Technology Innovation News Survey

Entries for May 16-31, 2020

Market/Commercialization Information

REQUEST FOR PROPOSAL 89303319REM000034 FOR THE IDAHO CLEANUP PROJECT (ICP) PROCUREMENT

U.S. DOE, EM-Environmental Management Consolidated Business Center, Cincinnati, OH.
Contract Opportunities at Beta.SAM, Solicitation 89303319REM000034, 2020

This acquisition is unrestricted and contains no small business set-aside provisions, NAICS code 562910. The Department of Energy is releasing the final RFP for the Idaho Cleanup Project (ICP) - Radioactive Waste Management Complex Closure and Other Mission Objectives procurement through its ICP procurement website at https://www.emcbc.doe.gov/SEB/icp/rfppage.php. Monitor that website for updates and answers to questions. Questions must be submitted by 11:59 PM ET on June 10, 2020. Offers are due by 3:00 PM ET on July 28, 2020.
https://beta.sam.gov/opp/a01f8d07dbae4c0eb92c89859c028506/view

REDUCING MERCURY USE AND STRENGTHENING SUPPLY CHAINS IN MALI'S ARTISANAL AND SMALL-SCALE GOLD MINING SECTOR

Department of State, Bureau of Oceans - Int. Environmental - Scientific, SFOP0007026, 2020

This project is intended to reduce the use of mercury in artisanal and small-scale gold mining (ASGM) through education, better technology, stronger equipment supply chains, and more responsible gold supply chains. This project, part of a larger U.S. Government initiative to work comprehensively with ASGM sectors, requires communicating and coordinating with other U.S. projects and policy makers from international organizations and other governments. The closing date for applications is July 31, 2020. A single award with a ceiling of $493,750 is anticipated.
https://www.grants.gov/web/grants/view-opportunity.html?oppId=327432

LUCKEY REMEDIATION SERVICES

Dept. of the Army, W072 Engineering District Buffalo, NY.
Contract Opportunities at Beta.SAM, Solicitation W912P420R0004, 2020

This procurement is a total small business set-aside under NAICS code 562910. The Luckey site, located in Wood County, OH, was used for beryllium processing in support of the national defense program from 1949 to 1961. Contaminants of concern include beryllium, lead, radium-226, thorium-230, uranium-234, and uranium-238 in soils, sediments, groundwater, fill materials, and miscellaneous debris. Services shall consist of environmental remediation and support for the U.S. Army Corps of Engineers, Buffalo, New York District. Offers are due by 3:00 PM ET on August 5, 2020.
https://beta.sam.gov/opp/3c089db6ad794f1a9908fe7ee41c04fe/view

ORONOGO-DUENWEG REMEDIATION AND REPAIR SITE SPECIFIC CONTRACT

U.S. EPA, Region 7 Contracting Office, Lenexa, KS.
Contract Opportunities at Beta.SAM, Solicitation 68HE0720R0048, 2020

When the solicitation is released, it will be issued as a HUBZone set-aside under NAICS code 562910 for remediation and repair work at properties located in the Oronogo-Duenweg Mining Belt site in Jasper and Newton counties, Missouri. Repair will be conducted for three properties previously remediated within Operable Unit 1 and remediation is required for one mine waste area. Monitor FedConnect at https://www.fedconnect.net/FedConnect/?doc=68HE0720R0048&agency=EPA for release of the solicitation. https://beta.sam.gov/opp/380a19ab604a43f193a3ceeab10f526c/view

Cleanup News

ESTIMATION OF SELF-NEUTRALISATION RATES IN A LIGNITE PIT LAKE

Opitz, J., M. Alte, M. Bauer, W. Schafer, and T. Soll.
Mine Water and the Environment [Published online 25 May 2020 prior to print]

