Technology Innovation News Survey

Entries for May 16-31, 2023

Market/Commercialization Information

ENGINEERED LANDFILL CAP AT THE SEAWAY FUSRAP SITE

U.S. Army Corps of Engineers, Buffalo District, Buffalo, NY
Contract Opportunities on SAM.gov, Solicitation W912P423B0008, 2023

This is a total small business set-aside under NAICS code 562910. The U.S. Army Corps of Engineers, Buffalo District, requires a contractor to provide environmental remediation support at the Seaway Landfill Site in the Town of Tonawanda, New York. The project involves excavation, transport, and disposal of FUSRAP-contaminated soil, and constructing the engineered landfill cap for areas A, B, and C. The selected remedy for the landfill is the capping of specified areas to minimize surface water infiltration, limit erosion of the cover over landfill contents, and limit the release of liquids and gas. The major components of this project are: mobilization and site prep work; monitoring, sampling, testing, and analysis of contaminants; preparing and installing landfill cap; layering of fill and topsoil; road repair; rip rap, drainage, and ditch improvements; and project oversight and supervision. The Government intends to award one firm-fixed-price construction contract from this solicitation. The estimated construction cost is between $10,000,000 and $25,000,000. Offers are due by 3:00 PM EDT on July 28, 2023.
https://sam.gov/opp/d9eff12643804bdfa6281950527a0993/view

MARTIN BURKE MINE NON-TCRA

U.S. Department of Agriculture Forest Service, Glenwood Springs, CO
Contract Opportunities on SAM.gov, Solicitation 1240LT23R0050, 2023

This is a total small business set-aside under NAICS code 562910. The U.S. Department of Agriculture Forest Service requires a removal action at the Burke Martin Mine Non-Time Critical Removal Action (Non-TCRA) Project located in the White River National Forest in Summit County, Colorado. The overall scope of this Removal Action is to channel mine effluent away from specific contaminant source areas (waste piles and sediment tailings) and control specific contaminant source areas (waste piles and sediment/tailings areas) from migration to nearby surface water or other media/areas. The Contractor, Subcontractor, and all employees are required to be certified in accordance with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 1910.120(e)(3)(i) 40-Hour course for General Site Worker (HazWOPER). The estimated magnitude of construction for this project is between $250,000 and $500,000. The Government contemplates the award of a firm-fixed-price contract with a period of performance estimated to be between July through the end of November; this depends upon the contract award date and favorable site conditions into the late season. Offers are due by 5:00 PM MDT on July 12, 2023.
https://sam.gov/opp/3de40836b19d4e729319ab2ec9dcd671/view

OPTIMIZED REMEDIATION CONTRACT AT MCCONNELL AIR FORCE BASE, KS - REQUEST FOR PROPOSALS

U.S. Department of the Air Force, Air Force Installation and Mission Support Center, Joint Base San Antonio, Lackland, TX
Contract Opportunities on SAM.gov, Solicitation FA890323R0032, 2023

This is an 8(A) set-aside under NAICS code 562910. The U.S. Department of the Air Force's 772d Enterprise Sourcing Squadron (772d ESS) in conjunction with the Air Force Civil Engineer Center Environmental Directorate (AFCEC/CZ), requires Optimized Remediation Services at McConnell Air Force Base in Sedgwick County, Kansas. Work includes, but is not limited to, the following activities: Preliminary Assessment/Site Inspection; Response Complete or Site Closeout; Remedial Action-Operation with Optimization; Remedial Action-Operation or Long-Term Management (as appropriate); Advanced Site

Characterization; Supplemental Site Investigation; development of Conceptual Site Models; Groundwater Monitoring Program Updates; Remedy Evaluation and Recommendations; Cost/Benefit Analysis; and Decision Document Amendments. The Air Force desires that all sites be cleaned up to standards that allow for the current or reasonably anticipated future land use of the property. The award will be a Firm-Fixed-Price contract. Offers are due by 4:00 PM EDT on July 10, 2023.
https://sam.gov/opp/8f0b3dca574d4ba08cedbdc1d11073c7/view

