

Technology Innovation News Survey

Entries for August 16-31, 2019

Market/Commercialization Information

RESEARCH LABORATORY SUPPORT FOR THE EPA OFFICE OF RESEARCH AND DEVELOPMENT AT RTP, NC

Environmental Protection Agency, Office of Research and Development (ORD), Cincinnati, OH.
Federal Business Opportunities, Solicitation 68HERC19R0061, 2019

The mission of EPA's ORD is to conduct decontamination and consequence management research with an emphasis on rapid and cost-effective cleanup and restoration of buildings and broad outdoor areas to support EPA's ability to respond to all-hazards contamination events. Researchers seek to identify and develop optimal technologies and procedures for effective and efficient decontamination, disposal, and related activities (e.g., evaluation of sampling and analytical techniques for measurement of chemical, biological, and radiological agents; assessing fate and transport of such agents) while maximizing protection of decontamination crews, the general public, and the environment. They also investigate the dispersion and exposure potential of chemical, biological, and radiation releases in indoor and ambient environments. Research is conducted to characterize exposures to chemicals across the whole exposure assessment paradigm in the areas of source identification and characterization; transport, transformation, and fate of pollutants; atmospheric chemistry and physics; source apportionment; exposure measurements; biomonitoring; exposure and dose modeling; and methods development. Proposals are due via FedConnect by 4:00 PM ET on Thursday, October 17, 2019. <https://www.fbo.gov/spg/EPA/OAM/OH/68HERC19R0061/listing.html>

TECHNICAL AND ADMINISTRATIVE SUPPORT FOR THE U.S. EPA NATIONAL DRINKING WATER PROGRAM

Environmental Protection Agency, Office of Acquisition Solutions, Cincinnati, OH.
Federal Business Opportunities, Solicitation 68HE0C18R0081, 2019

This acquisition will be conducted on a full and open basis under NAICS code 541611. U.S. EPA's Office of Ground Water and Drinking Water is responsible for the National Drinking Water Program, for which this contract will provide technical and analytical support. This IDIQ contract will have a period of performance from the effective award date through five years for the ordering period, with an additional 12 months for completion of task orders issued during this period. Both firm-fixed-price and time-and-material task orders will be issued. The minimum order amount is \$100,000 and the maximum amount of orders shall not exceed \$35M. For the full range of contract support required, see the Performance Work Statement attached to the FedBizOpps notice. Proposals are due by 4:30 PM ET on October 17, 2019 <https://www.fbo.gov/spg/EPA/OAM/OH/68HE0C18R0081/listing.html>

HAZARDOUS MATERIALS WORKER HEALTH AND SAFETY TRAINING

DHHS, National Institutes of Health, Funding Opportunity RFA-ES-19-003, 2019

NIEHS invites applications for cooperative agreements to support the development of model programs for the training and education of workers engaged in activities related to hazardous materials and waste generation, removal, containment, transportation and emergency response. This funding opportunity announcement aims to prevent work-related harm through safety and health training. The training programs will transmit skills and knowledge to workers in how best to protect themselves and their communities from exposure to hazardous materials encountered during hazardous waste operations, hazardous materials transportation, environmental restoration of contaminated facilities, or chemical emergency response. U45 clinical trials will not be allowed. See additional details at <http://grants.nih.gov/grants/guide/rfa-files/RFA-ES-19-003.html>. About \$28M is available in estimated program funding. The closing date for applications is November 21, 2019. <https://www.grants.gov/web/grants/view-opportunity.html?oppId=319531>

Cleanup News

ASSESSMENT OF BED HYDRAULICS AND METAL LOADINGS IN A PASSIVE VERTICAL FLOW BIOREACTOR IN COMMERCE, OKLAHOMA

Cremeans, M.M., J.F. Devlin, T.C. Osorno, and R.W. Nairn.
Groundwater Monitoring & Remediation 39(3):40-47(2019)