Natural anaerobic biogeochemical acid mine drainage passive treatment processes were observed in the extensive shallow water zone of a polymictic pit lake in the former German lignite district of Upper Palatinate. Although continuously fed by acidic metalliferous groundwater, lake-pH increased from 3.5 to circumneutral over ~10 years. The acidity inflow was estimated at ≈5900 kmol from 2014-2018, which

corresponds to an average inflow of ≈1190 kmol/a. Results indicated that the pit lake self-neutralized due to beneficial environmental and ecological conditions, amplified and potentially initialized by the circumneutral discharge from a chemical mine water treatment plant, driven by well-known biogeochemical mechanisms such as natural microbial sulfate reduction.
https://link.springer.com/content/pdf/10.1007/s10230-020-00692-9.pdf

RECORD OF DECISION FOR THE BALLARD MINE
EPA Region 10, 182 pp, 2019

This Record of Decision addresses Operable Unit [OU]1 of the Ballard Mine Superfund Site. The selected remedy includes a combination of engineered source controls, permeable reactive barriers, sediment control best management practices, and engineered wetland treatment cells. A key element is controlling the release of contaminants from waste rock dumps and mine pits by backfilling pits; consolidating, grading, and shaping waste rock; and constructing an approximately 5- to 6-ft-thick engineered cover system over more than 500 acres. Monitored natural attenuation will act as a polishing step or a final treatment stage if groundwater contamination remains after treatment. Remedial construction will be implemented in phases, aligning with the anticipated recovery of phosphate ore from different areas of the site. The overall timeline for construction is estimated to be 6-8 years and the cost of implementing the remedy, ~$41 million. https://semspub.epa.gov/work/10/100176934.pdf

URANIUM MINING: POST-CLOSURE LAND USES - A PERSONAL GLOBAL REVIEW
Waggitt, P.W.
Proceedings of the 13th International Conference on Mine Closure p.997-1002(2019)

A selection of former uranium mining sites from around the world is presented where remediation has been completed or is ongoing, and post-mining land use has been established or is nearing completion. The examples are drawn from Europe, the United States of America, and Australia. This article is Open Access at https://papers.acg.uwa.edu.au/p/1915_78_Waggitt/

Demonstrations / Feasibility Studies

DISCHARGE SYSTEM 2019 ANNUAL OPERATIONS AND MAINTENANCE REPORT BERKELEY PIT AND DISCHARGE PILOT PROJECT
Atlantic Richfield Company, 17 pp, 2019

A full-scale pilot test is being conducted to evaluate treatment technologies and water management methods to meet Butte Mine Flooding Operable Unit Consent Decree requirements at the Berkeley Pit and control water elevation in the pit. The report summarizes the Discharge System annual operations and maintenance for 2019 as part of the pilot project. The system withdraws and treats Berkeley Pit water in the existing Horseshoe Bend Water Treatment Plant and discharged to the Yankee Doodle Tailings Impoundment (YDTI). YDTI water is then treated in a polishing facility that utilizes multi-media fractionation; reverse osmosis; a product tank; and polymeric coagulant, antiscalant, carbon dioxide, and organosulfide reagent systems chemical feed systems to remediate high pH (9.5-10.5) water. The water is then discharged into Silver Bow Creek. In 2019, the Discharge System successfully treated 447 million gals of water from the YDTI before offsite discharge. Additional components of the Discharge System will continue to be commissioned and demonstrated during 2020.
https://pitwatch.org/wp-content/uploads/2020/04/Discharge_System_2019-Annual-OM-Rpt.pdf

LABORATORY AND FIELD-BASED ASSESSMENT OF THE EFFECTS OF SEDIMENT CAPPING MATERIALS ON ZINC FLUX, BIOAVAILABILITY, AND TOXICITY
Cervi, E.C., K. Thiamkeelakul, M. Hudson, A. Rentschler, S. Nedrich, S.S. Brown, et al.
Environmental Toxicology and Chemistry 39(1)240-249(2020)

