

Monday, August 24, 2009 PM

Poster Session

Presentations from 12:00:00 PM to 2:00:00 PM - Alumni Cafe

Abstract ID: 1685

Separation and Recovery of Molybdenum, Cobalt, Nickel Aluminum and Vanadium from Spent Hydrodesulfurization Catalysts by Solvent Extraction (SX)

A. Cotrim¹, C. Araya¹, and P. Filho¹. ¹Produquimica Industria e Comercio S/A

The sulfuric acid leaching of rosted spent hydrodesulfurization catalysts (NiMo and CoMo) contain molybdenum, cobalt, nickel, aluminum and vanadium. The recovery of these metals includes (1) Extraction of molybdenum and vanadium by SX (Alamine 336); (2) Separation a large part of the aluminum by precipitation and recovery 80% of the aluminum; (3) Extraction the remainder aluminum by SX (Cyanex 272 or Dehpa) and recovery as aluminum sulfate; (4) Separation and recovery of nickel and cobalt by SX (Cyanex 272) in pH between 4 and 5 or strongly ammonium media by LIX-64 support in ion exchange resin.

Abstract ID: 1732

A Study of the Recovery of Nickel and Cobalt by Pressure Oxidation of Pyrrhotite Tailings

E. Guerra¹ and R. Mathew¹. ¹Laurentian University

The pressure oxidation of pyrrhotite was studied under conditions similar to those employed in the Zinc Pressure Leach Process. Oxygen consumption was measured using a totalizing digital flowmeter and correlated to the rate of pyrrhotite oxidation by the stoichiometric formation of hematite and elemental sulfur, which was confirmed using X-ray diffraction and SEM-EDX analysis of the residues. In order to mitigate the negative effect of elemental sulfur on oxidation rates, by occlusion of pyrrhotite particles, the effects of surfactants and a solid sorbent for sulfur on the kinetics of pyrrhotite oxidation were evaluated.

Abstract ID: 1838

Thallium Speciation in Mine Effluent

P. Huntsman-Mapila¹, M. Jatar¹, M. King¹ and C. Rickwood¹. ¹Natural Resources Canada

Because of concerns being raised on the potential impacts of its release to the aquatic environment, thallium (Tl) has recently been recommended as a monitoring parameter under the Metal Mining Effluent Regulations. Toxicity data has indicated that speciation of thallium will be critical in assessing the environmental risk since Tl(I) and Tl(III) toxicity have been shown to differ by orders of magnitude. A simple ion-exchange technique is being adapted to obtain thallium speciation data in mine and metallurgical effluents. The data to be collected will be used to assess the relevance of thallium as a contaminant of concern for the mining sector.

Abstract ID: 1840

Manufacturing of Titanium Pressure Tank With Blow Forming Method

H. Lee¹, J. Yoon¹ and Y. Yi¹. ¹Korea Aerospace Research Institute

Titanium spherical and cylindrical tanks for aerospace application were manufactured with gas blow forming of titanium sheets. This is possible due to its superplasticity at high temperatures. In this presentation, an innovative manufacturing method to produce complex configuration from titanium multi-sheets by low hydrostatic pressure was presented. Finite element analysis on superplastic blow forming process has been carried out in order to improve the forming process when manufacturing subscale cylinder structure using Ti-6Al-4V multi-sheets. The simulation focused on the reduction of forming time and obtaining finally required shape throughout investigating the deformation mode of sheet according to the forming conditions and die geometry. From pre-sized titanium sheets, near net shape is obtained by superplastic blow forming conducted using gas pressure of 4MPa at 875. The result shows that the manufacturing method with superplastic forming of multi-sheets of titanium alloy has been successful for near net shape forming spherical and cylindrical tanks.

Abstract ID: 1828

Surface Bioactivation of Cobalt-Base Alloy During Investment Casting Process

H. Minoue¹, M. Meratian², M. Fathi², A. Kermanpur² and H. Ghazvinizade². ¹Isfahan University of Technology, ²Isfahan University of Technology

Cobalt-base alloys are used for manufacturing surgical implants due to their biocompatibility. Bioactive coatings on the implants improve their fixations in human body. In this study surface bioactivation of the Co-Cr alloy during the investment casting process, was investigated. The Co-Cr alloy was poured into the investment mold which previously coated with hydroxyapatite powder. Specimens were analyzed by XRD, SEM, EDX and optical microscopy. The bioactivity was evaluated by immersion of specimens in the simulated body fluid at 37°C for 4 weeks. Formation of bone-like apatite on the surface of specimens indicated the surface bioactivity of the obtained specimens

