Corrosion evaluation of anodized and unanodized titanium for application in pressure leaching
ID: 71049
Type: Student

**Speaker:** Jing Liu, The University of British Columbia, Canada  
**Author(s):** J. Liu, A. Alfantazi, E. Asselin

The excellent corrosion resistance of titanium in many environments is due to the presence of an inert, strongly adherent surface oxide film. In this work, anodic oxide films (AOFs) are produced on commercially pure titanium in 0.5 mol/L sulfuric acid solutions over a wide potential range (up to 80 V) at room temperature. Electrochemical methods like open circuit potential measurement, linear polarization resistance and electrochemical impedance spectroscopy (EIS) are used to study the corrosion response of anodized titanium in 30 g/L sulfuric acid solutions between 25 °C and 55 °C. The corrosion rates of unanodized titanium in sulfuric acid solutions in the presence of Cl-, Cu2+ and Fe3+ are measured up to 150 °C. The surface morphology and chemical composition of titanium are studied by scanning electron microscopy and X-ray photoelectron spectroscopy (XPS).

A novel mixer-settler-mixer three chamber integrated extractor for performing three-liquid-phase extraction of Li, B and Mg from salt-lake brines
ID: 73471
Type: Contributed

**Speaker:** Kun Huang, Institute of Process Engineering, Chinese Academy of Sciences, China  
**Author(s):** K. Huang, H. Liu

A novel mixer-settler-mixer three chamber integrated extractor has been proposed for performing liquid-liquid-liquid three phase continuous extraction of Li, B and Mg from salt-lake brines. The three-liquid-phase system consists of three liquid layers, i.e. organic top phase, polyethylene glycol (PEG)-rich middle phase and (NH4)2SO4 aqueous bottom phase. Various influences from flow rate of three liquid phases, stirring speed, phase ratios, aqueous pH values, molar ratios of Fe/Li and Mg/Li, initial Cl- concentrations, added amounts of (NH4)2SO4 and PEG2000 on three-liquid-phase partitioning of Li, B, and Mg were investigated. Experimental results indicate that Li can be enriched into top organic phase, B into middle PEG phase, while Mg remain in bottom aqueous phase. The present work highlights a feasible apparatus to perform continuous three-liquid-phase extraction. The results are important for future industrial application of proposed three-liquid-phase extraction technique to recover Li and B values from salt-lake brines in west China.

A Novel Zinc Electrowinning Anode Comprising Amorphous RuO2-Ta2O5 Catalyst
ID: 73118
Type: Student

**Speaker:** Masashi Ueda, Doshisha University, Japan  
**Author(s):** M. Ueda, T. Zhang, M. Morimitsu

This paper presents a novel anode for zinc electrowinning, which consists of an amorphous RuO2-Ta2O5 catalytic coating formed on a titanium substrate. The amorphous RuO2-Ta2O5 coating gives a high active surface area for oxygen evolution, which results in the voltage reduction of zinc electrowinning up to 700 mV compared to lead alloy anodes and more than 100 mV compared to amorphous IrO2-Ta2O3/Ti anodes. The novel anode also works well to suppress manganese oxide deposition and accumulation on the anode, which is a significant issue of zinc electrowinning, because zinc electrowinning solution usually has a high content of manganese ions. Since oxygen evolution is promoted and manganese oxidation is suppressed at the same time, the novel anode can reduce energy consumption and amount of sludge of zinc electrowinning and is expected as an environmentally friendly anode for zinc electrowinning.
An Experimental Study of the Effect of Bromide on Aluminum Cathode Corrosion
ID: 71285
Type: Contributed
Speaker: Neil Gao, Teck Metals Ltd., Canada
Author(s): N. Gao, C. Curtis, D. Liu, J. Gonzalez
Fluoride and chloride are major contributors to enhanced corrosion of aluminum cathodes used in the zinc electrowinning process. However, little is known about the effect of bromide and the compounded effect of fluoride, chloride and bromide. In this experimental study, aluminum cathode samples were partially immersed in electrolytes containing various concentrations of halide ions either under applied current or under rest potential conditions. Tests were conducted with or without continuous addition of concentrated bromide solutions to the electrolytes. Samples of the electrolyte were periodically taken to monitor the halide concentrations. The surface morphology of the corroded aluminum samples was examined using a scanning electron microscope. The study found that bromide readily oxidized to bromine under the applied current condition but remained unchanged under the rest potential condition. With continuous release of bromine from the electrolyte, pitting corrosion was greatly aggravated on the portion of the cathode above the solution line.