The efficacy of AquaBlok™ limestone, and limestone-bone char capping materials for decreasing Zn dissolution from sediments under natural and reasonable worst-case conditions (pH = 5.5) was evaluated. Field exposures were conducted in situ in limnocorrals and ex situ in core tube mesocosms. Simultaneous in situ and ex situ toxicity tests were conducted using *Daphnia magna*, *Hyalella Azteca,*, and *Chironomus dilutes* exposed to surficial sediments, caps, and hypolimnetic overlying waters for 4 d. No differences in responses between treatments involving sediment capping materials in both in situ and ex situ tests were observed, likely due to dissolved Zn in surface water being below the hardness-adjusted threshold effects levels (164 µg/L). Both studies provided site-specific data to select an effective remedy with reduced uncertainty compared to laboratory and chemistry-only approaches.
https://setac.onlinelibrary.wiley.com/doi/pdf/10.1002/etc.4612

BONITA PEAK MINING DISTRICT BIOCEMENT-A PILOT STUDY
EPA Region 8, 2 pp, 2019

One of the leading sources of metals loading to nearby waterways originates from the runoff of contaminated soils from mine tailings in the Bonita Peak Mining District. To stabilize the solid media in

source areas, EPA is implementing a BioCement pilot study on the north side of the former Kittimac Mill. BioCement technology provides an innovative erosion control strategy that uses "microbial induced calcite precipitation." to solidify loose soils into rock. Four 5' × 15' areas of the Kittimac site will be treated with BioCement over two months. If successful, this technology will be used to stabilize additional tailings and soil. https://semspub.epa.gov/work/08/100006791.pdf

ASSESSING BIOCHAR APPLICATION TO IMMOBILIZE CD AND PB IN A CONTAMINATED SOIL: A FIELD EXPERIMENT UNDER A CUCUMBER-SWEET POTATO-RAPE ROTATION

Jiang, S., J. Liu, J. Wu, G. Dai, D. Wei, and Y. Shu.
Environmental Geochemistry and Health [Published online 23 April 2020 prior to print]

Litchi branch biochar (BC) was used to stabilize Cd- and Pb-contaminated agricultural soil near Dabaoshan Mine in South China during a cucumber-sweet potato-rape crop rotation over one year. BC was pyrolyzed at 600°C and applied at four rates [(0 t/ha (T0), 10 t/ha (T1), 20 t/ha (T2), and 30 t/ha (T3)]). Results showed that BC application increased the pH, cation exchange capacity, and soil organic matter. After the cultivation of crops, pH decreased gradually, with the biggest drop of 0.45 pH units in T3 treatment after rape cultivation. BC application increased the yield of three crops up to onefold to twofold in T3 treatment as compared to the control. The uptake of Cd and Pb in all three crops decreased with the increase in BC doses, which was related to the decrease in bioavailable metals in their respective soil treatments.

IN-PIT BATCH TREATMENT OF ARSENIC: LABORATORY STUDIES AND FIELD TRIAL

Mine Environment Neutral Drainage Program, 71 pp, 2019

Lab and field studies were conducted to demonstrate in-pit batch treatment of arsenic-contaminated water in mine pits using ferric sulfate. The overall objective of the investigation was to demonstrate that in-pit batch treatment of arsenic represents a viable and economical alternative to traditional water treatment applications. Phase 1 included a bench-scale study that was used to define the design criteria, including the attainable treatment efficiencies, the required reagent dosages, and the sludge production rates. Phase 2 of this study included a field-scale treatment trial that evaluated the practicality and efficacy of in-pit batch treatment of arsenic within the Night Hawk Lake Mine open pit, as informed by the results in Phase 1. Total and dissolved arsenic concentrations at 3 depths were compared pre- and post-treatment in 3 sampling events at two stations (NHP 1 and NHP2). Immediately post-treatment, total arsenic concentration at the surface at NHP1 decreased from 0.6 mg/L to 0.01 mg/L total arsenic with a dissolved concentration <0.002 mg/L for a treatment efficiency of ~98% within the surface depths. The mid-depth samples for the same sampling event were ~0.03 and 0.01 mg/L for the total and dissolved arsenic concentrations, respectively. The arsenic concentrations at depth remained close to the initial concentrations before treatment. http://mend-nedem.org/wp-content/uploads/3.60.1.pdf

Research

STUDY ON THE APPLICATION OF FLOATING BEDS OF MACROPHITES (*VETIVERIA ZIZANIOIDES* AND *PHRAGMITES AUSTRALIS*) IN PILOT SCALE FOR THE REMOVAL OF HEAVY METALS FROM AGUA FORTE STREAM (ALENTEJO-PORTUGAL)