Abstract ID: 1830

Effect of Casting Parameters on Wear Behavior of ASTM F-75 Cobalt-base Alloy

H. Ghazvinizadeh¹, M. Meratian², A. Kermanpur², M. Fathi² and H. Minoue². ¹Isfahan University of Technology, ²Isfahan University of Technology

The co-base alloy is widely used as a biocompatible alloy in medicine for manufacturing implants. In order to examine the effects of casting parameters on microstructures and wear behavior of this alloy, the wear resistances of cast Co-28%Cr-6%Mo alloy sliding against UHMWPE have been investigated using a pin-on disk type wear testing machine. The wear loss of UHMWPE against the cast alloy at mold preheating temperature of 700 °C was found to be much smaller than the other condition. The alloy with a refined grain size would exhibit excellent wear resistance compared to other alloy with coarse carbide.

Abstract ID: 1921

Column Leaching of Nontronitic Laterite and Recovery of Nickel and Cobalt from Pregnant Leach Solution

C. Köse¹ and Y. Topkaya¹. ¹Middle East Technical University

In this research, the possibility of column leaching of a lateritic nickel ore located in the western part of Turkey was studied. For this purpose, a column leaching set-up was prepared and nontronitic type lateritic ore containing 1.2%Ni, 0.044%Co and 15.95%Fe was placed in the column having 10 cm in

diameter. With the help of a peristaltic pump, the ore was leached with sulphuric acid in about 4 months. After characterisation of the pregnant leach solution obtained, neutralization and purification of the preg was carried out with limestone powder. Finally, mixed hydroxide precipitation was done with MgO powder.

Abstract ID: 1928

Degradation of Thermal Barrier Coated Superalloy Component During Service

H. Lee¹ and K. Yoo¹. ¹Korea Electric Power Research Institute

The time dependent degradation of first-stage blades for gas turbine was investigated. The specimens were prepared from the operating facilities, in the Bo-ryoung combined-cycle plant, and their equivalent operating hours were 24,000 and 52,000hrs, respectively. Although there are many investigation of superalloys and coatings in the laboratory, it is important that practical failures during service also be analyzed. The components in the hot gas section of turbine such as combustors, blades and vanes are subjected to the high gas velocity and temperatures causing excessive oxidation and corrosion. A microstructural investigation of TBC (thermal barrier coating) and substrate, Ni-based superalloy, showed the degradation process of TBC and single crystal superalloy strengthened by intermetallic compounds precipitation, r' (Ni₃(Al,Ti), less than 1 μ m. Microstructural comparison of coating surface showed that exposure to the environment increased thickness of TGO (Thermal Grown Oxide) and β depletion region, and then debonding and spallation of TBC were occurred finally. In the case of substrate, Ni-based superalloy, the shape and size of r' were changed with increasing operating time. Especially, in the leading and tailing edges of blades, the size of r' was bigger and the shape was more circular than other region. It can be thought that the leading and tailing edges of blades can be the degradation starting point of first-stage blades.

Abstract ID: 1937

Potential Use of Smelter Slag in Emerging Industries

M. Sudbury¹. ¹MPS Consulting

Copper smelter slag is comprised primarily of fayalite a rare mineral that does not exist in massive form on the Earth's surface. Fayalite has a number of unique combinations of properties that suggest potential uses in emerging industries. Work to better document slag properties and the match with the needs of emerging industries is proposed with examples of some possible applications.

Abstract ID: 1957

Pyrrhotite and It's Effect on Ore Processing

C. Wercholz¹, F. Ford and G. Henderson. ¹University of Toronto / Vale Inco

The pyrrhotite group consists of a collection of iron monosulfides with varying iron content and the general formula (Fe_{1-x}S), where 0 < x < 0.125. In Sudbury ore, this group includes monoclinic pyrrhotite (magnetic) and hexagonal pyrrhotite (non-magnetic). This crystallographic variation has an impact on ore processing, affecting the overall grade and recovery to the bulk concentrate. This study characterizes pyrrhotite from three of Vale Inco's ore deposits in the Sudbury area with varying proportions of hexagonal and monoclinic pyrrhotite using X-ray diffraction, optical microscopy, electron microprobe and flotation testing to demonstrate the effect of pyrrhotite variation on ore processing.