R7 ORONOGO-DUENWEG MINING BELT - OPERABLE UNIT 1 REMEDIAL ACTION, TRI-STATE MINING DISTRICT

U.S. Environmental Protection Agency, Region 7 Contracting Office, Lenexa, KS
Contract Opportunities on SAM.gov, Solicitation 68HE0723R0047, 2023

When this solicitation is released on or about July 15, 2023, it will be competed as a total small business set-aside under NAICS code 562910. EPA Region 7 plans to issue a Request for Proposal (RFP) for a non-residential, site-specific contract for Remedial Actions to be performed within the Oronogo Duenweg Mining Belt (ODMB) Superfund site in Jasper County, Missouri. A base with four option periods is contemplated. Tasks will consist of site remediation of soil surficial mine waste areas, contaminated soil, and contaminated intermittent stream sediment. The primary activities associated with the remedial action involve excavation, consolidation, and disposal of mine waste and associated contaminated soil/sediments, property restoration, and revegetation. Remediation efforts include, but are not limited to, obtaining signed access to properties, excavation of mine waste, transport and disposal of mine waste in one of the designated mine waste repositories within ODMB, filling and plugging of mine shafts, backfilling and grading each remediated area to the extent necessary for the area to drain, installation and maintenance of erosion controls, and revegetating the remediated areas with the designated seed types to minimize erosion in accordance with design plans to be provided by EPA. EPA anticipates an Indefinite Delivery/Indefinite Quantity contract with fixed-unit prices consisting of a base period and four 12-month option periods.
https://sam.gov/opp/3b8a3579b36449ddaf93b606f0f2ea7d/view

Cleanup News

EMBEDDING CLIMATE CHANGE RISK INTO MINE CLOSURE PLANNING: A CASE STUDY OF TAILINGS CLOSURE DESIGN AT BALLARAT GOLD MINE

Trotta, L.M. and T.H. Ridgway. Mine Closure 2022: 15th International Conference on Mine Closure, Australian Centre for Geomechanics, Perth, pp. 259-266, 2022

This paper outlines the climate change risk assessment process undertaken for the Ballarat Gold Mine tailings storage facility (TSF), specifically the considerations, procedures, and outcomes of the assessment. It also describes how these processes prompted reevaluating the final TSF design to enable it to withstand projected extreme climate events. Results of the assessment were then incorporated into the site-wide risk assessment and risk mitigation plan. Closure planning allows mines and smelters to evaluate climate projections under different emission scenarios, identify and assess potential future climate hazards and associated risks, and modify final landform design to accommodate the identified physical climate risks. Long-term climate change data projections are required for long-term closure assessments to be effective. Undertaking assessments early allows the closure design to accommodate current and forward hydrological projections and long-term behavioral changes of the capping material with respect to potential changes in climate conditions, such as increased temperatures and extended solar exposure.
https://papers.acg.uwa.edu.au/d/2215_15_Trotta/15_Trotta.pdf

FARO MINE, YUKON TERRITORY, CANADA: A CASE STUDY FOR OPTIMISING ZINC LOAD CAPTURE BY CLEAN WATER DIVERSION AND FOCUSED CONTACT WATER CAPTURE

Adams, B.M., K.H. Scully, J.T.C. Seto, and B. Harrison. Mine Closure 2022: 15th International Conference on Mine Closure, Australian Centre for Geomechanics, Perth, pp. 341-354, 2022

Seepage from sulfidic waste stored in the Faro Mine waste rock dumps (WRDs) has variably impacted groundwater and surface water to the North Fork of Rose Creek (NFRC), a fish-bearing surface water body, which passes along the toe of the WRDs. Zinc is the primary parameter of concern, reaching several orders of magnitude higher than applicable water quality guidelines and previous yearly max concentrations. Intercepting contact water before reaching the NFRC is challenging due to the complex seepage patterns within the WRDs and the creek's proximity. Despite existing collection systems intercepting high-concentration seepage pathways, zinc concentrations in the creek remained elevated. The NFRC Realignment Project commenced to 'keep clean water clean' by diverting the NFRC into the non-contact water diversion channel (NCWDC) and allowing focused collection of WRD seepage in the remnant NFRC channel. The first phase of the contact water collection and conveyance system focused on the interception of shallow groundwater and surface flow in the remnant NFRC. Isolating the clean water through the NCWDC substantially reduced the surface water available for dilution. Both the uncertainty in capturing contact water before it reaches the creek and the inefficiency of capturing contact water once mixing occurred with creek flow were mitigated. A year after commissioning the NFRC Realignment Project, performance monitoring shows measured zinc concentrations in the NFRC ~2 orders of magnitude lower at the downstream monitoring station than realized by previous efforts. https://papers.acg.uwa.edu.au/d/2215_22_Adams/22_Adams.pdf

