

Hayashi, K., T. Washio, Y. Masaki, T. Hamai, T. Sakata, M. Sakoda, M. Kobayashi, N. Masuda, and N. Sato.
Proceedings from the postponed 14th IMWA Congress - "Mine Water Solutions," 2020

Full-scale demonstration tests (flow rate 100 L/min) of a biological passive treatment system were conducted at an abandoned mine site in Japan to treat acid mine drainage (AMD) containing iron and zinc. Aerobic and anaerobic vertical-flow bioreactors utilized iron-oxidizing and sulfate-reducing bacteria (SRB). In the aerobic reactor, AMD containing 35 mg/L of Fe was treated to below the wastewater standards by using a water transfer method, such as a cascade. In the anaerobic process, the applicability of a process using ethanol or rice bran as organic resources of SRB was studied. *See* ***pages 106-109:***
https://www.imwa.info/docs/imwa_2020/IMWA_2020_proceedings.pdf

EFFECTS OF CATTAILS AND HYDRAULIC LOADING ON HEAVY METAL REMOVAL FROM CLOSED MINE DRAINAGE BY PILOT-SCALE CONSTRUCTED WETLANDS

T.T. Nguyen, S. Soda, A. Kanayama, and T. Hamai
Water 13(14):1937(2021)

Removal of heavy metals from neutral mine drainage of a closed mine in the Kyoto prefecture was demonstrated using pilot-scale constructed wetlands (CWs). The CWs were filled with loamy soil and limestone and were planted with or without cattails. The hydraulic retention time (HRT) in the CWs was shortened gradually from 3.8 to 1.2 days during 3.5-months of operation. A short HRT of 1.2 days in the CWs was sufficient to achieve the effluent standard for Cd (0.03 mg/L). The CWs planted with or without cattails reduced the average Cd concentrations from 0.031 to 0.01 and 0.005 mg/L, Zn from 0.52 to 0.14 and 0.08 mg/L, Cu from 0.07 to 0.04 and 0.03 mg/L, and As from 0.011 to 0.006 and 0.006 mg/L. Heavy metals were removed mainly by adsorption to the soil in both CWs. The biological concentration factors in cattails were >2 for Cd, Zn, and Cu. The translocation factors of cattails for all metals ranged from 0.5 to 0.81. Sulfate-reducing bacteria (SRB) were detected only from soil in the planted CW. Although cattails were a minor sink, the plants contributed to metal removal by rhizofiltration and incubation of SRB and may have produced sulfide precipitates in the rhizosphere. https://www.mdpi.com/2073-4441/13/14/1937

TREATMENT AND RECOVERY OF IRON FROM ACID MINE DRAINAGE: A PILOT-SCALE STUDY

Yang, X.H.H. K. Tan, S. Hou, J. Cai, X. Yuan, Q. Lan, J. Cao, and S. Yan.
Journal of Environmental Chemical Engineering 10(1):106974(2022)

A chemical oxidation technology was applied in a 12 m^3/d pilot-scale treatment process to precipitate high-concentration iron (510.3 ± 50 mg/L) from acid mine drainage under acidic conditions. Results showed that the Fe^{2+} oxidation rate and total Fe (TFe) removal rate exceeded 99%, while the loss of Cu and Mn was

SUCCESSFUL PASSIVE TREATMENT OF SULFATE RICH WATER

Robinson, J., J. Dodd, I. Andrews, J. Gusek, L. Josslyn, and E. Clarke.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 8pp, 2021

A passive sulfate reduction system with iron scrubbers was identified as the most viable option to treat elevated sulfate in landfill leachate. Bench-scale trials were conducted using a biochemical reactor with different proportions of wood chips, straw, manure, limestone, and biochar to culture sulfate-reducing bacteria. The concept of 'bugs on booze' was also trialed using a fixed bed anaerobic bioreactor, where alcohol was added to enhance the sulfate reducer activity. The resulting treated leachate was then passed through haematite, magnetite, and iron filings to remove sulfide generated by the bacteria, with an aerobic wetland used to polish the effluent. The success of the bench-scale project led to a pilot-scale system being constructed and monitored in Spring 2020. Results confirmed the success of the bench-scale testing and provided useful insights to manage the system, particularly in winter months. https://www.imwa.info/docs/imwa_2021/IMWA2021_Robinson_477.pdf