Abstract ID: 1959

Mechanical Phase Transformation in Mn Steel Effect of Surface Properties

A. Si Eddine¹ and B. Naima¹. ¹University of Science and Technology

For a lot of applications in the mechanical industry, both attractive and mechanical properties of materials and wear resistance are required. Usually such a combination is achieved only by performing surface treatments. The aim of this investigation is the consolidation of 12% Mn steel surface by treatment of impacts. After treatment, we show by optical and scanning microscopy, X ray diffraction, X ray spectrometry analysis and also by the realization of micro hardness diagrams, the effect of this kind of treatment on the mechanical and structural stability of the surface zone. Among of many obtained results, we distinguish the clear surface consolidation induced by a modification of surface zone crystalline structure. The mechanical deformation causes the transformation from an austenitic structure to the martensitic structure. The correlation between surface structure and mechanical properties will be presented and discussed in details in the COM2009.

Abstract ID: 2029

Material Characterization for Aerospace Alloys for Tube Hydroforming Applications

M. Anderson¹, P. Boucher¹, B. Gholipour², M. Jahaz² and J. Savoie³. ¹Ecole De Technologie Superieure, ²Pratt & Whitney, ³National Research Council

The aim in this study was to develop process modeling tools for the manufacturing of aerospace components using tube hydroforming process. An essential input for finite element modeling is the material model, which can affect the accuracy of the simulation results. The present work focuses on characterizing the behaviour of aerospace alloys (Inconel 718, stainless steel 321 and 17-4 PH) during deformation and understanding the effect of multiple annealing heat treatments on their formability. Thus, tensile samples were prepared from the sheet material and pulled up to the neck point. The test was interrupted at the neck and an annealing heat treatment was performed to restore the material. This pulling/annealing cycle was repeated until the final fracture occurred. An optical strain measurement system, ARAMIS, was used to measure the maximum strain during the tensile tests. Based on these results, free expansion tests were performed to study the effect of annealing on the formability of the tube material.

Abstract ID: 2089

Quantity and Morphology Study of Inclusions During Steelmaking

H. Yoo¹, L. Chan¹ and H. Hwang¹. ¹University of Toronto

The first objective of this research was to evaluate the techniques for detecting inclusions using different microscopes such as optical, confocal, and SEM with secondary and backscatter electrons (BSE) for detecting inclusions in the billet sample (ASTM 529 steel) . SEM with BSE mode was chosen to study the quantity and size distribution of inclusions at different stages of steelmaking. The results indicated that macro- inclusions (>30µm) are reduced from furnace to ladle, and the billet has the most micro- inclusions (>10µm).The second objective was to apply a standardized SPEED- EDX/SEM procedure to study the types and morphologies of inclusions. The results showed that aluminium, manganese, and sulphur

oxides are abundant at the early stage of steelmaking; however, manganese sulphide becomes dominant in the billet.

Abstract ID: 2093

Recovery of Nickel and Copper from Mineral Wastes Using Bacterial Leaching

A. Munoz¹. ¹Institute of Chemistry

It was evaluated the effect of bacteria presence in the solubilization of nickel and copper from two types of nickel tailings (slag from smelting and tailings from flotation process). Bacterial cultures and mineral tailings were controlled during the process by means of physical and chemical parameters as pH, Eh, total concentration of Ni and Cu in solution. The leaching systems presented an increase in pH and Eh in all the conditions tested, and the solubilization of metals was influenced by these parameters. The results show that the bioleaching presented better percentages of metal solubilization from flotation tailings than scoria tailings.

Abstract ID: 2091

Reduction of Power Consumption in Zinc Electrowinning

F. Parada¹ and E. Asselin¹. ¹University of British Columbia

Approximately 7 million tons per annum of zinc are produced globally by electrowinning which is a power intensive process. Power consumption is proportional to cell voltage which is thermodynamically limited to the potential difference between the oxygen evolution and zinc reduction reactions. Several approaches which are currently under investigation for the reduction of power consumption in zinc electrowinning and which focus on alternative anode reactions are summarized in this report. In particular, methanol and formic acid oxidation as anodic reactions are examined. There remain several important materials, engineering and process challenges associated with the new approaches which are presented in this work. However, given the current and anticipated future cost of energy, further research in this field is warranted.