GOOD ACID AND METALLIFEROUS DRAINAGE MANAGEMENT BEGINS WELL BEFORE MINE CLOSURE: A NEW ZEALAND EXAMPLE

Sinclair, E.J.P. and P. Weber. Mine Closure 2022: 15th International Conference on Mine Closure, Australian Centre for Geomechanics, Perth, pp. 375-388, 2022

Legacy issues associated with acid and metalliferous drainage (AMD) were identified during the acquisition of the Canterbury Coal Mine. After operational activities began, a strategic approach to AMD management was undertaken to address the legacy AMD and future potential issues. This included a staged response to characterize and schedule materials, assess AMD risks, and implement appropriate engineering controls. These efforts significantly reduced the effects of AMD, including improved pH and reduced acidity loads. This article covers the steps undertaken to resolve the legacy AMD issues and minimize AMD impacts associated with ongoing operational activities such that a robust best practicable mine closure plan ensures good long-term environmental outcomes with minimal active management requirements. https://papers.acg.uwa.edu.au/d/2215_25_Sinclair/25_Sinclair.pdf

COMPLETION OF THE NORTH END BOX CUT WASTE LANDFORM REHABILITATION: IMPLEMENTATION CHALLENGES AND LEARNINGS

Chester, P., K. McNamara, E. Charsley, and S. Lee. Mine Closure 2022: 15th International Conference on Mine Closure, Australian Centre for Geomechanics, Perth, pp. 525-538, 2022

The North End Box Cut (NEBC) waste dump, located on the edge of the site's current operational footprint, contained ~2.6 Mt of potentially acid-forming (PAF) shale material. Planning and design work was conducted to apply best practice standards to the legacy waste dump. The rehabilitation earthworks were completed after 25 months of project implementation. The project required moving 3 million cubic meters of material, enough to fill the Melbourne Cricket Ground (MCG) twice, spanning 72 ha (~36 MCG fields), and utilizing 550 kg of seed. Lessons learned from the project were incorporated into an optimized 'tip-to-close' design at a second PAF waste dump to significantly reduce closure liability and enable progressive rehabilitation. This article highlights the closure liability reduction opportunities that can occur when rehabilitation activities are integrated into the mine plan. https://papers.acg.uwa.edu.au/d/2215_37_Chester/37_Chester.pdf

Demonstrations / Feasibility Studies

ASSESSING PILOT-SCALE TREATMENT FACILITIES WITH STEEL SLAG-LIMESTONE REACTORS TO REMOVE MN FROM MINE DRAINAGE

Kim, D.-M., H.-S. Park, J.-H. Hong, and J.-H. Lee.
Mine Water and the Environment 41:402-414(2022)

A pilot study tested a steel slag-limestone reactor and compared a successive alkalinity-producing system (SAPS) and a SAPS incorporating slag to treat mine water at the Ilwol mine in South Korea. The SAPS decreased Mn from 23.3 to 7.4 mg/L on average because the alkalinity generated led to saturation with rhodochrosite. Adding a slag reactor removed Mn to levels of 0.002-1.8 mg/L from influent Mn as high as 17.1 mg/L with a residence time of 5-25 h. Mn-containing carbonates and oxides were precipitated, supported by the geochemical modeling, and observed with scanning electron microscopy with energy dispersive spectroscopy. The increased alkalinity in the SAPS before the slag reactor helped remove Mn at a pH of 8.0-8.3. Mn removal and Mn-standardized Mn removal rates in the slag reactor were 0.76 mg/L/h and 0.105/h on average, respectively. The passive treatment of Mn using Fe-pretreatment, an alkalinity-generation system, a slag-limestone reactor, and a wetland rather than a SAPS that includes slag, an oxidation-settling pond, and a wetland is suggested to help meet Mn and pH effluent standards consistently.