A passive vertical flow bioreactor (VFBR) engineered treatment pond was used to remediate groundwater contaminated from improperly abandoned, over-drilled, and cased legacy boreholes at the Mayer Ranch in Commerce, Oklahoma. The VFBR promoted metal sorption and precipitation as sulfides by established reducing conditions in the groundwater. To verify that operations were unhindered by nonuniform flow in the VFBR, a flow uniformity assessment was done using a streambed point velocity probe (SBPVP), which was independently validated with a water balance. The outflow calculated from the SBPVP data came within 30% of the value suggested by measured inflow rates to the pond, supporting the conclusion that flow through was occurring with a satisfactory level of uniformity. Water flow rates through the reactive bed were up to an order of magnitude greater than those employed in prior column testing, contributing to metal loading rates estimated to be 2 orders of magnitude greater than those tested in the columns. Rapid chemical reactions that likely occurred close to the pond water-sediment interface contributed to the treatment system achieving its design objectives. *More information*
<https://itrcweb.org/bcr-1/Content/Appendix%20B%20Case%20Studies/B2%20Mayer%20Ranch%20Commerce%20Site.ht>

BRALORNE-TAKLA MERCURY MINE: INNOVATIVE RISK MANAGEMENT AND RECLAMATION

Runnells, J., T. McConkey, T. Gillett, and B. Power.
41st British Columbia Mine Reclamation Symposium 17-20 September, Williams Lake, BC, 2018

In 2005, the Crown Contaminated Sites Program began assessing on-site wastes, equipment, and other materials at the historic Bralorne-Takla mercury mine. Investigations confirmed the presence of unacceptable risks to human health and ecological receptors. Remedial objectives were identified to return the mine site to forest ecosystem. Remediation

included capping mine openings, demolishing structures, disposing of hazardous waste off-site, consolidating non-hazardous waste in 2 on-site landfills, revegetating, and implementing administrative risk controls to protect future site users. The cover design included innovative elements to support forest growth. Selection of native species for seed mix, shrub and tree replanting focused on returning the mine site to a forest ecosystem and supporting traditional use of the land. Monitoring covers, drainage systems, landfill gases, water quality, vegetation performance, and land use risk controls are ongoing. Additional monitoring includes ambient mercury vapor monitoring and biomonitoring. <https://open.library.ubc.ca/cIRcle/collections/59367/items/1.0374935>

TREATMENT DESIGN AND PROGRESS AT THE RICHARD MINE DISCHARGE

Cayton, S. | 2019 West Virginia Mine Drainage Task Force Symposium, 26-27 March, Morgantown, WV, 48 slides, 2019

The Deckers Creek Watershed spans 64 mi² across Preston and Monongalia Counties in North Central West Virginia. Deckers Creek flows ~24 miles and is listed on the West Virginia 303(d) list of impaired streams due to its acidity and metals and fecal coliform contamination stemming from the nearby Richard Mine. The Friends of Deckers Creek nonprofit watershed group aimed to turn Deckers Creek from a liability into an asset. For the past 19 years, the nonprofit focused its efforts on remediating acid mine drainage to remove Deckers and its tributaries from the 303(d) list. After years of monitoring and advocating for the cleanup of the Richard Mine across the community, the Natural Resource Conservation Service was awarded \$3.375 million to assist the nonprofit to remediate the site in 2017. Although the design is in the beginning stages due to ongoing land negotiations, the plan is to install a large-scale active treatment site that will include an active doser, a clarifier, and additional treatment measures. **Slides:** <https://wvmdtaskforce.files.wordpress.com/2019/03/2019-1430-cayton-deckers-creek-tf-2019.pdf> **Longer abstract:** <https://wvmdtaskforce.files.wordpress.com/2019/03/2019-3-cayton-deckers-creek-abstract.pdf> *More information* <https://deckerscreek.org/projects/>

CLERMONT COAL MINE REHABILITATION PRACTICES

Kimber, C. | CRC Care Mine Rehab Conference, 19-21 June, Newcastle, NSW, Australia, 34 slides, 2019

A coordinated approach to rehabilitation planning and implementation was developed for the Clermont Coal Mine in Queensland, Australia, customized to the unique characteristics of the site. Key elements of the approach included setting realistic rehabilitation targets, providing consistent work to ensure continuity of the rehabilitation workforce, and establishing open and meaningful communication at appropriate times. The site adopts a rolling 2-year rehabilitation cycle, with the initial tasks comprising bulk earthworks and landform shaping, followed by detailed trimming, drainage works and revegetation. The site presents several challenges, including a seasonal climate, dispersive soils and high landforms. Measures adopted at the site include the use of tri-linear slopes to stabilize long batters (the side slopes of cuttings and embankments) and control erosion, trials of a range of seed mixes and ground stabilization approaches, different topsoil combinations, use of basalt for armoring and various drainage design techniques. Many of the approaches applied at Clermont Coal Mine could be applied at other coal and mineral mines to improve rehabilitation outcomes across the industry. <https://www.minedlandrehab.com.au/chris-gimber.html>

