MONTANA TECH - MINERAL INDUSTRY 2023 INAUGURAL FALL SYMPOSIUM

Friday October 6, 2023 8:00am - 5:00pm SUB Copper Lounge

ABSTRACTS (Page 1)

THE FUTURE OF MINING IN A 21ST CENTURY ECONOMY

K. Marc LeVier, K. Marc LeVier & Associates, Inc, SME President 2023, Denver CO

The demand for minerals has never been greater. The mining industry will be challenged to produce more critical minerals domestically and develop mineral independence over the next 25 years. The presentation will provide a brief history of rare earths in the US, outline the demand for domestic production, and the need for a balanced and consistent permitting plan for the US. All of this will require a greater workforce and a large number of new mines.

REPAIR OF A CEMENTED ROCK FILL TRANSFER PASS

Bracken V. Spencer, PE, PMP, Principal Engineer, Alpine Consulting & Mining Engineering, PLC, Bozeman MT

Cemented Rock Fill (CRF) is transferred to lower production levels at an underground mine through the use of a steel-lined, six-foot diameter borehole. The CRF backfill build up near the collar had been managed through the use of controlled blasting. Over repeated blasts, the steel liner deformed and further restricted flow of CRF through the pass. A team comprised of three firms collaborated to develop a methodology, tools, and materials to remove the damaged portion of the liner, enlarge the collar diameter and install new, single piece liners. This presentation reviews the methodology, work flow and lessons learned through the project life cycle.

APPLICATION OF UNDERGROUND PRE-SPLITTING IN BUTTE, MT

McKoy Gebhardt, Senior, Mining Engineering, Montana Technological University, Butte MT

The use of presplitting applications in an underground mine setting is a method of reducing overbreak in the rib and back when blasting occurs. Presplitting performed at the Underground Mine Education Center (UMEC) on Montana Technological University's campus in Butte, Montana showed a dramatic decrease in the amount of overbreak incurred in the blasting process. Application of the presplitting technique occurred after pre-splitting presentations at ISEE in San Antonio. This presentation will report on the application of pre-splitting techniques and the results to date.

CONSTRUCTION OF TWIN 1400 ALIMAK RAISES AND THE INSTALLATION OF 850 HP FANS

Cole Deringer, Project Engineer, Sibanye-Stillwater Mining Corporation, Nye Operations, Nye MT

This presentation will discuss, at a high level, when to use Alimak vs other vertical development methods and design elements that need to be considered in order to have a smooth build and fan installation.

HYDROMETALLURGICAL RECOVERY OF RARE EARTH FLUORIDES FROM RECYCLED MAGNETS

Isaac Cobbinah, MS Student, Metallurgical & Mineral Processing Engineering, Montana Tech, Butte MT

Magnets containing substantial quantities of rare earth elements (REEs) are currently one of the most sought-after commodities because of their strategic importance. Recycling REE magnets after their life span has been identified to be a unique approach for mitigating environmental issues that originate from mining and also for sustaining natural resources. The approach is hydrometallurgical, with leaching and precipitation followed by separation and recovery of neodymium (Nd), praseodymium (Pr) and dysprosium (Dy) in the form of rare earth fluorides (REF) as the final product. The methodology is specifically comprised of sulfuric acid (H_2SO_4) leaching and ammonium hydroxide (NH_4OH) precipitation followed by reacting the filtrate with ammonium bifluoride (NH_4F-HF) to yield the REF. Additional filtering also produces ammonium sulfate ($(NH_4)_2SO_4$) as a byproduct fertilizer. Quantitative and qualitative evaluations by means of XRD, ICP and TGA-DSC to determine decomposition of ammonium jarosite, which is an impurity in the recovery process were performed. Additionally, conditional and response variables were used in a surface-response model to optimize REF production from end-of-life magnets. A REF recovery of 56.2% with a REF purity of 62.4% was found but optimization tests will be conducted to improve on these results.