PASSIVATION OF HEAVY METALS IN COPPER-NICKEL TAILINGS BY IN-SITU BIO-MINERALIZATION: A PILOT TRIAL AND MECHANISTIC ANALYSIS

He, Z., Y. Xu, X. Yang, J. Shi, X. Wang, Z. Jin, D. Zhang, and X. Pan.
Science of The Total Environment 838(Part 4):156504(2022)

Lysinibacillus fusiformis (Lf), a strain of ureolytic bacteria with bio-mineralization ability, was isolated from copper-nickel mine tailings in Xinjiang and applied to a pilot trial to solidify tailings under field conditions. Pilot trial results (0.5 m^3 in scale) showed that Lf effectively solidified the tailings. The compressive strength of the solidified tailings increased by 121 ± 9%, and the permeability coefficient decreased by 68 ± 3%. Compared to the control, the leaching reduction of the solidified tailings of Cu and Ni was >98%, and that of As was 92.5 ± 1.7%. Two mechanisms of tailings solidification and heavy metal passivation were proposed based on the findings of Fourier transform infrared spectroscopy, X-ray diffraction, scanning electron microscopy, high-resolution transmission electron microscopy, and energy-dispersive X-ray spectroscopy mapping. Biogenic calcite filled the interstices of the tailings particles and cemented the adjacent particles, improving the mechanical properties and reducing permeability. Moreover, heavy metal colloids were incorporated into large-sized calcite crystals, and heavy metal ions were sequestered within the calcite lattice.

INFLUENCE OF SEDIMENT QUALITY AND MICROBIAL COMMUNITY ON THE FUNCTIONING CAPACITY OF A CONSTRUCTED WETLAND TREATING ALKALINE LEACHATE AFTER 5.5 YEARS IN OPERATION

Hudson. A., J.G. Murnane, T. O'Dwyer, M. Pawlett, and R. Courtney.
Science of The Total Environment 867:161259(2023)

A pilot-scale wetland was implemented to treat alkaline bauxite residue leachate and investigate the feasibility of constructed wetlands (CWs) to buffer alkaline pH. After 5.5 years, samples of supernatant water and sediment were collected at 0.5 m increments along the 11 m long wetland. Water samples were analyzed for pH, EC, and metal(loid) content, while the sediment was subjected to physicochemical assessment and element fractionation. Microbial biomass and community were assessed by phospholipid fatty acid analysis and functionality by the Rapid Automated Bacterial Impedance Technique. Results demonstrate that the CW effectively treated bauxite residue leachate, reducing influent pH from 11.5 to 7.8. Trace element analysis revealed an effective reduction in Al (94.9%), As (86.7%), and V (57.6%), with substrate analysis revealing a frontloading of elevated pH and trace element content in the first 5 m of the wetland. Sediment Al, As, and V were present mostly (>94% of the total) in recalcitrant forms. Sediment Na was mostly soluble (48-62%), but soils were not sodic (ESP<15%). Investigations into the microbial community revealed the greatest biomass in the first 5 m of the wetland, where pH, electrical conductivity, and metal contents were greatest. Microbial respiration using endemic *Phragmites australis* as a substrate demonstrates an ability to cycle recalcitrant carbon sources within a CW system.