Borralho, T., D. Gago, and A. Almeida.
Journal of Ecological Engineering 21(3):153-163(2020)

A six-month study tested the efficiency of a macrophyte floating bed technology (using *Vetiveria zizanioides* or *Phragmites australis*) to remove heavy metals fromstream water. Experiments were performed in polyvinyl chloride tanks, each with 1 m^3 nominal capacity, filled with ~0.8 m^3 of water from the stream that was renewed monthly. The floating beds consisted of a high-density polyethylene floating system and an organic plant support mat filled with a plant density of 285 plants/m^2. The heavy metal removal rates obtained were Fe = 40%; Zn = 33%; Cu = 23%; and Mn = 14% (*Vetiveria zizanioides*) and Fe = 27%; Zn = 19%; Mn = 17%; and Cu = 14% (*Phragmites australis*). The growth of macrophytes showed the ability to survive in the acid mine drainage-containing waters without severe damage in their external and anatomical morphology, although their growth suffered inhibition.
http://www.jeeng.net/pdf-118285-48122?filename=Study%20on%20the%20Application.pdf

TREATMENT EFFICIENCY OF IRON-RICH ACID MINE DRAINAGE IN A TRI-UNIT PILOT SYSTEM

Genty, T., B. Bussiere, M. Benzaazoua, C.M. Neculita, and G.J. Zagury.
Environmental Science and Pollution Research 27:8418-8430(2020)

Iron-rich acid mine drainage was treated in a lab-scale tri-unit pilot reactor (2.65 m^3) for one year. The first unit consisted of a passive biochemical reactor, filled with a reactive mixture (50% of manure, sawdust, maple chips, compost, urea, sediment, and sand; 50% of calcite) to neutralize acidity and to partially remove metals. The second unit contained wood ash and acted as neutralizer and iron retention filter. The last unit was a second passive biochemical reactor filled with a reactive mixture (98% of

manure, sawdust, maple chips, compost, urea, sediment, and sand; 2% of calcite) as a polishing step to remove residual metals. The pH increased from 3 to ~ 6, and redox potential decreased significantly (from 550 mV to 100 mV). Fe decreased from 4 g/L to ~100 mg/L. The performance of the multistep treatment system was controlled by the capacity of the wood ash to immobilize iron

EVALUATION OF CHARCOAL ASH NANOPARTICLES POLLUTANT REMOVAL CAPACITY FROM ACID MINE DRAINAGE RICH IN IRON AND SULFATE

Kefeni, K.K., and B.B. Mamba.
Journal of Cleaner Production 251:119720(2020)

Namibian hardwood charcoal ash was used to remove metals and sulfate from acid mine drainage. Results indicated almost complete and partial removal of toxic metals and sulfate, respectively.

BIOGEOCHEMICAL CHARACTERIZATION OF METAL BEHAVIOR FROM NOVEL MUSSEL SHELL BIOREACTOR SLUDGE RESIDUES

Butler, S.C., J. Pope, S.R. Chaganti, D.D. Heath, and C.G. Weisener.
Geosciences 9(1):50(2019)

A laboratory mesocosm study investigated the physio-chemical and biological influence of anoxic storage (burial deep within a waste rock dump) and exposure to oxic environments (use of sludge on the surface of the mine) on sludge material created by a mussel shell bioreactor treating acid mine drainage (AMD). Microbes in an oxic environment increased the formation of oxyhydroxides, and acidic conditions increased metal mobility. In an oxic and circumneutral environment, the AMD sludge may be repurposed to act as an oxygen barrier for mine tailings or soil amendments. Anoxic conditions would likely promote the biomineralization of sulfide minerals in the AMD sludge by sulfate-reducing bacteria, which were abundant in the system. The anoxic conditions reduced the risk of Zn associated with oxides, but increased Fe associated with organic material. Fewer risks were associated with anoxic burial but repurposing in an oxic condition may be appropriate under favorable conditions.
https://scholar.uwindsor.ca/cgi/viewcontent.cgi?article=1205&context=glierpub

