Tuesday, August 25, 2009 AM

HYDROMETALLURGY of Nickel and Cobalt Symposium including the Processing of Valuable By-Products Containing Materials

Presentations from 8:30:00 AM to 12:00:00 PM - Fraser Lower

SULPHIDES

Abstract ID: 1747

Nickel and Cobalt Recovery from a Bulk Cu-Ni-Co Concentrate Using the CESL Process

D. Jones[1], S. Knoerr[2], K. Mayhew[2], L. O'Connor[2] and T. Williams[2]. [1]Teck Corporation, [2]CSIRO Minerals

Presenting from 8:30:00 To 8:55:00 - Tuesday

CESL has developed a hydrometallurgical process for treating Copper and Nickel sulphide concentrates, including bulk concentrates. Both Cu and Ni are leached efficiently into solution, using a proprietary pressure oxidation process, along with other base metals, notably Co. A previous publication (2002) has described the Cu recovery from a low grade bulk concentrate, Mesaba, using this CESL Process, including an extensive piloting campaign. Ni and Co recovery from the same solution was contemplated at the time, but not finalized. This paper will describe the latest work at CESL on Ni and Co recovery from the same concentrate. The flowsheet includes Ni -Co separation, and describes available options for Ni products.

Abstract ID: 1721

The Recovery of Cobalt from Baja Mining Corp's El Boleo Project

D. Dreisinger[1], R. Molnar[2], T. Gluck[1], K. Baxter[3] and J. Riordan[4]. [1]Baja Mining Corporation, [2]SGS Lakefield Research Limited, [3]Bateman Engineering Pty Ltd, [4]Bateman Solution Purification Group

Presenting from 8:55:00 To 9:20:00 - Tuesday

The Boleo Copper-Cobalt-Zinc-Manganese Project of Baja Mining Corp. is situated adjacent to Santa Rosalia on the Baja Peninsula of Mexico. The El Boleo ore is a mixed oxide-sulfide deposit with major values in copper, cobalt, zinc and manganese. The metallurgical process designed to treat the El Boleo orebody involves a sulfuric acid leach in seawater using oxidative and then reductive leaching to maximize metal extraction. The leach solution is separated from the barren solids via counter current washing through a series of high rate thickeners. Copper is recovered using conventional SX-EW processing as cathode. Zinc and cobalt are extracted from the copper SX raffinate after iron and aluminum precipitation. The CSIRO DSX solvent system (Versatic® 10 and LIX® 63 mixture) are used in this extraction. Manganese remains in the DSX raffinate and is recovered by soda ash addition as a high quality manganese carbonate precipitate. Zinc and cobalt are acid stripped from the loaded DSX solvent. Zinc is then re-extracted away from cobalt using Cyanex® 272 extractant and stripped into a highly concentrated strip liquor (+100 g/L Zn) and directed to either a spray dryer or a granulator for production of zinc sulfate monohydrate. The zinc solvent extraction raffinate, containing cobalt, advances to a further SX circuit using Cyanex® 272, for the recovery of cobalt as cobalt cathode. In this paper, the detailed results from bench and integrated pilot plant testing for cobalt recovery from the El Boleo ore will

be described. The results will highlight the use of solvent extraction and specialty ion exchange resins to recover high purity cobalt electrolytic cathode. The results of this testing are currently being used to engineer the commercial plant at El Boleo.

Abstract ID: 1751

Reductive Leach Process for Improved Recovery of Nickel and Cobalt in the Sherritt Hexammine Leach Process

J. Budac[1], R. Kofluk[1] and D. Belton[1]. [1]Sherritt International

Presenting from 9:20:00 To 9:45:00 - Tuesday

A new process has been developed, at Sherritt, which can improve the extractions, across the ammonia leach process, for nickel and cobalt from 99.3% to 99.8% and 96.5% to 98.6% respectively. The new process involves treatment of the refinery tailings with a reductive leach step followed by selective precipitation of iron to leave nickel and cobalt in solution. An extra benefit of the new process is that by including a floatation step unreacted sulphides can also be collected and recyled back to the head of the leach circuit.