PASSIVE TREATMENT OF ACID MINE DRAINAGE WITH ACTIVE GEOCOMPOSITES

Martins, G, S. Niewerth, and C. Cheah. Mine Closure 2022: 15th International Conference on

Mine Closure, Australian Centre for Geomechanics, Perth, pp. 321-328

A vertical flow pond covered with an active geocomposite was created for an abandoned nickel mine in Finland using a thin layer of highly active cation adsorbent mechanically stabilized and fixed between two layers of geotextile. The thin active geocomposite layer can be installed with a constant layer thickness and has higher efficiency for water treatment than a thick layer of stone due to the large surface area of the absorbent. The simplified installation process of the geocomposite can decrease construction time for large-scale filter ponds. A pilot field was built in Finland to prove the application's long-term efficiency. Weekly samples collected during the first 3 months showed reductions of nickel (average of 65%) and aluminum and copper (average >90%). In addition, the reduction of other metals and pH were documented. https://papers.acg.uwa.edu.au/d/2215_20_Martins/20_Martins.pdf

Research

ENVIRONMENTAL IMPACT ASSESSMENT OF THE SUBSURFACE IN A FORMER W-SN MINE: INTEGRATION OF GEOPHYSICAL METHODOLOGIES

De Almeida, H., M.C.G. Marques, H. Sant'Ovaia, R. Moura, and J. Espinha Marques.
Minerals 13(1):55(2023)

This research proposes an innovative approach that integrates different geophysical techniques to characterize the impact of mining activity on the subsurface in an area surrounding the tungsten mine of Regoufe in northern Poland. Sulfide-rich tailing accumulation may have caused acid mine drainage (AMD), where leaching led to soil contamination, as evidenced by its acidic character and anomalous concentrations of Potentially Toxic Elements (PTE). Electrical resistivity and electromagnetic geophysical methods were used to measure subsurface electrical properties. In addition, seismic refraction and multichannel analysis of surface waves were performed to characterize the geometry, depth, and geomechanical behavior of the soil and rock bodies. Integrating these techniques allowed the interpretation of hydrogeological sections and a 3D resistivity volume to gain insight into the distribution of potentially contaminating fluids and tailings material present in the mining valley. https://www.mdpi.com/2075-163X/13/1/55/pdf?version=1673854937

USING MERCURY STABLE ISOTOPE FRACTIONATION TO IDENTIFY THE CONTRIBUTION OF HISTORICAL MERCURY MINING SOURCES PRESENT IN DOWNSTREAM WATER, SEDIMENT AND FISH

Eckley, C.S., C. Eagles-Smith, T.P. Luxton, J. Hoffman, and S. Janssen.
Frontiers in Environmental Chemistry 4:1096199(2023)

A study used measurements of Hg stable isotopes in soil, sediment, water, and fish to differentiate Hg from an abandoned Hg mine from non-mine-related sources within the Willamette River watershed, including free-flowing river segments and a downstream reservoir. Total-Hg (THg) concentrations in reservoir fish were 4-fold higher than those further downstream (>90 km) from the mine site in free-flowing sections of the river. Mercury stable isotope fractionation analysis showed that the mine tailings (δ^{202}Hg: -0.36‰ ± 0.03‰) had a distinctive isotopic composition compared to background soils ((δ^{202}Hg: -2.30‰ ± 0.25‰). Similar differences in isotopic composition were observed between stream water that flowed through the tailings (particulate bound δ^{202}Hg: -0.58‰; dissolved: -0.91‰) versus a background stream (particle-bound δ^{202}Hg: -2.36‰; dissolved: -2.09‰). Hg isotopic composition within reservoir sediment indicated that the proportion of the Hg related to mine release increased with THg concentrations. In fish samples, the opposite trend was observed; the degree of mine-related Hg was lower in fish with higher THg concentrations. While sediment concentrations clearly show the influence of the mine, the relationship in fish is more complicated due to differences in methylmercury (MeHg) formation and the foraging behavior of different fish species. The fish tissue δ^{13}C and Δ^{199}Hg values indicate a higher influence of mine-sourced Hg in fish feeding in a more sediment-based food web and less so in planktonic and littoral-based food webs. Identifying the relative proportion of Hg from a local contaminated site can help inform remediation decisions, especially when

the relationship between total Hg concentrations and sources does not show similar covariation between abiotic and biotic media.
https://www.frontiersin.org/articles/10.3389/fenvc.2023.1096199/pdf

LABORATORY SIMULATION OF THE SWAMPY FOREST SYSTEM FOR THE PASSIVE TREATMENT OF ACID MINE DRAINAGE IN COAL MINE RECLAMATION AREAS