STEEL SLAG-LIMESTONE REACTOR WITH RESISTANCE TO FE: LABORATORY AND PILOT SCALE EVALUATIONS OF MN TREATMENT EFFICIENCY

Kim, D.-M., Y.-S. Oh, H.-S. Park, D.-G. Im, W.-L. Lim, H.-R. Kwon, and J.-H. Lee.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 6 pp, 2021

A study evaluated Fe-tolerance to assess the mechanism and the Mn treatment efficiencies of steel slag (S), steel slag and limestone (40%/60%, SL), and steel slag and Mn-coated gravel (40%/60%, SG) reactors. In bench-scale experiments, a layer of 4-5 cm diameter gravel was installed at the bottom of each reactor to create uniform upward flow, and each was operated for 366 days. Initial inflow Mn concentrations were 30-50 mg/L, and residence times were 0.6-1.8 d. After the reactions with only Mn, Fe and Mn were added to the inflow for 41 days. Fe, Fe^{2+}, and Mn concentrations were 4.5-24.4 mg/L, 3.1-12.0 mg/L, and 32-46 mg/L, respectively, and residence times were 0.8-1.5 d. Pilot-scale treatment systems were installed and operated in six mines located throughout South Korea. Inflow Mn concentrations ranged between 2 and 45 mg/L and operation periods ranged between 0.5 and 4 years. In the pilot-scale studies, 95-99% of Mn was removed during the maximum test period of 4 years. Precipitation as Fe and Mn carbonates may have contributed to removing Mn and resistibility to Fe. https://www.imwa.info/docs/imwa_2021/IMWA2021_Kim_243.pdf

Research

NEW TECHNIQUE YIELDS PROMISING RESULTS FOR URANIUM REMOVAL IN THE FIELD

National Institute of Environmental Health Sciences, Superfund Research Program (SRP), February 2022

A technology developed by researchers may remove uranium and other heavy metals from groundwater near abandoned mines using ion flotation, where a surfactant attracts metal ions that are carried to the surface of the solution by air bubbles. They are then concentrated into a small volume of foam that can be disposed of or regenerated into another product. Green rhamnolipid surfactants can selectively bind to uranium during ion flotation but have not been tested previously under realistic environmental conditions. GlycoSurf's specialized green surfactants are produced synthetically and have similar properties to rhamnolipids made from biological organisms. In both cases, the materials are made using sustainable production methods, can biodegrade, can be recycled, and have low toxicity. Collaborators tested biologically derived rhamnolipids and GlycoSurf's bio-inspired rhamnolipids using groundwater samples collected from the Monument Valley site, a former uranium processing mill on the Navajo Nation in northeastern Arizona. Although the technology failed to remove uranium at the natural pH level, it was successful when conditions were appropriately adjusted.
https://tools.niehs.nih.gov/srp/1/ResearchBriefs/pdfs/SRP_ResearchBrief_326_508.pdf

BIODIVERSITY BENEFITS OF COAL MINE WATER REMEDIATION SCHEMES FOR BIRD LIFE

Jaques, R.O., A.M.L. Moorhouse-Parry, R. Carline, W.M. Mayes, and S.L. Hull.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 6 pp, 2021

The presence and use of two UK coal mine water treatment systems by bird species were assessed in a study that combined modified British Trust for Ornithology Breeding Bird Survey monitoring with habitat surveys. Over thirty species were documented at the sites, including four red-listed, eight amber-listed, and eighteen green-listed species. Statistically significant bird groups associations with specific habitat types suggest that a mosaic of habitats at coal mine treatment systems benefits bird diversity and that these sites may have conservation potential at the landscape level.
https://www.imwa.info/docs/imwa_2021/IMWA2021_Jaques_206.pdf

HYDROTHERMALLY-ALTERED FELDSPAR AS AN ENVIRONMENTALLY-FRIENDLY TECHNOLOGY TO PROMOTE HEAVY METALS IMMOBILIZATION: BATCH STUDIES AND APPLICATION IN SMELTING-AFFECTED SOILS