Demonstrations / Feasibility Studies

USER GUIDE: PULVERIZED PAPER AS A SOIL CARBON SOURCE FOR DEGRADED TRAINING LANDS

Busby, R., H.A. Torbert, and S.A. Prior.
ESTCP Project RC-201416, 27 pp, 2018

A demonstration and validation project utilized pulverized paper waste as a soil amendment to improve degraded military training lands. The demonstration occurred in Fort Polk, Louisiana, on 2 soils representative of soils on military training lands. Each site consisted of 4 blocks, with a treatment replicated in each block. On the first site, rates of 8, 16, 24, and 32 tons/acre were applied, along with a control and a standard practice plot consisting of lime and fertilizer. Rates were halved for the second site. Paper was incorporated into the soil, and sites were seeded with standard native warm-season prairie grasses. At the end of each growing season, plant species cover and composition; standing biomass, plant, and soil nutrient analysis; soil metal analysis; and soil pH and bulk density data were collected. The paper application rate was positively correlated with native plant cover, deficient plant, and soil nutrient concentrations, and soil pH, and negatively correlated with invasive plant cover, biomass, and soil bulk density. Native plant cover was 45% higher at the highest paper application rates compared to controls, and most planted grass nutrient concentrations increased with increasing paper application rate. No EPA-regulated contaminants for land application of wastes increased with increasing paper application rate. An estimated \$300/ton savings of diverted paper was calculated by comparing the cost savings of using versus landfilling the paper. At a recommended application rate of 16 tons/acre, a total savings of \$4,700 per acre is possible, equating to estimated annual cost savings of \$20,000 with 70 tons of paper diverted.

<https://www.serdp-estcp.org/content/download/49272/469954/file/RC-201416%20User%20Guide.pdf>

PILOT STUDY OF IN SITU BIOLOGICAL TREATMENT AT THE SILVER KING MINE, KENO HILL, YUKON

Gault, A.G., J.M. Harrington, C. Robertson, M.C. Simair, and V.P.M. Friesen.
11th ICARD IMWA 2018 Annual Conference, September 10-14, Pretoria, South Africa. IMWA Proceedings (Volume I), 2018

Part of closure planning for the United Keno Hill Mines site in central Yukon, Canada included evaluating options for long-term treatment of several flowing adits in which Cd and Zn are the principal contaminants of concern. A 3.5-yr in situ pilot test conducted at the Silver King Mine was initiated to evaluate the potential closure strategy to treat Cd and Zn using in situ biological treatment. Pumped mine water was mixed with methanol or molasses as a carbon source and reinjected to create an environment ideal for sulfate-reducing bacteria to grow, precipitating Zn and Cd in the process. Four molasses injections were performed in 2015, each lasting between 24 and 42 days, and 2 additional injections of methanol followed in 2016, totaling 105 days. Genomic analysis confirmed the presence of sulfate-reducing bacteria dominated by members of the *Desulfosporosinus* genus. Following carbon injection, Zn and Cd concentrations declined by >90%. Despite rising slowly over time, Zn and Cd concentrations remained below both their pre-treatment concentrations and the effluent quality standards such that carbon injections on an annual basis may maintain low metal concentrations. https://www.imwa.info/docs/imwa_2018/IMWA2018_Gault_121.pdf

TESTING IRON REMOVAL IN A TRIFURCATED PILOT PLANT FOR PASSIVE TREATMENT OF CIRCUM-NEUTRAL FERRUGINOUS MINE WATER

Opitz, J., M. Alte, M. Bauer, and S. Peiffer.
International Mine Water Association (IMWA) Conference, 15-19 July, Perm, Russia, 2019