Approach for Early Evaluation of Pressure Oxidation for a Refractory Gold Ore Deposit
ID: 71805
Type: Contributed
Speaker: Shane Singh, Hatch Consulting Ltd., Canada
Author(s): S. Singh, M. Eichhorn, K. Fraser
In the exploration phase of a project, individuals are commonly confronted with decisions to invest, explore, or abandon. For refractory gold deposits, oxidative pretreatment is required to unlock precious metals trapped in sulphide minerals for economic recovery. Pressure oxidation is a compelling technology for refractory gold ore since it offers high sulphur oxidation throughput and high precious metal recoveries. Major factors for the deposit, such as gold grade, gold to sulphur ratio, mining method, and other metal credits can be used in a high-level economic model of a pressure oxidation project to place the project into an economic zone such as no potential, low, moderate and high. There are several important capital and operating cost estimates and assumptions made explicit for this model. This “rule-of-thumb” approach should be used with caution and with an understanding of its basis in order to prevent errors in decisions coming from its inappropriate application.

ID: 73993
Type: Contributed
Speaker: Thomas Johnson, Ashland Performance Materials, USA
Author(s): T. Johnson, J. Graham, D. Kelley
Hydrometallurgical processes can be exceptionally corrosive. This is particularly true in acid leaching processes for copper, cobalt, nickel and rare earth elements. In the last five years, several large hydromet plants have been built in North America (Vale - Long Harbour, Baja Mining - El Boleo and Molycorp - Mountain Pass). Hundreds of storage tanks, extraction vessels and electrowinning cells along with miles of piping were designed and fabricated to withstand the aggressive environments inherent in these processes. One key element all three projects had in common was the extensive use of FRP in equipment design. As a material of construction, FRP provided equal if not improved durability relative to alternative corrosion resistant alloys at a considerably lower cost. This paper will highlight the extensive use of FRP in these three world scale projects and why it was chosen for each process.
Capacity Enhancement of Newmont Mining Corporation's Twin Creeks Whole Ore Pressure Oxidation Facility
ID: 71487
Type: Contributed
Speaker: Tom Krumins, Hatch Ltd., Canada
Author(s): M. Eichhorn, T. Krumins, L. Zunti, F. Ruff
Hatch Ltd. has recently completed a project to increase refractory gold ore processing capacity at Newmont Mining Corporation's Twin Creeks facility. The objective of the project was to increase throughput by approximately 10% by adding a third autoclave feed pump to each of the two autoclave circuits. To minimize project capital cost, autoclave feed pumps from Newmont's decommissioned Lone Tree facility were evaluated and found to be suitable for this new service. The existing pressure oxidation circuit was reviewed in a debottlenecking study to determine other upgrades required to facilitate the increased throughput. Interruption to operations was minimized with a detailed construction plan, supplemented with detailed 3D layout model sequencing studies. The focus of this paper is project development, multi-discipline design considerations, and implementation results.

Characterization of the Micro Galvanic Activity in Coupled Carbon Steel/Zinc by Electrochemical Techniques
ID: 72636
Type: Poster
Speaker: Moussa Bounoughaz, University of Boumerdes, Algeria
Author(s): M. Bounoughaz, E. Salhi
The galvanic activity of coupled carbon steel/zinc was carried out by the use of the SVET (Scanning Vibrating Electrode Technique) that provides images of micro-galvanic activity in real time and the steady state electrochemical techniques. The effect of the number and distribution of zinc anodes was measured and the effectiveness of the protection of the carbon steel was estimated. Two models of repartition were studied. The first model was made by placing six anodes zinc into the carbon steel sample and the second model by placing eight zinc anodes. The results of both models show that the distance between the zinc anode and carbon steel plays an important role in the protection of the carbon steel. When eight zinc anodes were activated, some shadows appeared in the steel surface, indicating the presence of leaks in the protection that could lead to the corrosion of carbon steel.

Corrosion Studies at Teck's CESL Hydrometallurgical Facility
ID: 71336
Type: Contributed
Speaker: Jeff Riha, Teck Resources Ltd., Canada
Author(s): J. Riha, D. Schwartz, R. Bruce
Titanium has long been the standard material of construction for equipment for low pH, high-chloride service in chemical process industries. However, recent corrosion studies conducted by Teck at their CESL hydrometallurgical copper pilot plant in Richmond have identified a super duplex stainless steel that may be applicable in some applications where titanium is normally used. The paper will focus on the recent corrosion test results including the rationale for alloy selection, test methodologies and inherent challenges, and comparisons to standard ANSI testing methods.