Ribeiro, P.G., J.M.P. Souza, M. Rodrigues, I.C.A. Ribeiro, T.S. de Carvalho G. Lopes, Y.C. Li, and L.R.G. Guilherme. | Journal of Environmental Management 291:112711(2021)

A study evaluated the capabilities of HydroPotash (HYP-1 and HYP-2) and a commercial zeolite adsorbent to immobilize Cd, Zn, and Pb from aqueous solution and contaminated soil from a Zn-smelting area (classified as soil-high, soil-intermediate, and soil-low, based on their level of soluble metal concentration). HYPs removed 63.8-99.9% Zn, 20.6-40.7% Cd, and 68.4-99.7% Pb from aqueous solution. In a batch test at pH 5.5, HYPs sorbed more Cd than zeolite. Analyses of scanning electron microscopy-energy dispersive X-ray spectroscopy after desorption indicated that Pb was effectively adsorbed. In soil-high, HYPs immobilized 99.9% of Zn, Cd, and Pb after one week of incubation, and effects persisted up to 84 days. Increased soil pH promoted by HYPs appeared to be the main factor controlling metal sorption. Findings indicate the high potential of the material for Cd, Zn, and Pb stabilization to recover areas affected by mining/smelting activities with multi-element contamination.

THE TREATMENT OF ACID MINE DRAINAGE USING VERTICALLY FLOWING WETLAND: INSIGHTS INTO THE FATE OF CHEMICAL SPECIES

Nguegang, B., V. Masindi, T.A.M. Msagati, and M. Tekere.
Minerals 11:477(2021)

Acid mine drainage (AMD) was treated in a vertically flowing wetland enriched with *Vetiveria zizanioides* as a decontaminating media and soil as the substrate. Water percolated through the substrate was collected and characterized every five days for 30 days. Results revealed a tolerant index of 1.03 for *Vetiveria zizanioides* and a net reduction of metals and sulfate. The removal efficacy of chemical species was observed to obey the following order: Fe (71.25%) > Zn (70.40%) > Mn (62%) > Al (56.68%)> $SO4^{2-}$ (55.18%) > Ni (35%) > Cu (18.83%). The removal of chemical species was further aided by the used substrate, which could be attributed to the accumulation of chemical species on the soil through precipitation, adsorption, and phytoretention. Substrate plays a significant role in removing metals, while the grass and external factors accounted for the remaining chemical species attenuation. The distribution of chemical species was predominantly in the roots, except manganese, which was transferred in the shoot (67%). AMD chemical species present in the substrate and the grass components confirmed that the plants played a huge role in removing contaminants. The PH REdox EQuilibrium geochemical model confirmed that metals existed as di-and-trivalent complexes in AMD. Available metals were precipitated as metals hydroxides and oxy-hydrosulfates by the substrate. Results indicate that vertically flowing wetland can be used for passive treatment of AMD, particularly at active and abandoned mines. *This article is* ***Open Access*** *at* https://www.mdpi.com/2075-163X/11/5/477/htm

COPPER MINE TAILINGS VALORIZATION USING MICROBIAL INDUCED CALCIUM CARBONATE PRECIPITATION

de Oliveira, D., E.J. Horn, and D.G. Randall.

Journal of Environmental Management 298:113440(2021)

The solidification of copper mine tailings was studied using microbial-induced calcium carbonate precipitation (MICP) to valorize the waste stream. The toxicity of copper on *Sporosarcina pasteurii*, the ureolytic bacteria which drives the MICP process, was investigated using bio-columns. The bio-columns produced from copper mine tailings had a compressive strength of 0.54 MPa, lower than bio-columns produced from beach sand (1.85 MPa). The low porosity of the copper mine tailings limited the depth to which the MICP reaction could successfully occur, resulting in the formation of a 1.8 mm ± 0.4 mm crust around the outer extremities of the bio-columns. Particle size was a key deciding factor, and, as a result, MICP is not suitable to produce 'thick' bio-cemented materials from small particles (