Noor, I., Y.F. Arifin, B.J. Priatmadi, and A.R. Saidy.
Scientific Reports 13:6077(2023)

A lab simulation experiment was conducted to obtain the basic data required to use swampy forest system treatment for acid mine drainage (AMD) to lower costs, increase capacity, and provide a natural process to mitigate AMD. The lab system experiment showed the compliance performance for treating AMD, with an incompliance value changing to the compliance value of the threshold parameter. The basic data for scale-up reference comprises determining the capacity of the flow rate, the volume of water flowing into the swampy forest system, and the retention time needed to obtain, at the end of the treatment process, a water quality that meets the quality standard parameter values before the wastewater is released to public water bodies. The lab system can be used as a reference when scaling up to a pilot project to design and construct a swampy forest system in the field. *This article is* ***Open Access*** *at* https://link.springer.com/article/10.1038/s41598-023-32990-x.

STUDY OF NATURAL ATTENUATION AFTER ACID IN SITU LEACHING OF URANIUM MINES USING ISOTOPE FRACTIONATION AND GEOCHEMICAL DATA

Liu, Z., C. Li, K. Tan, Y. Li, W. Tan, X. Li, C. Zhang, S. Meng, and L. Liu.
Science of The Total Environment 865:161033(2023)

Groundwater samples were collected from 26 wells located within, adjacent, upgradient, and downgradient of a post-mining site to analyze the fate of U(VI), SO_4^{2-}, $\delta^{34}S$, and $\delta^{238}U$, and reveal the main mechanisms governing migration and attenuation and the spatiotemporal evolutions of contaminants in the confined aquifer. The $\delta^{238}U$ values vary from -0.07‰ to 0.09‰ and -1.43‰ to 0.03‰ in and around the post-mining site, respectively. The $\delta^{34}S$ values vary from 3.3‰ to 6.2‰ and from 6.0‰ to 11.0‰ in and around the post-mining site, respectively. Detailed analysis suggests large differences between the range of isotopic composition variation and the range of pollutants concentration distribution. The estimated Rayleigh isotope fractionation factor is 0.9994-0.9997 for U, and 1.0032-1.0061 for S. The isotope ratios of U and S can be used to deduce the migration history of the contaminants and the irreversibility of the natural attenuation process in the anoxic confined aquifer. Combining the U and S isotopic fractionation data with U and S concentrations improved the understanding of reducing conditions along the flow path. The study also indicated that natural attenuation can be used as a cost-effective remediation scheme when geological conditions are favorable for redox reactions.

PHYSICAL-CHEMICAL RECOVERY OF A MONTANE STREAM AFTER REMEDIATION OF ACID MINE DRAINAGE: TIMING AND EXTENT AFTER TURNING OFF THE TAP

Meyer, J.S., E.H. Lloyd, S. Bevers, and J.F. Ranville.
Environmental Toxicology and Chemistry 42(2):495-511(2023)

Physical-chemical conditions were monitored in the North Fork of Clear Creek in Colorado before, during, and after the start of lime treatment to remove metals from two major inputs of acid mine drainage (AMD) water. More than two decades of historical monitoring data were also analyzed. Concentration-discharge (C-D) and load-discharge (L-D) plots accounted for discharge dependence in concentrations and loads of metals, major ions, and other water chemistry parameters. Total and dissolved concentrations and loads of the metals decreased after remediation began, with the largest decreases usually occurring during low stream flow. However, post-remediation concentrations and loads remained slightly to considerably higher than the reference, likely due to unidentified groundwater seeps and/or small surface flows. Dissolved Cu concentrations decreased much less than total Cu concentrations because the percentage of total Cu in the dissolved phase increased considerably as particulate Fe (PFe) concentration decreased. The study showed that 1) water chemistry could change to a new

steady state or pseudo-steady state relatively quickly after major AMD inputs to a stream are remediated; 2) elevated flows during snowmelt and rainfall periods can mobilize additional amounts of major ions and metals, resulting in in-stream concentrations that are manifestations of both dilution and mobilization; 3) although lime treatment of AMD-related waters can decrease metal concentrations, it does not decrease elevated concentrations of major ions that might impair sensitive stream invertebrates; 4) although Fe is toxic to aquatic organisms, PFe adsorbs other metals and thereby protects against their toxicity; and 5) use of C-D and L-D plots and element ratios can indicate the presence of unidentified AMD inputs to a stream.

