2nd Ni/Co/Cu Event

CYTEC
Delivering Technology Beyond Our Customers' Imagination™

ALTA 2011
NICKEL/COBALT/COPPER
CONFERENCE

MAY 23-25, 2011
BURSWOOD CONVENTION CENTRE
PERTH, AUSTRALIA

ALTA Metallurgical Services
Castlemaine, Victoria,
Australia

Ask The Mining Chemical Leaders

For mining operators seeking improved performance, a dynamic collection of knowledge from the leading manufacturer of mining reagents is only a conversation or a mouse click away. Our team of metallurgists and engineers will work with you to find the right Cytec product, or develop a tailored solution, for your ore types and plant conditions. Our mining experts can match our portfolio of technologies to your unique needs and operational objectives. See for yourself what nearly a century of experience can bring.

cytec.com/miningleaders

CYTEC

Alumina Refining | Mineral Processing | Solvent Extraction

Email: custinfo@cytec.com | Worldwide Contact info: www.cytec.com/miningleaders
US Toll Free: 800-652-6013 | Tel: 973-357-3193

PROCEEDINGS OF
NICKEL-COBALT-COPPER SESSIONS AT ALTA 2011
MAY 23-25, 2011, PERTH, AUSTRALIA

A Publication of
ALTA Metallurgical Services
138A Duke Street, Castlemaine,
Victoria 3450, Australia
http://www.altamet.com.au

ISBN: 978-0-9871262-0-7

The content of the papers is the sole responsibility of the authors

To purchase a copy of this or other publications visit
http://www.altamet.com.au/publications.htm

CONTENTS

Treatment of Laterites	Page
The Direct Nickel Process - Continued Progress on the Pathway to Commercialisation *Fiona McCarthy & Graham Brock, Direct Nickel Pty Ltd, Australia*	**2**
Recent Developments in the Chloride Processing of Nickel Laterites *Bryn Harris and Carl White, Neomet Technologies Inc., Canada*	**12**
Study of Certain Parameters in Laboratory-Scale Prereduction of Sivrihisar Laterite Ores of Turkey *Ender Keskinkilic, Atilim University & Saeid Pournaderi, Ahmet Geveci & Yavuz A. Topkaya, Middle East Technical University, Turkey*	**25**
The Agata Nickel Project – Project Update, A Potential Low Cost Nickel Producer in the Surigao District of Northern Mindanao, the Philippines *Boyd Willis, Boyd Willis Hydromet Consulting, Australia & Jon Dugdale, Mindoro Resources, Australia & Tony Climie, Mindoro Resources, Philippines*	**35**
Why make MHP? *Tony Treasure & Harald Muller, Metals Finance Corp., Australia*	**66**
Chemical Aspects Of Mixed Nickel-Cobalt Hydroxide Precipitation and Refining *James Vaughan & William Hawker, University of Queensland, & David White, Metallurgical Consultant, Australia*	**81**
Sequential Leaching of Nickel Laterite Ores *Nicole Botsis & Helen Watling, Parker CRC for Integrated Hydrometallurgy Solutions, CSIRO Minerals Down Under Flagship & Wilhelm van Bronswijk, Curtin University, Australia*	**92**
Heap & Bioleaching	
Optimizing Nickel Laterite Agglomeration for Enhanced Heap Leaching *Jonas Addai-Mensah, Ishmael Quaicoe & Ataollah Nosrati, University of South Australia, George Franks & Liza Forbes, University of Melbourne, Lian Liu, University of Queensland, David J. Robinson & John Farrow, CSIRO Process Science and Engineering & Minerals Down Under National Research Flagship, Australian Minerals Research Centre, Australia*	**108**
Prophecy Resources Corp, Lynn Lake Nickel Project, Nickel Bioleach Development Mintek Laboratory Test Work Program Update *Andrew J. Carter, Tetratech, UK*	**123**
Talvivaara Sotkamo Mine – Bioheapleaching of a Polymetallic Nickel Ore in Subarctic Conditions *Marja Riekkola-Vanhanen, Talvivaara Mining Company Ltd., Finland*	**150**
A Study into the Possible Application of BioHeap Technology to Forrestania *Jason Fewings, Western Areas NL, Australia*	**164**
Solid-Liquid Separation	
Novel Automatic Pressure Filter for Hydrometallurgical and Flotation Concentrate Dewatering Applications *Dustin Pepper & Patrick Jay, FLSmidth, USA*	**182**
SX/IX/EW	
Oxidation in Copper SX processes *Troy Bednarski, Matthew Soderstrom & Shane Wiggett, Cytec Industries, USA/Australia*	**199**
Manganese in SX/EW Plants *Gabriel Zarate, Anglo American, Chile*	**209**
Contamination Management in Solvent Extraction Plants *Graeme Miller, Miller Metallurgical Services, Australia*	**218**
Cyanex 272 Extraction Process Modelling Update *Matthew Soderstrom Cyril Bourget & Boban Jakovljevic, Cytec Industries, USA/Canada*	**232**
The Development of a New DSX Process for the Separation of Nickel and Cobalt from Iron and Aluminium and Other Impurities *C.Y. Cheng, Z. Zhu and Y. Pranolo, The Parker Centre, CSIRO Minerals Down Under National Research Flagship, Australia*	**240**
Selective Separations in the Cobalt, Uranium and Sulfuric Acid Industries *Steven R. Izatt, Neil E. Izatt, and Ronald L. Bruening, IBC Advanced Technologies Inc., USA*	**253**
Development of a Novel Smart Anode for Environmentally Friendly Electrowinning Process *Masatsugu Morimitsu, Doshisha University, Japan*	**260**
Development of Anode Bag Technology in Nickel Electrowinning *Ville Nieminen, Henri Virtanen & Eero Tuuppa, Outotec Oyj, & Noora Kaakkolammi & Rauno Luoma, Norilsk Nickel Harjavalta Oy, Finland*	**266**