Abstract ID: 1726

Pressure Oxidative Leaching of Slags from Nickel Smelters: An Update

I. Perederiy[1], V. G. Papangelakis[1] and C. Jia[1]. [1]University of Toronto

Presenting from 9:45:00 To 10:10:00 - Tuesday

Smelter and converter slags produced at non-ferrous smelters inevitably contain entrapped base metals, such as Ni, Co and Cu. It has been found that base metal entrapments occur in the form of localized sulfide (matte) inclusions as well as oxides evenly dispersed in fayalite. These metals can be extracted from both types of slags by means of pressure oxidative acid leaching. However, the metals in the form of oxide can be extracted only if the fayalite matrix is completely dissolved in sulfuric acid. Moreover, the addition of oxygen at high temperatures (~250°C) enables the regeneration of sulfuric acid through hematite precipitation which is essential to high metal/Fe ratios of the leachate. The extent of acid regeneration and the effect of oxygen overpressure on iron oxidation were investigated in detail.

Abstract ID: 1722

Recovery of Cobalt from Polymetallic Concentrates - NiCo Deposit, NWT, Canada - Pilot Plant Results

R. Molnar[1], M. Canizares[2], A. Mezei[2] and M. Samuels[3]. [1]SGS Lakefield Research Limited, [2]SGS Mineral Services Lakefield Laboratory, [3]Fortune Minerals Limited

Presenting from 10:30:00 To 10:55:00 - Tuesday

This paper provides an overview of the NICO deposit process development work throughout the past decade, with emphasis on the latest results on the recovery of cobalt. The results presented in the paper were produced by an integrated pilot plant carried out in 2008. The NICO “IOCG” (iron oxide - copper - gold) type deposit is located in the Mazenod Lake district near the Snare hydroelectric complex, approximately 160 km northwest of Yellowknife, Northwest Territories, Canada. Cobalt is recovered by flotation into a concentrate wherefrom it is leached by pressure oxidation followed by solution purification (involving copper solvent extraction and iron removal), ion exchange, precipitation and electrowinning.

The pressure oxidation occurs with selective rejection of arsenic and iron allowing environmentally acceptable tailings disposal as ferric arsenate. The process relies entirely on commercially proven unit operations and equipment and the integrated pilot exercise proved its technical feasibility. This paper summarizes the results of the purification of the cobalt solution and its electrowinning as cathode.

Abstract ID: 1718

The Recovery of Nickel And Cobalt from the Northmet Deposit Using the Platsol™ Process with Production of Mixed or Separate Nickel and Cobalt Hydroxides

D. Dreisinger[1], R. Molnar[2], A. Mezei[1], K. Baxter[3] and M. Wardell-Johnson[3]. [1]University of British Columbia, [2]SGS Lakefield Research Limited, [3]Bateman Engineering Pty Ltd

Presenting from 10:55:00 To 11:20:00 - Tuesday

The NorthMet deposit of PolyMet Mining contains a large reserve of copper-nickel-cobalt-precious metal mineralization. Historically it has been difficult to recover separate copper and nickel concentrates of a quality broadly acceptable to custom smelters using conventional mineral processing techniques. Recently, improved flotation methods have yielded the ability to produce separate and saleable concentrates during a projected initial startup period for the NorthMet deposit. However, after the initial transition period, it is expected that production of a bulk flotation concentrate followed by PLATSOL™ hydrometallurgical treatment will be used to produce copper, nickel/cobalt and precious metal products. The PLATSOL™ process uses chloride-assisted total pressure oxidation treatment of a bulk concentrate to digest the base and precious metal content of the bulk concentrate into an autoclave solution. Following solid-liquid separation, the solution is then treated sequentially for precious metal recovery by reductive precipitation, copper solvent extraction and electrowinning and finally, nickel and cobalt recovery by precipitation. During the pilot plant testing of the PLATSOL™ process for NorthMet bulk concentrate treatment, two variations on nickel and cobalt recovery were tested including mixed hydroxide precipitation with magnesia and separate nickel and cobalt hydroxide precipitation following solvent extraction separation with Cyanex 272. The results of the pilot plant testing of the nickel and cobalt recovery circuits for NorthMet are presented.