A passive treatment pilot plant was implemented at an abandoned, open-pit lignite mine site to investigate the suitability of serially connected settling ponds, wetlands and sediment filters for passive iron removal capable of reaching a 1 mg/L compliance limit. The system was designed to collect comparable hydraulic and hydrochemical data to investigate performance, kinetic relationships, and critical influencing factors as a basis for upscaling. After demonstrating reproducibility at equal flow rates in 3 identical lines, hydraulic variation was used to develop comparison data for sizing a full-scale passive system. The multi-stage setup was successful in reducing iron concentrations of 10 mg/L to the 1 mg/L goal. Area-adjusted removal rates were relatively low due to low hydraulic loading. Dependence of both treatment efficiency and area-adjusted removal on hydraulic loading was demonstrated during the variation period, showing direct and inverse relationships at graded flow rates, respectively. Future work will include further variation periods with intermediate, higher and lower flow rates to expand the database and the generation of high-resolution mass balances using continuously monitored turbidity as a proxy for (particulate) iron in the pilot plant to design a full-scale system. https://www.imwa.info/docs/imwa_2019/IMWA2019_Opitz_256.pdf

ACID MINE DRAINAGE PILOT REMEDIATION SYSTEM USING WASTE PRODUCTS FROM THE STEEL MANUFACTURING AND SUGAR INDUSTRIES

Naidu, T.S., C.M. Sheridan, L.D. Van Dyk, and A. Higginson.
International Mine Water Association (IMWA) Conference, 15-19 July, Perm, Russia, 2019

A 2-step chemical and biological treatment scheme that incorporates steel slag and sugarcane bagasse waste products was pilot-scale tested to treat acid mine drainage (AMD). A slag eluate buffered AMD and precipitated metals in a sedimentation tank. AMD was then passed through a packed bed containing sugarcane bagasse inoculated with sulfate-reducing bacteria (SRB) as a polishing step to remove sulfate, precipitate metal sulfides, and elevate pH to near-neutral conditions. A portion of the effluent was recycled through a packed bed of slag to create the eluate for pre-treatment of the raw AMD solution. The AMD was characterized by pH 2.6 and was contaminated with 174 mg/L Al, 245 mg/L Ca, 4289 mg/L Fe, 334 mg/L Mn, 415 mg/L Mg and 16333 mg/L SO₄²⁻. Operation of the pilot-scale system treating 200-1000 L/day has thus far shown maximum Al, Fe, Mn and SO₄²⁻ removals of 97%, 87%, 100%, and 87%, respectively. The dissolution of the slag and the alkalinity generation was found to occur mainly due to CaO and MgO dissolution. The SRB functioned in the slag eluate and a maximum sulfate reduction of 76% was found in the bioreactors. https://www.imwa.info/docs/imwa_2019/IMWA2019_Naidu_121.pdf

Research

PHYTOSTABILIZATION OF ZN AND CD IN MINE SOIL USING CORN IN COMBINATION WITH BIOCHARS AND MANURE-BASED COMPOST

Sigua, G.C., J.M. Novak, D.W. Watts, J.A. Ippolito, T.F. Ducey, M.G. Johnson, et al.
Environments 6(6):69(2019)

The effect of biochar additions (BA) with or without manure-based compost (MBC) was evaluated on shoots biomass, roots biomass, uptake, and the bioconcentration factor (BCF) of Zn and Cd in corn (*Zea mays L.*) grown in mine soil. Biochar additions of beef cattle manure (BCM), poultry litter (PL), and lodgepole pine were applied at 0, 2.5, and 5.0% (w/w) in combination with different rates (0, 2.5, and 5.0%, w/w) of MBC, respectively. Shoots and roots uptake of Cd and Zn were significantly affected by BA, MBC, and the interaction of BA and MBC. Corn plants that received 2.5% PL and 2.5% BCM had the greatest Cd and Zn shoot uptake, respectively. Corn plants with 5% BCM had the greatest Cd and Zn root uptake. When averaged across BAs, the greatest BCF for Cd in the shoot (92.3) was from application of BCM and the least BCF was from application of PL (72.8). The incorporation of biochar enhanced phytostabilization of Cd and Zn. Concentrations of water-soluble Cd and Zn were lowest in soils amended with manure-based biochars, which improved the biomass productivity of corn. *This article is Open Access at* <https://www.mdpi.com/2076-3298/6/6/69>.