SUCCESSIVE ALKALI DIFFUSION CERAMIC REACTOR: LONG-TERM REMOVAL OF ACIDITY AND HEAVY METALS IN ACID MINE DRAINAGE

Kim, M., Y. Yoon, N. Kamal, C.E. Choong, M. Jang, and G. Lee.
Journal of Water Process Engineering 53:103858(2023)

A novel alkali diffusion reactor using ceramic porous media (ceram-ADR) was developed to treat acidity and heavy metals in acid mine drainage (AMD) long-term without external energy. Batch and column tests were performed to investigate the neutralization capabilities of six alkaline chemicals (i.e., MgO, $CaCO_3$, CaO, SiO_2, Na_2CO_3, and $NaHCO_3$) and the effects on pore size and hydraulic retention time (HRT) of ceram-ADRs. Among the chemicals, the ceram-ADR containing $NaHCO_3$ yielded a suitable pH range for water quality guidelines (pH values from 5.0 to 9.5) with an HRT of 1-2 days and had the best efficiency in terms of consistent alkaline diffusion and long-term heavy metal removal (>99%). The precipitation process was a major mechanism in the removal of heavy metals. Based on the continuous column tests, ceram-ADR successfully treated three consecutive runs with ~340 bed volumes of AMD for neutralization and heavy metal removal, indicating that the ceram-ADR can be maintained for over three years without a lapse in performance.

General News

CLOSING PIT LAKES AS AQUATIC ECOSYSTEMS: RISK, REALITY, AND FUTURE USES

Lund, M.A. and M.L. Blanchette. | Wires Water e1648(2023)

In this article pit lake closure and future uses are assessed from a practical standpoint, focusing on the risks and options available. The term "future uses" is used rather than "beneficial end use" because a desired end use is by nature "beneficial." The socio-political aspects of pit lake closure are not reviewed, but the authors recognize they are critical to closure success. In most cases, closing pit lakes as aquatic ecosystems is the most realistic goal that permits a variety of future uses in the short- and long-term. Focusing on the practical issues around pit lake creation and closure allows a realistic assessment of repurposing pit lakes for delivering ecosystem services and benefits to communities.
https://wires.onlinelibrary.wiley.com/doi/epdf/10.1002/wat2.1648

A REVIEW ON REMEDIATION OF IRON ORE MINE TAILINGS VIA ORGANIC AMENDMENTS COUPLED WITH PHYTOREMEDIATION

Sarathchandra, S.S., Z. Rengel, and Z.M. Solaiman. | Plants 12:1871(2023)

Existing physical, chemical, and amendment-assisted phytoremediation methods to rehabilitate mine tailings are compared from cost, reliability, and durability perspectives. The review concludes that amendment-assisted phytoremediation has received comparatively great attention; however, the selection of an appropriate phytoremediator is a critical step in the process. Moreover, phytoremediation efficiency is solely dependent on the amendment type and rate. Applying advanced plant improvement technologies, such as genetically engineered plants produced for this purpose, would be an alternative solution.
https://www.mdpi.com/2223-7747/12/9/1871/pdf?version=1683094371

A STEP-BY-STEP GUIDE FOR EVALUATING THE PREFERRED CLOSURE SCENARIOS USING A HYBRID OPTIONS ASSESSMENT MODEL

Lourel, I, D.J. Todd, and A.Y. Liu. Mine Closure 2022: 15th International Conference on Mine Closure, Australian Centre for Geomechanics, Perth, pp. 503-512, 2022