Crud and organic recovery economics in Mineral processing
ID: 71424
Type: Contributed
Speaker: Derek Ettie, GEA Westfalia Separator, USA
Author(s): D. Ettie
This presentation will follow the costly effects of crud, fine sediment particles and poor organic recovery in typical copper and rare earth processes. Recent advancements in equipment technology have resulted in short term paybacks for centrifuge technology. Existing installation data will be presented to demonstrate the economics of these processes and give the attendees valuable information to utilize in improving their existing processes.

DEVELOPING ALTERNATIVE INDUSTRIAL MATERIALS FROM MINING WASTE
ID: 73677
Type: Poster
Speaker: Javier Flores-B, Universidad Autónoma del Estado de Hidalgo, Mexico

The presence of mining waste (known as tailings or mining dumps) near residential zones has been a major health and environmental problem in the mining district of Hidalgo, Mexico, causing allergies and respiratory complications due to the strong winds that characterize the region. For this reason the development of industrial materials from mining waste is suggested in this paper. The stabilization of the tailings involved taking samples and determining their chemical composition and particle size. Afterwards, the alternative industrial materials were produced by using the tailings and heavy clay in order to give the composite a good green strength and plasticity during development, but above all to give it a compressive strength similar or higher than that of products derived from conventional processes.

Development of RuO2Ta2O5Ti Anode for Cobalt Electrowinning Using Acidic Chloride Solutions
ID: 73120
Type: Student
Speaker: Kentaro Izumi, Doshisha University, Japan
Author(s): K. Izumi, T. Zhang, M. Morimitsu

The anode reaction of cobalt electrowinning using acidic cobalt chloride solutions is mainly chlorine evolution, but cobalt oxyhydroxide is also produced on the anode if platinum group metal oxide coated titanium anode is used, because the oxidation of divalent cobalt is prior to chlorine evolution. For the matter, this paper presents the preparation and performance of amorphous RuO2Ta2O5coated titanium anodes, in which the anodic polarization behaviors and the inhibition of the unwanted side reaction are shown. The results include that the novel amorphous oxide anode works with a lower chlorine evolution potential than other oxide coated titanium anodes such as IrO2-Ta2O5/Ti and Ru0.3TiO.7O2/Ti anodes, and cobalt oxyhydroxide deposition is suppressed on the novel anode. These excellent features induce prevention of cobalt loss from the solution by the anodic reaction, an increase in cathode current efficiency, and no need to eliminate deposited cobalt oxide from the anode surface.

Development of selective separation and recovery system for various metals using ammonia modification epoxy-polymer supported on the spherical cotton
ID: 73110
Type: StudentPoster
Speaker: Shotaro Saito, Ibaraki Univ., Japan
Author(s): S. Saito, S. Ojima, S. Igarashi, M. Butsugan, H. Yamaguchi

The glycidyl methacrylate polymer having epoxy-group (EP-N1: Hitachi Chemical Co., Ltd., Japan) was modified chemically with ammonia. The obtained new functional polymer (EP-N1A) was supported on spherical cotton and filled in column. Furthermore, it was used as a solid phase extraction material for metal ions. Sixty-two kinds of metal were examined in detail with respect to each extractive behavior. As results, mercury, platinum and gold were selectively extracted from acid aqueous solution. EP-N1A spherical cotton has fast extraction speed and the extraction percentage
High Effective Adsorption of Hexavalent Chromium from Aqueous Solution using NH2-fuctionalized PGMA Microspheres
ID: 73564
Type: Contributed
Speaker: Liangrong Yang, Chinese Academy of Sciences, China
Author(s): L. Yang, X. Sun, H. Liu
PGMA microspheres with micron size were prepared by dispersion polymerization method, and then were modified by EDA and PEI. Subsequently, the adsorption behaviors of microspheres for the removal of Cr( ) were investigated. The results showed that Cr(VI) adsorption depended significantly on pH. The optimal pH values of these microspheres were around pH 2~5. The adsorption isotherms of these NH2-fuctionalized PGMA microspheres for Cr(VI) fitted well with Langmuir model. The maximum adsorption capacity of PGMA-NH2, g-PGMA-NH2, PGMA-PEI600, PGMA-PEI1800, PGMA-PEI10172, magnetic PGMA-NH2and magnetic PGMA-PEI10172 microspheres was 303.00, 500.00, 460.83, 485.44, 505.05, 263.16 and 492.61 mg/g respectively, which is much higher than that of other adsorbents reported in the past. Adsorption reached equilibrium within a short time and the adsorption process was endothermic and spontaneous in nature. Competition from coexisting anions (Cl-, NO3-, H2PO4-, HPO42-) was found insignificant except SO42-. The adsorption capacity did not change noticeably after four successive adsorption-desorption cycles.