COVELLITE (CUS) PRODUCTION FROM A REAL ACID MINE DRAINAGE TREATED WITH BIOGENIC H^2S

Silva, P.M.P., A.R. Lucheta, J.A.P. Bitencourt, A.L. Vilaca do Carmo, I.P.N. Cuevas, et al.
Metals 9:206(2019)

This study looked at biological treatment of acid mine drainage for valuable dissolved metals recovery as a new source of raw materials. Covellite (CuS) crystal synthesis was optimized by exposing real acid mine drainage collected from a Brazilian copper mine to H_2S produced by a sulfidogenic bioreactor for 48 and 96 h. https://www.mdpi.com/2075-4701/9/2/206/pdf-vor

THE DEVELOPMENT OF A TREATMENT PROCESS FOR THE MINE WATER CONTAINING ARSENIC AND THIOCYANATE FROM LAB SCALE TO PILOT PLANT SCALE

Vaxelaire, S., B. Jally, F. Battaglia-Brunet, and J. Jacob.
Proceedings of the International Mine Water Association (IMWA) Conference, 15-19 July, Perm, Russia, 2019

Mine drainage from ~8 million tonnes of cyanidation tailings at a former French gold mine contains around 8 mg/L of As and 1 g/L of SCN^- and is treated at a plant that produces large amounts of sludge. The present study aimed to develop a semi-passive mine water treatment process that decreases sludge production and improves treatment efficiency with a target discharge level <100 µg/L As.
https://www.imwa.info/docs/imwa_2019/IMWA2019_Vaxelaire_286.pdf

REMEDIATION OF MANGANESE-CONTAMINATED COAL-MINE WATER USING BIO-SORPTION AND BIO-OXIDATION BY THE MICROALGA *PEDIASTRUM DUPLEX* (AARLG060): A LABORATORY-SCALE FEASIBILITY STUDY

Thongpitak, J., J. Pekkoh, and C. Pumas. | Frontiers in Microbiology 10:2605(2019)

This study evaluated microalgal Mn biosorption and biooxidation of water from a rehabilitated coal mine reservoir. The microalga was tested in filtered water obtained from the rehabilitated site, nonfiltered water that was sterilized with an autoclave, and non-treated water. All treatments of living microalga supported Mn biooxidation and achieved >97% Mn removal.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6861300/pdf/fmicb-10-02605.pdf

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)

Detrital clay minerals that originated from the partial weathering of coal mining waste increased total As uptake in acid mine drainage sediments. Clays controlled As mobility during sustained redox cycling by (1) enhancing heterogeneous precipitation of Fe(III) precipitates ($Fe(III)_{NP}$) under oxic conditions which 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.

ESTUARY SEDIMENT TREATMENT FOR REDUCING SULFATE IN ACID MINE WATER
Fahruddin, F., A. Abdullah, Nurhaedar, and N. La Nafie.
Environment and Natural Resources Journal 18(2):191-199(2020)

Estuary sediments were used as a source of sulfate-reducing bacteria inoculums to reduce sulfate in acid mine water in a column bioreactor. Treatment T1 containing sediment and compost was compared to treatments T2 (sediment), T3 (compost), and the T4 control treatment containing only acid mine water. Treatment T1 reduced sulfate concentrations by 78%, compared to 56% in T2, 21% in T3, and 5% in T4. The reduction of sulfate was followed by increases in pH where T1 reached a pH value of 7.1, compared to treatments T2 and T3 which had pH values <5.5. Treatment T4 had a pH of 2.2. The reduced sulfate and increased pH were also followed by an increase of SRB growth, especially in T1.
https://ph02.tci-thaijo.org/index.php/ennrj/article/view/239889/163571

REMOVAL OF ZINC FROM CIRCUM-NEUTRAL PH MINE-IMPACTED WATERS USING A NOVEL "HYBRID" LOW PH SULFIDOGENIC BIOREACTOR
Holanda, R. and D.B. Johnson.
Frontiers in Environmental Science 8: Article 22(2020)