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THE MINERAL INDUSTRY IN GHANA

Mohammed Moro, MS Student, Metallurgical & Mineral Processing Engineering, Montana Tech, Butte MT

Ghana is blessed with large mineral deposits. However, it is only recently that new technology has made it possible to locate mineral deposits. Accordingly, it has attracted numerous international companies. The Mineral Industry in Ghana contributes to about 5% of the country's GDP, while minerals make up approximately 37% of total global exports. Ghana currently has 23 mines mostly for diamonds, bauxite, gold, and manganese. Gold is the most abundant, making Ghana the largest gold producer in Africa and the 6th largest producer globally. Gold mining companies include AngloGold Ashanti Limited, GoldFields Ghana Limited, Golden Star Resources Limited, Ansanko Gold Ghana Limited, Chirano Gold Mine, Perseus Mining Ghana Limited, Adamus Resurces Limited, and Newmont Ghana Limited which is the leading producer in Ghana. All operations are discussed but the focus is on Newmont Ghana Limited.

HISTORY OF FLOTATION THROUGH THE FIRST CHEMICALS AND EARLY MACHINES, PARTS I AND II

Courtney Young, Metallurgical & Materials Engineering, Montana Technological University, Butte MT

Flotation has roots to ancient times when adhesion was first used to cause mineral separations but was sporadic at best until bulk oil flotation commenced. Performance was improved and costs were decreased when bulk oil was eliminated though sequential discoveries of aeration, modifiers, neutral collectors, frothers and finally ionic collectors. The latter is synonymous with xanthates 100 years ago. This chemical evolution was simultaneous with the development of flotation machines. Although there is some referencing to current times, this presentation focuses how flotation technology advanced and highlights the historical firsts.

SURFACE CHEMISTRY OF ORFOM® D8 FOR DEPRESSING CU IN CU/MO SEPARATION WITH DIFFERENT COLLECTORS

Patrick Jeff Mensah, MS Student, Metallurgical & Mineral Processing Engineering, Montana Tech, Butte MT

In traditional chalcopyrite-molybdenite (Cu-Mo) separation, NaSH and NaCN are the most commonly used depressants; however, these inorganic chemicals raise environmental, safety and economic concerns. Hence, attention has shifted to organic depressants, particularly disodium carboxymethyl trithiocarbonate (Orfom® D8). For the past 8 years, Montana Tech investigators collaborated with Chevron-Phillips Chemical Company to determine how this depressant works. Through a variety of techniques and with xanthate as collector, they determined that, because it does not desorb the xanthate, it co-adsorbs and thereby masks the xanthate hydrophobicity. This makes the chalcopyrite hydrophilic, thus causing it to become depressed. In this study, a variety of different analytical techniques are being explored to not only confirm this mechanism but also to see if it applies to other collectors.

RARE EARTH MINERAL FLOTATION – A COMPARISON OF SILICATES TO OXIDES, CARBONATES AND PHOSPHATES

Abdul Wasiu Mamudu, MS Student, Metallurgical & Mineral Processing Engineering, Montana Tech, Butte MT

Rare earth minerals (REMs) are often recovered from ores using flotation, a technique that selectively separates the REMs from gangue minerals based on differences in hydrophobicity. However, flotation results are usually inconsistent, a phenomenon attributed to the REMs being solid solutions with varying concentrations of rare earth elements (REEs). To get around this issue, previous investigators at MT Tech controlled the REE content by examining "out-of-the-bottle" reagent-grade chemicals as pure synthetic REMs. After monitoring collector adsorption on rare earth oxides (REOs), carbonates (RECs) and phosphates (REPs), they concluded that REM flotation was controlled by REM type and REE cation size and ultimately by coordination number (CN) and lanthanide contraction (LC). These investigations have now been extended to rare earth silicates (RESs). However, in this case, various types of RESs were synthesized in the Metallurgical and Materials Engineering labs at MT Tech. X-ray Diffraction (XRD) was used to determine the RES types. While collector adsorption on the RESs was found to be comparable to that on REOs, RECs and REPs, results suggest that the effects of CN and LC also depend on the RES type.