Abstract ID: 2095

Precipitation Behavior of Elements in Synthetic Laterite Leach Solution

Z. Zhu¹, C. Cheng¹, W. Zhang² and Y. Pranolo¹. ¹CSIRO Minerals, ²Commonwealth Scientific And Industrial Research Organisation (csiro)

The precipitation behavior of elements remaining in the neutralized laterite leach solutions can significantly influence the separation and recovery of Ni and Co in the refinery processes. The precipitation behaviors of possibly present metals and silicon in synthetic laterite leach solution were studied at pH= 4-7 and 40°C. Study shows that the precipitation order is Cr(III)>Cu(II)>Al(III)~Fe(III) > Zn(II) > Ni(II) ~ Co(II) >Mn(II)>Ca(II)~Mg(II) at pH about 4.5, but after pH of 4.5, precipitation order has some little change. Before pH of 5, Cr(III) and Fe(III) can precipitate almost completely with less than 0.2 mg/L in neutralized solution. Cu can precipitate completely only after pH of 7, and Al(III) can not precipitate completely with 0.5-1 mg/L remaining in the neutralized solution within tested pH. Before pH 5.5, Ni and Co exist in the solid mainly in the form of sulfate by adsorption and after that mainly in the form of hydroxide by co-precipitation.

Abstract ID: 2097

Implementation of a High Throughput Inclusion Analyzer to Evaluate Steel Production

T. Drake¹. ¹Aspex Corporation

An aluminum deoxidation process for producing special bar quality (SBQ) steel was investigated to reveal various events that can lead to castability issues. To fully understand these effects, the authors have evaluated the inclusion content utilizing a high-throughput particle and inclusion characterization analyzer (PICA) which provides the size, shape, and elemental composition of all inclusions in a 50 mm² area of lollipop samples from both the ladle and tundish. Based on more than 30 heats, it was concluded that the major portion of inclusions consisted of calcium aluminate and spinel complexes. In addition, CaS inclusions were prevalent. Through basic comparative studies, the hardware of the facility could handle a significant amount of non-liquid (>60%) inclusions without signs of castability issues. In addition, the source of casting problems was correlated to both ladle practices and reoxidation events occurring in-line of the process.

Abstract ID: 2099

Passivation Behavior of Iron in Ammoniacal Caron Leach Solution

S. Roy¹ and E. Asselin¹. ¹The University of British Columbia

The electrochemistry of metal-water-ammonia systems is of significant concern to the extractive metallurgical industry due to the electrochemical nature of leaching reactions. This is exemplified in the Caron leach where poor recoveries of Ni/Co are experienced. In particular, the passivation of iron and its alloys are associated with paymetal losses during the extraction of Co and Ni. This poor recovery of Co/Ni from iron based laterites is believed to be due to either Co adsorption on Fe(OH)₃/Fe(OH)₂ or the passivation of the alloys formed during the reduction step. This work was undertaken to examine the electrochemical passivation of Fe in ammoniacal solution and to determine the stability of both Fe-oxides and Fe-ammines during anodic polarization. The passivation of iron begins at around -0.410 to -0.380 V (SHE) in the 15°C - 55°C temperature range in naturally aerated, oxygenated and de-oxygenated solutions. Under these conditions the maximum rate of anodic dissolution of ammines increased with temperature up to 0.03 A/cm². The window of stability of ammines also expanded slightly with temperature from 230 mV at 15°C to 310 mV at 55°C in oxygenated condition.

Abstract ID: 2100

Bioleaching of Ni and Co From Mine Wastes

O. Garcia Jr.¹ and A. Munoz¹. ¹Universidade Estadual Paulista

Bioleaching of tailings containing Ni/Co was evaluated using flasks containing flotation wastes or smelting wastes, incubated during 14 days. Other flasks with flotation wastes were inoculated (with or without Fe²⁺ addition) incubated during 50 days. The results showed only 13% Ni extractions from the slag and 45% from the flotation wastes. After 50 days of tailings bioleaching, 80% Ni and 35% Co extractions were obtained with Fe²⁺ addition or not. These findings indicated that Ni solubilization from the slag is acid dependent while for the flotation tailings, bacterial leaching seems to be a good alternative for Ni and Co extractions.

Abstract ID: 2101

Biological Leaching of Ni and Cu from Tailings and Slags

*A. Munoz*¹. ¹*Universidade Estadual Paulista*

The objective of this work is to evaluate the acidic and biological leaching of tailings containing Ni/Cu from a flotation and smelting plant with *Acidithiobacillus ferrooxidans*. In the slag inoculated flasks the results after 15 days showed only 13% Ni and 8% Cu extractions. For the flotation tailings bioleaching extractions were 45% for Ni and 16% for Cu. Here the presence of bacterial activity led to a higher solubility of Ni. These results indicated that Ni and Cu solubilization from the slag is acid dependent, while for the flotation tailings, bacterial leaching seems to be the best alternative.