CAN A BLEND OF AMENDMENTS BE AN IMPORTANT COMPONENT OF A REHABILITATION STRATEGY FOR SURFACE COAL MINED SOILS?

Abraha, A.B., E.H. Tesfamariam, and W.F. Truter.
Sustainability 11: 4297(2019)

The role of different amendments to alleviate compaction problems in rehabilitated mine soils were quantified in this study using 5 single amendments and 3 different blends of amendments mixed thoroughly with degraded mine soil in a 1:3 (amendment:soil) ratio. Two additional unamended soils with different bulk densities (BD) were included as benchmarks. Amendment applications reduced BD by 4-20%, enhanced infiltration rate by 15-70%, increased porosity by 5-35% and increased plant available water (PAW) by 9-33% compared with the unamended soils. Between amendments, the blends of amendments reduced BD by 9-16%, enhanced infiltration rate by 17-59%, increased porosity by 6-32%, and PAW by 4-28% compared with single amendments. A blend of amendments had better soil restoration capacity through improving porosity, infiltration rate, and plant-available water. *This article is Open Access at* <https://www.mdpi.com/2071-1050/11/16/4297>.

EFFECTIVENESS OF MONITORED NATURAL ATTENUATION (MNA) AS A GROUNDWATER REMEDY FOR ARSENIC IN PHOSPHATIC WASTES

Bessinger, B.A. and R.J.-C. Henne.
Groundwater Monitoring & Remediation [Published online 21 Aug 2019 prior to print]

A study evaluated MNA as a remedy for arsenic in groundwater at a former phosphate mining and manufacturing facility, likely sourced from acidic and saline process water that infiltrated through unlined ponds and ditches during historical manufacturing operations. As occurred in several chemical forms in phosphatic wastes, including unstable sulfide minerals, adsorbed surface complexes, and relatively insoluble phosphate and oxide minerals, and was associated with stable minerals. Sufficient levels of Fe oxyhydroxides were present at the site to effectively limit As migration at concentrations exceeding drinking water standards in the future in the Floridan aquifer. The geochemical evaluations required to satisfy EPA guidelines to determine whether MNA is an acceptable remedy for a site are

presented. The article also details the characterization and modeling that were used to demonstrate MNA effectiveness, which was ultimately selected as the remedy for As in groundwater.

ELECTROKINETIC REMEDIATION OF MANGANESE AND ZINC IN COPPER MINE TAILINGS

Ortiz-Soto, R., D. Leal, C. Gutierrez, A. Aracena, A. Rojo, and H.K. Hansen.
Journal of Hazardous Materials 365:905-911(2019)

In an evaluation of the effect of initial acidity and electric field intensity on the electrokinetic remediation of Mn and Zn from mine tailings at a Chilean copper mine, experiments focused on the effect of the applied electric field (1 and 2 V/cm), the H_2SO_4 concentration during pretreatment (1 and 2 mol/L) and the interaction between these factors in Mn and Zn concentration. From the obtained results, Mn and Zn can be removed from the analyzed tailings, with maximum net removal of 31.88% and 17.95%, respectively. Electromigration enhancement was confirmed by an analysis of variance with a significance level of 10% for the soluble and total metal concentration in the cathodic zone, where total concentration was increased to 24% and 11% for Zn and Mn, respectively.

SOIL RECLAMATION OF ABANDONED MINE LANDS BY REVEGETATION IN NORTHWESTERN PART OF TRANSYLVANIA: A 40-YEAR RETROSPECTIVE STUDY

Buta, M., G. Blaga, L. Paulette, I. Pacurar, S. Rosca, O. Borsai, F. Grecu, P. Ecaterina, et al.
Sustainability 11(12):3393(2019)

Researchers developed an ecological land restoration strategy to restore the ecological integrity of the 2 abandoned and disturbed mine lands in Aghiresu and Capusu Mare, in the Northwestern part of Transylvania. Soil quality changes were monitored over 40 years as a result of land restoration activities by examining 30 soil profiles and 450 soil samples collected from 3 depths (0-20 cm, 20-50 cm, and 50-80 cm). All the proposed plant covers (natural grassland, pasture cover, black locust, Norway spruce, and Scots pine) significantly improved the overall soil quality with the increasing years of reclamation following various patterns. Pasture cover most significantly enhanced the soil's microbial activity, organic carbon, nitrogen, phosphorus, and potassium content, followed by natural grassland. Results revealed that restoration of the vegetation cover on tailing dumps contributes to soil quality improvement through stabilization, pollution control, aesthetic improvement, and soil fertility. *This article is **Open Access** at <https://www.mdpi.com/2071-1050/11/12/3393/htm>.*