This article presents a potential process map for determining the preferred closure scenarios, including instructional steps, a hybrid options assessment model, and examples for each component. Prior assumptions should be verified through data gathering to fill knowledge gaps, establish context and baseline knowledge, and define the relevant closure domains and work elements. With input from subject matter experts, technical practitioners, and project stakeholders, integrated trade-off studies can be carried out using multi-criteria analysis (MCA) to assess the merit and impact of key decisions under each closure scenario. Compatible options between trade-off studies can be linked to form branches of a decision tree for each closure scenario, where the quantitative MCA scoring and qualitative ranking of the trade-off studies reveal preferences on possible decisions. Given the subjective nature of these assessments, different perspectives should be adequately considered/challenged, and the results tested through sensitivity analysis. The options selection process should be transparent, rigorous, defensible, and well-documented to form a robust basis for decisions with an enduring legacy. https://papers.acg.uwa.edu.au/d/2215_35_Lourel/35_Lourel.pdf

DRONE-BASED INVESTIGATIONS OF URANIUM MINING LEGACIES: AN AIRBORNE GAMMA SPECTROMETRY METHOD TO SUPPORT, INSPECT, AND MONITOR MINE CLOSURE PROCESSES

Preugschat, B.; C. Kunze, B. Wiens, and S. Altfelder. Mine Closure 2022: 15th International Conference on Mine Closure, Australian Centre for Geomechanics, Perth, pp. 623-632, 2022

Drone-based geophysical methods can be used to assess post-mining areas to facilitate remediation planning and monitor them as part of long-term institutional control in the post-closure phase. A case study of drone-based gamma spectrometric investigations is presented using legacies of former uranium mining that pose a direct threat to humans and the environment and are still present in the countries of Kyrgyzstan, Kazakhstan, Uzbekistan, and Tajikistan. In the DUBGEM project (Development of a UAV-Based Gamma Spectrometry for the Exploration and Monitoring of Uranium Mining Legacies), a drone-based detector system was developed to investigate and monitor these legacies. Two scintillation detectors ($CeBr_3$, NaI) with different crystal volumes can be used alternately. The drone is a custom-built heavy lift system with a maximum take-off mass of 25 kg. The measurement data can be displayed in real-time at a ground station to locate hotspots during the survey and plan subsequent detailed measurements. Using drone-based systems is particularly advantageous in mining regions that are difficult to access and potentially harmful to human health. The results of drone-based gamma spectrometry investigations obtained during a 2021 measurement campaign in Central Asia are also presented. The drone prototype developed in the project can also carry other sensors with a payload of up to 7 kg. In subsequent projects, a new Federal Institute for Geosciences and Natural Resources department - Research and Development Centre for Post-Mining Areas - will investigate former lignite post-mining areas in Germany using further geophysical sensor technology. https://papers.acg.uwa.edu.au/d/2215_44_Preugschat/44_Preugschat.pdf

IN-PIT DISPOSAL OF MINE TAILINGS FOR A SUSTAINABLE MINE CLOSURE: A RESPONSIBLE ALTERNATIVE TO DEVELOP LONG-TERM GREEN MINING SOLUTIONS

Cacciuttolo, C. and E. Atencio. | Sustainability 15(8):6481(2023)

Many old tailings storage facilities could be re-processed within the next few decades considering the prices of metals, new uses of metals which today are not valuable, and the application of new, more efficient metallurgical technologies. In-pit disposal of mine tailings (IPDMT) is an attractive alternative to use as part of responsible mine closure: mines could reprocess the mine tailings and place them in an open pit as part of sustainable mine closure. This article explores a little-explored, environmentally-friendly tailings disposal technique, returning mine tailings to their place of origin and providing long-term stability under a climate change scenario. The article presents the main features, benefits, and potential drawbacks of IPDMT, with an emphasis on a description of the main advantages and disadvantages of application; design issues related to IPDMT physical stability (pit slope stability, tailings transport, placement systems); IPDMT hydrological stability (water management, seepage control, hydrogeological monitoring,); and IPDMT geochemical stability. The article proposes to change the status quo of traditional management of mine tailings to a new paradigm where the technique of in-pit disposal of mine tailings can be considered a green

mining solution for mine closure. The article concludes with successful cases around the world that involved the implementation of this technique. *This article is **Open Access** at* https://www.mdpi.com/2071-1050/15/8/6481.

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