Abstract ID: 2104

An investigation on the Behavior of Gold Chloro-Complexes During the Precipitation of the Fe(III)-AsO₄-SO₄ Phase in Sulphate Solutions at 200-220°C

*D. Blais*¹ and *G. Demopoulos*¹. ¹*McGill University*

In this work the precipitation behavior of gold from gold (III) chloride species in synthetic sulphate solutions is studied in the temperature range 200-220 °C as it relates to pressure oxidation processes. In particular the possible co-precipitation of gold with ferric oxide, sulphate, or arsenate phases via incorporation within the precipitate's host crystal structure or via adsorption on the newly formed solids is examined. The research study involves precipitates formed under several conditions (pH, temperature, iron/arsenic ratio), such as hematite, scorodite or basic ferric arsenate sulphate, in the presence of low concentration AuCl₄⁻. Solutions and solids are characterized to ascertain the deportment of gold using XRD, SEM observation, Raman spectroscopy and EXAFS. In parallel to that, thermodynamic studies are underway, with the use of the OLI (a thermodynamic software which predicts the chemistry of a solution), to determine the stability of gold chloride.

Abstract ID: 2096

Elevated-pH Bioleaching of a Low-Grade Ultramafic Nickel Sulphide Ore in Stirred-Tank Reactors at 5 to 45 °C.

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The purpose of this work was to assess the technical feasibility of using elevated-pH bioleaching on a low-grade ultramafic nickel sulphide ore. The experimental plan was designed with two objectives: to minimize magnesium mobilization, and to maintain an acceptable level of nickel extraction. The initial rate of nickel extraction from pentlandite was observed to be inversely correlated to acidity at all temperatures tested (5 to 45 °C), whereas the final extraction of nickel after five weeks was determined to be moderately correlated to acidity at high temperatures and negatively correlated to acidity at low temperatures. The advantage of elevated-pH bioleaching was most evident at 5 °C, in which the final extraction of nickel at pH 5 was approximately 250% greater than at pH 3. The extraction of magnesium exhibited a strong negative pH-temperature interaction, resulting in considerable magnesium leaching (~ 43%) at pH 3 and 45 °C. The consumption of sulphuric acid directly tracked the extraction of magnesium over all experimental conditions. Bioleaching at elevated pH and low temperature substantially increased

the ratio of nickel to magnesium in the leachate, and resulted in a substantial reduction in sulphuric acid consumption.

Abstract ID: 2109

A TGA Study of the Roasting of Nickel Concentrate

R. Pandher¹. ¹University of Toronto

In this study, the roasting behaviour of nickel concentrates from two Canadian nickel smelters was examined by thermogravimetric analysis (TGA). TGA tests were carried out on 100mg samples at temperatures ranging from 400°C- 850°C under inert or oxidizing atmospheres. The goal of the study was to investigate the formation and stability of metal sulphates. The tests showed that while the sulphates were stable at lower temperatures, the stability decreased as the temperature increased.

Abstract ID: 2110

New Method for Determining Nickel Speciation in Workplace Aerosols Using X-Ray Near-Edge Structure Spectroscopy

L. Van Loon¹, J. Warner and M. Dutton. ¹Canadian Light Source

X-ray absorption near-edge structure (XANES) spectroscopy provides new interpretations of Ni speciation in sulfidic Ni processing, particularly with respect to soluble Ni in workplace aerosol samples. Typically, Ni speciation is identified using a sequential extraction developed by the Ni industry for speciating workplace exposures. However, as this technique and its variants become more widely applied, there is evidence that the method may not always accurately estimate soluble and metallic Ni. Because of the importance of speciated exposure reconstruction to the determination of carcinogenicity classification of individual Ni compounds, we have begun to evaluate alternative speciation methodologies for Ni. Here we present the results of a study comparing Ni speciation results obtained using XANES spectroscopy and sequential extraction.

Abstract ID: 2115

Using MgCl₂ Molten Salt Hydrates to Extract Nickel From Saprolite Ores

J. De Bakker¹. ¹Not Available

Several authors have noted that if an acid leach is performed in brine, rather than pure water, the activity of the acid increases and the leach becomes more aggressive. We are taking this concept a step further and present a flowsheet in which saprolite ore is leached by a MgCl₂ molten salt hydrate (MSH). An MSH is a brine concentrated to the point where there are less than ~8 water molecules per molecule of salt; it occupies the middle ground between aqueous solution and molten salt. In our flowsheet, the saprolite is leached by HCl in a molten salt hydrate. The MSH is then hydrolyzed in the liquid state, regenerating the HCl. The process benefits from aggressive leaching; a leach temperature higher than 100 degrees; and hydrolysis at less than 300 degrees.