INNOVATIVE IN SITU REMEDIATION OF MINE WATERS USING A LAYERED DOUBLE HYDROXIDE-BIOCHAR COMPOSITE

Veselska, V., H. Sillerova, B. Hudcova, G. Ratie, P. Lacina, B. Lalinska-Volekova, L. Trakal, P. Sottnik, Ľ. Jurkovic, M. Pohorely, D. Vantelon, I. Safarik, and M. Komarek.
Journal of Hazardous Materials 424(Part A):127136(2022)

A comprehensive field-scale study incorporated layered double hydroxides (LDHs) into hybrid biochar-based composites and applied the innovative material to remediate As- and Sb-rich mine waters. Hydrous Fe oxides (HFOs) present within the composite enhanced the total adsorption efficiency of the composite for As(V) and Sb(V). Equilibrium experiments confirmed that the composite had a stronger interaction with As(V) than Sb(V). As(V) removal from mine water was achieved in batch and continuous flow column systems, reaching up to 98% and 80%, respectively. Sb(V) showed different behavior to As(V) during treatment, reaching adsorption efficiencies of up to 39% and 26% in batch and column experiments, respectively. Sb(V) migration in mine water was mostly attributed to its dispersion before showing affinity to the composite. The proposed column technology may be suitable for the field remediation of small volumes of contaminated water.

SUSTAINABLE AND EFFICIENT STABILIZATION/SOLIDIFICATION OF PB, CR, AND CD IN LEAD-ZINC TAILINGS BY USING HIGHLY REACTIVE POZZOLANIC SOLID WASTE

Wang, H., C. Ju, M. Zhou, J. Chen, Y. Dong, and H. Hou.
Journal of Environmental Management 306:114473(2022)

A sustainable and efficient method was proposed to immobilize Pb, Cr, and Cd in lead zinc tailings (LZTs) using ground granulated blast furnace slag (GGBFS) and rice husk ash (RHAs) solid waste. Leaching toxicity, fraction distribution, unconfined compressive strength, environmental risk assessment, and hydration products were explored to better assess the immobilization performance and mechanism. LZTs were mixed and molded with different constituents of GGBFS and RHAs at different curing temperatures. Up to 99% of the Pb, Cr and Cd were immobilized mainly in the residual fraction form in the LZTs. The amount of bioavailable fractions decreased by ~99.83% (Pb), 99.58% (Cr), and 97.05% (Cd). Following stabilization/solidification (S/S) disposal, Pb, Cr, and Cd showed low to no risk. Though RHAs effectively stabilized Pb and GGBFS stabilized Cr, both materials showed almost equal effects on Cd. Ettringite, C-S-H gel, and portlandite were the main hydration products to immobilize Pb, Cr, and Cd and provided a source of strength. Honeycomb or reticular network C-S-H gel possessed a higher specific surface area, higher pore volume, and bigger pore size than the other materials. The proposed method could explain the sustainability and efficiency of Pb, Cr, and Cd S/S in LZTs using RHAs.

General News

FACILITATING OPEN PIT MINE CLOSURE WITH MANAGED AQUIFER RECHARGE

Cook, P.G., A.D. Miller, I. Wallis, and S. Dogramaci.
Groundwater [published online 30 January 2022 before print

A study shows that an optimal distance exists for re-injecting extracted water far enough from

the mine to minimize the amount of groundwater that flows back into the pit during mine operations (resulting in additional pumping) but close enough to accelerate the recovery of the water table post-mine closure. Dewatering operations usually cease following mine closure, and the water table near the pit begins to rise. The water table will eventually recover if the pit is backfilled, but this may take several hundred years. Re-injecting extracted water into the subsurface may accelerate water table recovery. The optimal injection distance increases with the aquifer hydraulic diffusivity and the mine life and typically ranges between ~ two and nine times the radius of the mine pit. Where the mine pit is not backfilled, the relative reduction in drawdown due to injecting all the pumped water at the optimal distance is between ~10% and 50% after a recovery time equal to the mining period, increasing to 30% to 90% after a recovery time five times the mining period. The relative drawdown reduction due to managed aquifer recharge will be even greater for a pit that is backfilled when mining ceases.