Incorporating Radiant Heat Exchange into Finite Element Models of Hydrometallurgical Process Equipment
ID: 72227
Type: Contributed
Speaker: David McMullen, Hatch, Canada
Author(s): D. McMullen
Radiation plays a critical role in the thermal behaviour of Hydrometallurgical process equipment. This is particularly important when designing equipment used in pressure leach/oxidation processes. In order to simplify this non-linear mode of heat transfer, the effects of radiation had previously been incorporated in a convective film coefficient in finite element models (FEM). This method omits the effects of radiosity, thus limiting the forecast required for the design of refractory lining systems in autoclave vessels. This study sought to investigate the role of radiosity and found that 60% of the heat loss in the real life behaviour of an autoclave is due to radiation. This study validates the use of radiosity in FEM through thermal loading using a combination of simple geometries and complex environments such as vessel nozzle clusters. Consequently, this study has found that the inclusion of radiosity in FEM simulates actual equipment operating conditions.

Large phase ratio extraction and enrichment of rare-earth ions by a novel gas-assistant column extractor
ID: 73470
Type: Contributed
Speaker: Kun Huang, Institute of Process Engineering, Chinese Academy of Sciences, China
Author(s): K. Huang, H. Liu
We proposed a novel gas-assistant column extractor to perform large aqueous-to-oil phase ratio extraction and enrichment of rare-earth ions from low-content aqueous leach solutions. Batch and continuous experiments were conducted to test enrichment and separation efficiency of rare-earth ions. Experimental investigations on the feed-in solutions containing La, Pr, Nd and Lu about 10 to 100 mg/L were carried out in order to determine the extraction
performance of the gas-assistant extraction column. The results demonstrate that enrichment and separation efficiency of light and heavy rare-earth ions is dependent on air bubbling rate, solvent flow rate and aqueous-to-oil phase ratio. The operational aqueous-to-oil phase ratio can be higher than 200:1, and percent extraction of rare-earth ions reaches above 95% after 5min. of air bubbling. The present work indicates that the new equipment can be employed for performing extraction processes of higher aqueous-to-oil phase ratio, and rare-earth ions with low concentrations (<100 mg/L).

Leaching Kinetics of a copper oxide ore in sulphuric acid solution
ID: 71666
Type: Contributed
Speaker: Momboyo Clotilde Apua, University of Johannesburg, South Africa
Author(s): M. Apua, M. Kime, M. Mollagee
The copper oxide ore bearing mainly malachite was leached in sulphuric acid. The effects of leaching period, stirring speed, temperature, and pH on the leaching rate were studied. recovery of 92.89 % Cu, 67.84 % Co and 74.34 % Fe were obtained using the optimal experimental conditions of 1h leaching time, 500 rpm stirring speed, 70°C temperature, and pH 1.5. The shrinking core model \[ 1-(1-a)^{(1/3)}=kCt/(r_o)=kt \] will be studied to determine the dissolution kinetics.

Mercury Removal from Pressure Oxidation Vent Gas at Newmont Mining Corporation’s Twin Creeks Facility
ID: 71484
Type: Contributed
Speaker: Lyle Zunti, Hatch Ltd., Canada
Author(s): T. Krumins, C. Stunguris, L. Zunti, S. Blaskovich
Hatch Ltd. has recently completed a project to substantially reduce mercury emissions from vent gas at Newmont Mining Corporation’s Twin Creeks refractory gold pressure oxidation facility. The objective of the project was to make each of the two autoclave circuits compliant with recent U.S. federal environmental regulation, EPA–HQ–OAR–2010–0239. The optimal process design was determined through an assessment of various flow sheets and mercury removal technologies. The process was developed around existing constraints imposed by plant operations. Project implementation was supported through process test work, permit development, and process throughput validation. A detailed execution plan, including a 3D layout model, was used to integrate the new equipment into each of the two circuits during their scheduled annual downtime. This paper provides an overview of the process options evaluated, the project execution plan and the corresponding challenges, as well as resulting operational performance.