A laboratory-scale, continuous-flow hybrid sulfidogenic bioreactor (HSB) was used to remediate synthetic and actual circum-neutral pH, Zn-contaminated water bodies from two abandoned metal mining sites. The reactor was fed zero-valent sulfur (ZVS) and sulfate potential electron acceptors and a glycerol potential electron donor. The bacterial consortium used in the reactor included several species of acid-tolerant bacteria that catalyze the dissimilatory reduction of both ZVS and sulfate and a novel acidophilic ZVS-reducing Firmicute. In both cases, >99% of Zn was removed from solution as ZnS using both in-line and off-line configurations. Both mine waters contained sufficient alkalinity to neutralize the generation of acidity resulting from ZnS formation. A potential scenario for full-scale treatment of one of the mine waters using an HSB is described. This article is Open Access at
https://www.frontiersin.org/articles/10.3389/fenvs.2020.00022/full

MECHANISMS FOR THE REMOVAL OF CD(II) AND CU(II) FROM AQUEOUS SOLUTION AND MINE WATER BY BIOCHARS DERIVED FROM AGRICULTURAL WASTES
Bandara, T., J, Xu, I.D. Potter, A. Franks, J.B.A.J. Chathurika, and C. Tang.
Chemosphere 254:126745(2020)

Biochars derived from poultry litter, lucerne shoot, vetch shoot, canola shoot, wheat straws, and sugar-gum wood were used to evaluate their capacity to immobilize Cd(II) and Cu(II) from aqueous solution and contaminated mine water in batch sorption experiments.

LONG-TERM PERFORMANCE OF A UASB REACTOR TREATING ACID MINE DRAINAGE: EFFECTS OF SULFATE LOADING RATE, HYDRAULIC RETENTION TIME, AND COD/SO_4^{2-} RATIO
[illegible] Sancinetti, and R.P. Rodriguez.
[illegible]

ANALYSIS OF PLANT AND SOIL RESTORATION PROCESS AND DEGREE OF REFUSE DUMPS IN [illegible]
[illegible] Research and Public Health 17:1975(2020)
[illegible] improve the ecological stability of coal mining areas.
https://www.mdpi.com/1660-4601/17/6/1975/pdf

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[illegible] REALIZING BENEFICIAL END USES FROM ABANDONED PIT LAKES
[illegible] successful closure with beneficial end uses.
https://www.mdpi.com/2075-163X/10/2/133/pdf

[illegible]
[illegible] This paper is Open Access at https://www.mdpi.com/2073-4441/11/12/2493/htm

[illegible] AS A REMEDIATION STRATEGY TO [illegible]
[illegible] materials under long-term submergence.

EVALUATION OF ECOLOGICAL RESTORATION SUCCESS IN MINING-DEGRADED LANDS
[illegible] indicators.

INNOVATIVE AND SUSTAINABLE APPROACH FOR PHYTOREMEDIATION OF MINE TAILINGS: A REVIEW
[illegible]
This review looks at innovating a sustainable solution to stabilize mine tailings using bioremediation and phytoremediation.
https://link.springer.com/content/pdf/10.1007/s42768-019-00022-y.pdf

[illegible] IONS, RECYCLING STRATEGIES, AND [illegible]
[illegible] agricultural fertilizer, and building materials are described. Phytoremediation technologies are discussed.

DISTINGUISHING RECLAMATION, REVEGETATION AND PHYTOREMEDIATION, AND THE [illegible]
[illegible] near future.

CRITICAL REVIEW OF APPLICATIONS OF IRON AND STEEL SLAGS FOR CARBON [illegible]
Iron and steel slags possess characteristics suitable for engineering applications, which are described in this article along [illegible] fugitive gas emissions such as [illegible] from municipal solid waste landfills and attain zero-emissions landfill.

The Technology Innovation News Survey welcomes your comments and suggestions, as well as information about errors for [illegible] with any comments, suggestions or corrections and Technology Innovation at [illegible] presentations, or papers does not constitute a U.S. EPA endorsement of their contents, only an acknowledgment that they exist and may be relevant to the Technology Innovation News Survey audience.