EFFICIENT METHODOLOGIES IN THE TREATMENT OF ACID WATER FROM MINES WITH RECOVERY OF BYPRODUCTS

Aduvire1, O., M. Montesinos, and N. Loza.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 7 pp, 2021

A staged acid-water treatment methodology is presented to make byproduct recovery economical and reduce contamination by diminishing the amount of non-usable slurry. Direct and staged treatment results are compared, including which byproducts were collected at different pH levels during staged treatment. Experimental neutralization and precipitation tests were conducted using various reagents and pH values to obtain the dosing of reagents and the treatment sequence. Based on the results of the tests and the hydrogeochemical characterization of the effluents, the processes and stages to consider are chosen in the design of the processing facility. These methodologies may reduce the costs of treating mine water, extend the life of waste deposits, reduce the discharge of solid and liquid waste into the environment, and allow the recovery and collection of by-products with potential economic use. https://www.imwa.info/docs/imwa_2021/IMWA2021_Aduvire_1.pdf

NUMERICAL MODELLING OF MINE POLLUTION TO INFORM REMEDIATION DECISION-MAKING IN WATERSHEDS

Byrne, P., P. Onnis, R.L. Runkel, I. Frau, S.F.L. Lynch, A.M.L. Brown, I. Robertson, P. Edwards.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 6 pp, 2021

A numerical modeling methodology is presented to evaluate potential improvements in stream water quality resulting from mine pollution source remediation. High spatial resolution synoptic sampling data from a Welsh watershed were used to calibrate the One-Dimensional Transport with Inflow and Storage (OTIS) solute transport model. Simulation of mine pollution remediation scenarios using OTIS revealed decreases in stream Zn concentrations between 9% and 62% under mean streamflow conditions. Remediation scenarios under low streamflow conditions were less effective (< 1% to 17% decrease in Zn concentrations) due to diffuse and metal-rich groundwater inflows.
https://www.imwa.info/docs/imwa_2021/IMWA2021_Byrne_66.pdf

GRAVEL BED REACTORS: SEMI-PASSIVE WATER TREATMENT OF METALS AND INORGANICS

Mancini, S., R. James, E. Cox, and J. Rayner.
Proceedings of the 14th IMWA Congress, Mine Water Management for Future Generations, 12-15 July, virtual, 6 pp, 2021

Gravel Bed Reactors (GBR™) are a versatile semi-passive treatment technology to address various water quality issues by altering the geochemistry of extracted mine water. The technology offers a simpler, cost-effective alternative to water treatment facilities, packed or fluidized bed reactors, and the possibility to reuse waste rock as packing media. GBRs can be small systems installed in remote, challenging environments and have the potential to treat

mine water at the source.
https://www.imwa.info/docs/imwa_2021/IMWA2021_Mancini_322.pdf

MINE WATER USE, TREATMENT, AND REUSE IN THE UNITED STATES: A LOOK AT CURRENT INDUSTRY PRACTICES AND SELECT CASE STUDIES

Miller, K.D., M.J. Bentley, J.N. Ryan, K.G. Linden, C. Larison, B.A. Kienzle, L.E. Katz, A.M. Wilson, J.T. Cox, P. Kurup, K.M. Van Allsburg, J. McCall, J.E. Macknick, M.S. Talmadge, A. Miara, K.A. Sitterley, A. Evans, K. Thirumaran, M. Malhotra, S.G. Gonzalez, J.R. Stokes-Draut, and S. Chellam. | ACS ES&T Engineering 2(3):391-408(2022)

Current practices in mine water are identified, including how water is used in mining, influent, and effluent water quality, treatment technologies, and end uses to inform future research on implementable, reliable, and cost-effective advanced water treatment in the mining sector. Available literature was reviewed to evaluate mining in the U.S., and a techno-economic assessment on water use and disposal for three detailed case studies applicable to lithium, uranium, and copper mines was performed. Case studies highlight specific industry examples of distinct extraction methods, geographical regions, and mined commodities. Hypothetical scenarios based on case study baselines revealed potential impacts to mine water available for beneficial reuse using novel water treatment technologies and alternate water management strategies. The paper concludes by assessing national-level impacts resulting from the reuse of treated mine source water.

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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