Modeling of Platinum Extraction by Aliquat 336 in the Presence of Alkaline Metal Salts
ID: 69466
Type: Student
Speaker: Hesam Hassan Nejad, Memorial University of Newfoundland, Canada
Author(s): H. Hassan Nejad, S. Shafiei Zadeh, S. Alam
Salting out effect of five alkaline metal salts on platinum extraction using Aliquat 336 has been investigated and KCl showed the best effect in both efficiency and selectivity. modelling of platinum extraction from synthetic solution has also been conducted considering the effect of four variable parameters including contact time, extractant and HCl concentration as well as A/O ratio. A mathematical model by the help of Design Expert software has been developed using Response Surface Methodology (RSM technique) and Central Composite Design (CCD). Optimized conditions are also investigated. Our results showed huge potential to extract platinum up to 99% by Aliquat 336.
ID: 72911  
Type: Contributed  
Speaker: H. Mao, PanGang Group Research Institute Co., Ltd., China  
Author(s): H. Mao, H. Hu, X. Chen

Hydrochloric acid regeneration is used most for HCl recovery from waste pickle liquors from steel industry. In industrial mineral process, HCl acid leaching and spent liquor recycling becoming very popular now. A number of different process routes for HCl recovery and their advantages are reviewed. As the commercially available systems are optimized for pickle liquor for steel-making, the modification and optimization needed for industry mineral process are discussed. However, the impact of tightening environmental standards and stringent air permit policies makes it more and more challenging in using HCl regeneration while trying to keep industry mineral production cost under control and to maintain products have economically competitive advantage.

Optimization of the Usable Life of Lead Electrowinning Anodes
ID: 74010  
Type: Contributed  
Speaker: Timothy Ellis, RSR Technologies, USA  
Author(s): T. Ellis, A. Mirza, E. Lombard

Lead (Pb) based anodes are the dominant technology for electrowinning process’ in sulfate based media, e.g. Copper, Nickel, Cobalt, & Manganese. The lifecycle of electrowinning anodes is very dependent upon tank house operating conditions and maintenance of the anodes including cleaning and straightening. A presentation is made which relates optimal operational condition to enhance anode lifecycles. This presentation will focus on the operational aspects of maximizing the utilization of Pb electrowinning anodes.

Optimum Condition of vanadium recovery from power plant fly-ash with considering nickel behavior during the acidic leaching process using Orthogonal Array Design
ID: 71611  
Type: Student  
Speaker: Elmira Nazari, University of Tehran, Iran  
Author(s): E. Nazari, F. Rashchi, M. Saba

In this study, recovery of vanadium from power plant fly-ash was developed using a hydro metallurgical process consisted of acidic leaching using sulfuric acid. While dissolution of vanadium in acidic condition, dissolution of nickel may occur and participate in recovery procedure. Thus, objective is obtaining optimum condition of recovery of vanadium considering minimum dissolution of nickel, in order to separating vanadium from nickel was selective to the extent possible. Design of experiment was conducted based on Taguchi method (L16) to investigate the effect of some operating parameters which are: temperature (25-85°C), time (2-5hrs), S/L (1/5-1/20 Wt. %), acid concentration (5-20 V. %). The adopted method showed overall yield of 91% for vanadium. The optimum recovery yield of 89% for vanadium was presented considering minimum recovery of 19% for nickel under the optimum conditions proposed: temperature (65°C), time (3hrs), S/L (1:10 Wt. %) and acid concentration (20 V. %).

Recovery of Palladium from Plating Waste Solution via Homogeneous Liquid-Liquid Extraction (HoLLE).
ID: 71395  
Type: Poster  
Speaker: Takeshi Kato, Industrial Technology Institute of Ibaraki Prefecture, Japan  
Author(s): T. Kato, S. Igarashi, R. Ando
Palladium plating is mainly used as an electrical contact point in manufactured products. It has been required to easily and effectively recover palladium from plating waste solution. Homogeneous liquid-liquid extraction (HoLLE) utilizes the pH-dependent phase separation from a homogeneous solution. HoLLE can powerfully and rapidly concentrate metal within a few minutes. Based on HoLLE, recovery of palladium from plating waste solution was conducted. 96.6% of palladium was extracted into a sedimented liquid phase. After phase separation, the volume ratio (Va/Vs) of the aqueous phase (Va) and the sedimented liquid phase (Vs) was 556 (50 ml 0.09 ml). The procedure of HoLLE is simple and requires only the addition of a reagent. This technique has a potential for progressive recovery system of palladium from plating waste solution.