URANIUM NATURAL ATTENUATION DOWNGRADE OF AN IN SITU RECOVERY MINE INFERRED FROM A CROSS-HOLE FIELD TEST

Reimus, P.W., M.A. Dangelmayr, J.T. Clay, and K.R. Chamberlain.
Environmental Science and Technology 53(13):7483-7493(2019)

A field test conducted at a U in situ recovery site evaluated postmining natural attenuation downgradient of an ore zone. Approximately 1 million liters of water from an ore zone well was injected into an unmined ore zone serving as a proxy for a downgradient aquifer. After 1 year of pumping, ~39% of the injected U(VI) and ~100% of co-injected chloride was recovered. A geochemical/transport model calculated chloride and uranium concentrations at the pumping well and $^{238}U/^{235}U$ ratios, used to reflect uranium removal via reduction. About 50% of the injected U(VI) was reduced to U(IV), although the reduction capacity in the flow pathways between the injection and production wells was estimated to be nearly exhausted by the end of the test.

COPPER PHYTOEXTRACTION AND PHYTOSTABILIZATION POTENTIAL OF WILD PLANT SPECIES GROWING IN THE MINE POLLUTED AREAS OF ARMENIA

Ghazaryan, K.A., H.S. Movsesyan, H.E. Khachatryan, N.P. Ghazaryan, T.M. Minkina, et al.
Geochemistry: Exploration, Environment, Analysis 19(2):155-163(2018)

The phytoremediation potential of 16 native wild plant species growing in Cu-contaminated soils of a mining region in Armenia was evaluated in this study. In roots of dominant plant species, Cu concentrations varied between 55 mg/kg (*Hypericum perforatum*) and 775 mg/kg (*Thymus kotschyanus*), and in shoots of plants in the range from 33 mg/kg (*Teucrium orientale*) and 243 mg/kg (*Phleum pratense*). The high contents of soil organic matter and clay in the soil facilitated the decrease of the ratio $C_{bioavailable}/C_{total}$ and, as a result, the decrease of Cu accumulation capability of plants. *Thymus kotschyanus*, *Phleum pratense* and *Achillea millefolium* had the highest phytostabilization potential of all the studied species due to high bioconcentration factors of their roots and low translocation factors registered in these plants.

EFFECTS OF VEGETATION PATTERN AND SPONTANEOUS SUCCESSION ON REMEDIATION OF POTENTIAL TOXIC METAL-POLLUTED SOIL IN MINE DUMPS

Chen, F., Y. Yang, J. Mi, R. Liu, H. Hou and S. Zhang.
Sustainability 11(2):397(2019)

Plant growth, soil fertility, and the capacity of potential toxic metals (PTMs) using different vegetation patterns were investigated over 10 and 17 years to understand the role of vegetation pattern and spontaneous succession in the early phase of mine restoration projects. To do this, field and lab experiments on different vegetative patterns were conducted using combinations of rehabilitative plants (RP) and local plants (LP) at a metal mining dump in Sichuan, China. Phytoremediation using a simple vegetation pattern of RPs *Agave sisalana* and *Neyraudia reynaudiana* achieved a PTM pollution index of 9.28% lower, a soil fertility index of 21.86% lower, and biodiversity index of 73.69% lower than a complex vegetative pattern using RPs and LPs. Phytoremediation with a 10-year RP and LP pattern had a PTM pollution index 4.04% higher, a soil fertility index 4.48% lower, and a biodiversity index 12.49% lower than the 17-year RP and LP pattern. Results indicate the importance of choosing a suitable vegetation pattern to prevent spontaneous vegetation succession and ensure phytoremediation. *This article is **Open Access** at <https://www.mdpi.com/2071-1050/11/2/397/htm>.*

General News

MAKING A DIFFERENCE IN COMMUNITIES: CALIFORNIA GULCH SUPERFUND SITE
U.S. EPA Making a Difference in Communities webinar series, 22 February 2016