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REE EXTRACTION FROM SUBBITUMINOUS COAL FLY ASH WITH ORGANIC ACIDS AND LEACHING AIDS
Heidi Steiger, MS Student, Metallurgical & Mineral Processing Engineering, Montana Tech, Butte MT
Coal fly ash has potential as an alternative source of rare earth elements (REEs) due to its abundant availability, fine particle size, and reasonable REE concentrations. A review of existing literature indicates that, in many fly ashes, the REEs are encapsulated in glassy aluminosilicate cenospheres which necessitates the use of costly, reagent-intensive roasting as well as harsh acids. However, ash produced from subbituminous Powder River Basin coal appears to be more leachable. This ease of extraction allows for the consideration of weaker organic acids with heightened selectivity and reduced environmental impacts compared to traditional mineral acids. Results obtained in the absence and presence of leaching aids are presented and additionally compared to the literature.

TAILS REPROCESSING PROJECT AT GOLDEN SUNLIGHT MINE
Kristi Murphy, Site Manager, Barrick Gold Corporation, Golden Sunlight, Whitehall, MT
The Golden Sunlight Mine operated as a cyanide-leach, hard-rock gold mine for 37 years before going into closure in 2019. The first tailings impoundment, operated from 1983 to 1996, had a high sulfide grade and a thin clay liner. The Tailings Reprocessing Project was motivated to reduce any acid-generation potentiality from the sulfide content. Golden Sunlight installed a small flotation circuit in the original mill building to concentrate the sulfides into a saleable product as a fuel source for Nevada Gold Mines roasters.

TRACE ELEMENTS IN FLUORESCENT SPHALERITE OF THE PHILIPSBURG MINING DISTRICT, GRANITE COUNTY, MT
Celine Beaucamp, PhD Candidate, Earth Science and Engineering, Montana Technological University, Butte MT
Sphalerite from the Philipsburg mining district has been analyzed with Laser Ablation Inductively Coupled Mass Spectroscopy for trace elements in the mineral's lattice in order to tentatively explain unusually bright fluorescence under longwave UV radiation. Fluorescent samples contain variable amounts of Cd, Cu, Ga (averages 525 ppm), ± In (averages 114 ppm), Hg, Ge, and W (up to ~2000 ppm). Iron is remarkably low (average of ~100 ppm), while copper is high (average of 907 ppm). Blue and green fluorescence seems to be linked to a low amount of trace elements, while bright red fluorescence correlates to a high amount. In comparison, low-to-non-fluorescent samples from the same district contain higher Fe, Mn, Ag (>1000 ppm), Cd, Cu (average of 2280 ppm), As, Pb, Sb, Sn, and Ge (average of 255 ppm). Some of these elements require coupled substitution to maintain the overall charge balance. The link between trace elements and fluorescence is a novel approach to studying sphalerite.

POTENTIAL RECOVERY OF SPHALERITE AND CONTAINED CRITICAL MATERIALS FROM TAILINGS
Jillian Winnick, Senior, Metallurgcal & Materials Engineering, Montana Technological University, Butte MT
Tailings are wastes of gangue minerals from mining and metallurgical processes. They are often stored in areas referred to as ponds or impoundments. However, these sites are now proving to be valuable resources for today's demands as a result of improved technology but also because they are deemed critical to society as well as the military. In this presentation, the economic potential for the recovery of sphalerite will be addressed for producing zinc, indium, gallium and germanium from the tailings located near Philipsburg MT at the Trout Mine which was closed in 1963.

SAMPLING OR GAMBLING? Grab Your Coffee Cup and Let's Go to Vegas
Mick L. McCaslin PE, Regional Product Line Manager, Sampling, Preparation, & Analysis, FLSmidth, Salt Lake City, UT
This is a participatory presentation and a discussion of our sampling practices. An exploration of why we choose to make the compromises that we do…even though we often know better.