Remove nickel from slag lixivium of scrap copper smelting
ID: 71390
Type: Contributed
Speaker: Zheng XU, General Research Institute for Nonferrous Metals, China
Author(s): Z. XU, F. Huang, Y. Li, L. Yang
The nickel content reaches 640mg/l in the lixivium of slag of scrap copper smelting with the zinc content more than 100g/l. This high content nickel must be separated from the leachate not only for resource recovery, but also for the subsequent zinc electrowinning which must keep the nickel less than 1mg/l to make the electrowinning process carry out regularly. The lixivium was pretreated by zinc powder. Most of the copper and cadmium was precipitated and the nickel content was reduced to 8mg/l. Then the antimony salt method was used to separate the remanent nickel. After a series of experiment, the nickel was reduced to 0.9mg/l to meet the zinc electrowinning standard under the best condition of 95 °C, 350r/min stirring speed, 10g/l of zinc powder, 6mg/l of Sb2O3 and 60min of reaction time. The removed nickel will be refined by further metallurgic method.

Slurry Erosion Resistance of Fe-Mo-B-C-Si and Fe-Cr-Mo-B-C-Si Weld Overlays
ID: 71803
Type: Contributed
Speaker: SERGE DALLAIRE, SYNTHESARC INC., Canada
Author(s): S. DALLAIRE
The extent of damage to the industrial components in contact with solutions containing particles depends on the microstructure of materials and the particle impingement angles. This work presents the research work carried out to develop a weld overlay that resists slurry erosion at low and high particle impact angles. Overlays containing primary Fe₂B crystals in Fe₂B-Fe and Fe₂B-Fe-Cr supporting matrices have been first considered. However, they have presented a slight improvement in slurry erosion resistance compared to chromium carbide overlays. Increasing the wear resistance of the matrices by adding toughening elements was found as the key for increasing the slurry erosion resistance of overlays. The welding deposition parameters as well as the composition ranges in the Fe-Mo-B-C-Si and Fe-Cr-Mo-B-C-Si systems that lead to improved performance are exemplified. Considerable enhancement in slurry erosion resistance at low and high impingement angles is achieved with overlays containing refined microstructures.

Study of kinetics of iron loading onto iminodiacetic ion exchange resin
ID: 73888
Type: Student
Speaker: Parisa Abbasi, University of British Columbia, Canada
Author(s): P. Abbasi, B. McKevitt, D. Dreisinger
The ion exchange process (IX) is applied in mining industry, for removal of impurities from process streams, treatment of waste prior to the disposal and recovery of pay metal. Extensive studies have been dealt with the modeling of IX for the
case of a single metal loading onto iminodiacetic resin in the hydrogen form. However, in a real system, resin may be saturated by impurities (iron, calcium, magnesium, manganese), which are then displaced by the metal of interest. The present study provides an insight into the Ni²⁺/Fe²⁺ displacement process onto iminodiacetic ion exchange resin under non-infinite solution volume condition. The study involves the measurement of nickel loading under variety of experimental conditions as well as an attempt to model the loading process using the hybrid correlation advanced by McKevitt (2011). The importance of the experimental and modeling work are discussed in the context of resin in pulp recovery of nickel.

STUDY OF SILVER CEMENTATION WITH ZINC FROM RESIDUAL X-RAY FIXER

ID: 73551
Type: Poster

Speaker: Miguel Perez-Labra, UAEH MEXICO, Mexico
Author(s): M. Perez-Labra, M. REYES-PEREZ, J. ROMERO-SERRANO, E. ÁVILA-DAVILA, E. SALINAS-RODRIGUEZ, F. PATIÑO-CARDONA, F. BARRIENTOS-HERNÁNDEZ

Silver cementation with zinc powder from residual X-ray fixers was studied. The cementation process in terms of pH of solution was thermodynamically modeled using the software FactSage by constructing the potential-pH diagram at 298.15 K. The E-pH diagram showed that the cementation process leads to metallic silver together residual unreacted zinc. The experimental parameters tested were pH of solution (from 3.0 to 7.0), temperature (from 298.15 to 318.15 K) and the Ag/Zn ratio (1:1, 1:2, 1:3, 1:4 and 1:5). The results showed that the maximum silver cementation (99.93% Ag) occurs at 30 s of reaction, pH 6.0, 298.15 K and Ag/Zn ratio equals to 1:3. Silver cementation decreases at pH values of 3.0 and 4.0 and temperatures between 303.15 and 318.15 K. The X-Ray and SEM-EDS results showed that the cementation products are mainly formed by Ag and Zn.