Abstract ID: 1701

Sulfur Dispersing Agents in the Oxygen Pressure Leaching of Nickel Concentrate

L. Tong[1] and D. Dreisinger[1]. [1]The University of British Columbia

Presenting from 11:20:00 To 11:45:00 - Tuesday

The properties of nickel concentrate and sulfur dispersing agents, including lignosulfonate, Quebracho, ortho-phenylenediamine (OPD) and humic acid, were investigated. The adsorption mechanism of sulfur dispersing agents on elemental sulfur and nickel concentrate was discussed. The effect of sulfur dispersing agents on dispersing molten sulfur was evaluated by the interfacial studies. Both organic materials and inorganic materials have the ability to change the sulfide mineral surface from sulfophilic to sulfophobic. The effect of sulfur dispersing agents on nickel extraction was evaluated in pressure leaching experiments conducted in a 2 L batch autoclave. The stability of sulfur dispersing agents was discussed.

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Presentations from 8:30:00 AM to 12:00:00 PM - Room F441

PURIFICATION

Abstract ID: 1692

Extraction of Nickel with Pre-neutralized Organic Acids using Outotec Mixer Settler Technology

E. Paatero[1], B. Nyman[2], H. Laitala[1], J. Tamminen[3], E. Ekman[2] and T. Kankaanpaa[2]. [1]Outotec Oyj, [2]Outotec Research Oy, [3]Lappeenranta University of Technology

Presenting from 8:30:00 To 8:55:00 - Tuesday

Good pH control is essential for selectivity in the extraction of metals using reagents that are organic acids. Common industrial reagents in this category are di(2-ethylhexyl)phosphoric acid, bis(2,4,4trimethylpentyl)phosphinic acid (the active compound in Cyanex®272 by Cytec and in Ionquest® 290 by Rhodia) and the tertiary carboxylic acids as the Versatic™ Acid 10 by Hexion Specialty Chemicals. In order to avoid precipitation in the extraction apparatus, the reagents are often used partly pre-neutralized, e.g., by ammonia or caustic soda solutions. When these extractants are partly saponified, they start behaving like surfactants and form microemulsion and other aggregate structures. As the partly pre-neutralized solution is contacted with a metal-containing feed solution, the complexation takes place in a pseudo-homogeneous environment allowing fast extraction kinetics. The paper describes the theoretical basis of the phase behavior involved in these systems using the extraction of nickel with Versatic Acid 10 as an example. The paper reports how this phenomenon can be exploited in the Dispersion Overflow Pump (DOP®) unit of the Outotec mixer-settler for nickel extraction with illustrations from pilot size experiments. The extraction process was visually followed by taking high-speed photos of the dispersion inside the DOP as well as by recording the rate of extraction based on chemical analysis of samples from the DOP outlet channel.

Abstract ID: 1742

Manganese Removal From Nickel Laterite Mixed Hydroxide Precipitation Circuit By Oxidative Precipitation with SO_2/Air

W. Zhang[1], D. Robinson[1], D. Muir[1] and D. Collinson[1]. [1]Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Presenting from 8:55:00 To 9:20:00 - Tuesday

Soluble manganese(II) in nickel laterite high pressure acid leach solution is one of the major impurities which would partially co-precipitate with nickel and cobalt in the mixed hydroxide precipitation (MHP) to affect the quality of the MHP product for subsequent refining process and limitation to the nickel/manganese ratio in the feed ores for using MHP technology. Investigations have been carried out to examine the feasibility to partially remove soluble manganese(II) before MHP at two possible neutralisation stages: (1) primary neutralisation at pH 3.0 and 80°C and (2) secondary neutralisation at pH 4 and 60°C. The rate of manganese oxidative precipitation with SO_2/air from the primary neutralisation slurry was very slow at pH <3.5 and 80°C, most likely due to the slow mass transfer of oxygen in air through the viscous slurry at relatively high temperature. The oxidation rate was substantially improved by