For years, EPA has worked with the community of Leadville, Colorado, the Colorado Department of Public Health and the Environment, and other site stakeholders to complete cleanup at the California Gulch Superfund site and return the site to appropriate use. The Superfund site encompasses 18 sq mi, including the entire town of Leadville. This video highlights how the cleanup of a portion of the Superfund site, combined with the community's leadership and support for bringing new recreational resources to the area, has resulted in development of the Lake County Community Park and Fairgrounds. https://www.youtube.com/watch?v=_Jdi-AdBrLs&feature=youtu.be

FUZZY SYSTEM FOR DECISION SUPPORT OF POST-MINING REGIONS RECLAMATION (FSDR)

Krol-Korczak, A. and E. Brzychczy.
Archives of Mining Science 64(1):35-50

This article presents a fuzzy systems (FSDR) solution used to select the proper reclamation direction of post-mining areas created after operation has terminated for open-pit gravel and sand natural aggregate mines. Factors used to determine the selection of the direction and possible reclamation variants as input and output data of the fuzzy system are also offered. The rules base of the developed system as well as the mechanisms of inference and defuzzification are also characterized. Examples are included where the developed system was used.

A REVIEW OF THE IMPLICATIONS AND CHALLENGES OF MANGANESE REMOVAL FROM MINE DRAINAGE

Neculita, C.M. and E. Rosa.
Chemosphere 214:491-510(2019)

Beneficial and adverse effects of Mn on ecosystems and human health and a comparison of background and mine effluents Mn contents are summarized, stressing the need for Mn removal from mine drainage. Several technical options to address Mn contamination in acid and neutral mine drainage and the challenges associated with Mn removal are subsequently discussed. This paper presents up-to-date knowledge on the available physicochemical and biological processes deemed operative in Mn removal during mine drainage treatment and their limitations considering the distinctive behavior of Mn. The discussion is extended to passive treatment systems, highlighting both design criteria and operational requirements, as well as the factors that influence Mn removal efficiency. New perspectives on future research and development needs are identified to address the challenges in Mn removal during mine drainage treatment.

RE-THINKING MINING WASTE THROUGH AN INTEGRATIVE APPROACH LED BY CIRCULAR ECONOMY ASPIRATIONS
RE-THINKING MINING WASTE THROUGH AN INTEGRATIVE APPROACH LED BY CIRCULAR ECONOMY ASPIRATIONS

Current knowledge across social, environmental, technical, legal, regulatory, and economic domains is integrated into a new approach for exploiting, or rethinking, mining wastes to move toward a zero environmental footprint in the mining industry. This approach includes five key areas: social dimensions, geoenvironmental aspects, geomaterials specifications, economic drivers and legal implications for improved environmental outcomes, and circular economy aspirations, which are aligned with the 10 principles of the International Council on Mining and Metals. Applying circular economy thinking to mine waste presents a major opportunity to reduce the liability and increase the value of waste materials arising from mining and processing operations. *This article is **Open Access** at* <https://www.mdpi.com/2075-163X/9/5/286/html>.

SOIL-PLANT RELATIONSHIPS AND CONTAMINATION BY TRACE ELEMENTS: A REVIEW OF TWENTY YEARS OF EXPERIMENTATION AND MONITORING AFTER THE AZNALCOLLAR (SW SPAIN) MINE ACCIDENT

Madejon, P., M.T. Dominguez, E. Madejon, F. Cabrera, T. Maranon, and J.M. Murillo.
Science of the Total Environment 625:50-63(2018)

A literature review was conducted to summarize key research findings focused on soil-plant systems at the Aznalcollar mine since the occurrence of a large-scale mine accident in April 1998. The review includes information on mine slurry and contaminated soil characterization and on trace element (TE) monitoring performed over the past 20 years. Lab results on the soil amendments used as a reclamation technique at the site are discussed, focusing on the effects of different types of amendments at different spatial scales and their effectiveness with time. Other lab results discussed include monitoring TEs in soil and their transfer to plants to assess potential toxicity effects in the food web and using plants to biomonitor TEs in the environment. The experience acquired in making the Guadiamar Green Corridor a large-scale soil reclamation and phytoremediation case study is also evaluated

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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