Technical Risk Mitigation Through Rheometallurgical Generation of Process and Equipment Design Criteria

ID: 74022
Type: Contributed

Speaker: Alex Mezei, SGS Mineral Services, Canada
Author(s): A. Mezei, M. Ashbury

According to the rheometallurgical concept, the main root cause of the process risk primarily resides in disconnects between the optimized metallurgical parameters and the physical conditions created as a result. This leads in turn to the interruption of the continuous flow needed to maintain the functionality of the plant, leading to bottle-necks, slow or incomplete ramp-up, or worse, complete shut-down / decommissioning. The rheometallurgical process risk analysis addresses these situations by quantifying the flow and separation behaviour of the process pulps and slurries in order to ensure continuous functionality of each circuit and hence of the overall processing plant. The methodology is well proven across virtually all commonly applied mineral processing and hydrometallurgical unit operations. Whilst most effective when applied starting from the incipient stages of testwork and process development (and throughout the completion of the full feasibility study), the concept is equally applicable for commissioning and trouble-shooting.

The combined effect of fluorides and ferric ions on the uniform corrosion of titanium and titanium alloys in sulfuric acid

ID: 71132
Type: Contributed

Speaker: Paavo Laihonen, Outotec (Finland), Finland
Author(s): P. Laihonen, M. Lindgren

In the hydrometallurgical applications, titanium or its alloys are used as a material of construction in the most aggressive environments. The combined effect of fluorides and oxidizing ions on the uniform corrosion of titanium in sulfuric acid is
somewhat unknown. Titanium grades 2, 7 and 17 were investigated with electrochemical techniques at ambient temperature in sulfuric acid, containing varying amounts of ferric ions and fluorides. The electrochemical techniques included the open circuit potential measurements and the linear polarization resistance measurements. The titanium electrode surfaces were also investigated with scanning electron microscope after the corrosion tests.

The role of thiosulfate on the pitting behavior of stainless steel 316 as a material of construction in near-neutral solutions containing chloride ions relevant to gold leaching
ID: 71183
Type: Contributed
Speaker: Milad Roushanafshar, University of British Columbia, Canada
Author(s): M. Roushanafshar, A. Alfantazi
The pitting and oxidation behaviors of the stainless steel 316 (SS316) were examined in the solutions which contained NaCl 1 g/L in the presence of 0.01 M and 0.1 M sodium thiosulfate. Cyclic polarization (CP) and electrochemical impedance spectroscopy (EIS) were used to analyse the responds of SS316 toward thiosulfate concentration, temperature and applied potential. The CP showed that no pitting potential was observed in the presence of 0.1 M sodium thiosulfate when compared to the solution with 0.01 M sodium thiosulfate. The EIS results revealed that the applied potentials did not affect the surface of the sample and the same results obtained after applying 0.5 V and 1 V vs. SCE. In contrast, the applied potential significantly influenced the surface of the SS316 in low concentrations of thiosulfate and in the presence of NaCl.

Thermal design of refractory lined pressure oxidation autoclaves
ID: 72137
Type: Contributed
Speaker: Ian Donohue, Hatch, Canada
Author(s): I. Donohue, E. Barrette, P. Lauzon, M. Pearson
This paper presents the finite element approach for designing the refractory lining as a thermal barrier in pressure oxidation autoclaves. One dimensional cylindrical conduction equations for heat transfer are used to develop an initial refractory design that should prevent the membrane temperature from exceeding the design limit. In practice the nozzles and a region of the shell around each nozzle are typically too hot for the membrane, so weld overlay is applied as an acceptable alternative. Two and three dimensional finite element models are examined to mitigate the one dimensional assumptions, refine the lining design, and determine weld overlay requirements. It has been found that heat transfer through the autoclave is effectively simulated using the finite element method with a high degree of accuracy. The resulting finite element temperature gradients are compared with field measurements taken using a contact thermal couple and infrared thermal imaging camera.