Leaching of Sulphides	Page
Recovering Copper and Gold in Chloride System by Nikko Chloride Process *Kazuaki Takebayashi, Kazuhiro Hatano, Hiroshi Hosaka & Yoshifumi Abe, JX Nippon Mining and Metals Corporation, Japan*	**277**
Improving Cash Flow from Low Grade Nickel Concentrates *David Jones, Teck Resources Limited/ CESL, Canada*	**292**
New Projects	
Assarel Medet JSC Cu SX-TF-EW Project In Bulgaria *Hannu Laitala, & Marko Lampi, Outotec Oyj, Finland*	**312**
Lady Annie Operations – CST Restart 2010 *Anissa Horner, CST Minerals, Lady Annie, Australia*	**321**
Atmospheric Acid Leaching of Nkamouna Asbolinic Cobalt Concentrate with Pyrite as the Reductant *Herman Schwarzer, Alastair Holden & Brett Crossley, Lycopodium Minerals Pty Ltd, Australia & Roman Berezowsky, Geovic Cameroon, Canada & Brian Briggs, Geovic Mining Corp., USA*	**351**
Equipment & Materials	
A-Z of Autoclave Isolation *Pete Smith, Mogas Industries, USA*	**371**
High Pressure Autoclave Feeding at Maximum Solids Concentration and Efficiency *Heinz M. Naegel, FELUWA Pumpen GmbH, Germany*	**392**
Agitator Start-Up in Settled Bed Conditions Jochen Jung and Wolfgang Keller, *EKATO RMT GmbH, Germany*	**404**
Characteristics and Fabrication Quality Control of Large Pressure Leaching Autoclave *Hao Zhen-liang & Mao Lu-rong, Shanghai Morimatsu Pressure Vessel Co., Ltd, China*	**414**
Selecting Specialty Stainless Steel Grades for Sulphuric Acid Leaching Environments *Sophia Ekman, Outokumpu Stainless AB, Avesta Research Centre, Sweden*	**422**
PAL of Laterites Forum	
Murrin Murrin Operations - Past, Present and Future *Matt Brown, Minara Resources, Australia*	**435**
Coral Bay Nickel HPP-2 Project in Palawan, Philippines *Shinichiro Yumoto, Tozo Otani, Tadashi Nagai & Isao Ikeda, JGC Corporation, Japan*	**500**
Coral Bay Nickel HPAL Plant Expansion Project *James Elson Llerin, Isao Nishikawa[&] Munekazu Kawata, Coral Bay Nickel Corporation., Philippines*	**511**
Ramu Nickel Project Update *James Wang, Ramu NiCo Management (MCC) Ltd, PNG*	**524**
Carbon Friendly Nickel Processing and Pressure Acid Leaching: Reduced Carbon Emissions and More Efficient Acid Use for Higher Economic Returns *Simon Willis, Tim Newton, and Brett Muller, Simulus Engineers, Australia*	**538**
Additional Paper – Not Presented at Conference	
Recent Developments in Novel Phase Contacting Devices/Aspects for Hydrometallurgical Applications *Katragadda Sarveswara Rao, EEE, India*	**546**

ALTA 2011
NICKEL/COBALT/COPPER

TREATMENT OF LATERITES

THE DIRECT NICKEL PROCESS
CONTINUED PROGRESS ON THE PATHWAY TO COMMERCIALISATION

By

Fiona McCarthy and Graham Brock

Direct Nickel Pty Ltd, Australia

Presenters and Corresponding Authors

Fiona McCarthy and Graham Brock
fiona@directnickel.com
graham@directnickel.com

ABSTRACT

Over the past 12 months Direct Nickel has successfully demonstrated the reagent recycle process, which is fundamental to the DNi Process. Details of this programme and results are presented. In mid May 2011 a Demonstration Plant in Perth is 80% complete and should be operating before the end of calendar 2011. The Company is also drilling the Mambare project in PNG. Progress is both rapid and successful

RECENT DEVELOPMENTS IN THE CHLORIDE PROCESSING OF NICKEL LATERITES

By

Bryn Harris and Carl White

Neomet Technologies Inc., Canada

Presenter and Corresponding Author

Bryn Harris
bryn@neomet.com

ABSTRACT

The concept of chloride processing for nickel laterite ores is one that has been promoted over the past several years as a viable method for treating both the limonite and saprolite fractions of a laterite profile. This paper reviews the recent developments in the chloride-based flowsheet, with particular emphasis on the key breakthrough acid recovery and iron precipitation unit operation developed by Neomet Technologies Inc. It is shown that the use of an inert matrix significantly improves the kinetics and flexibility of acid recovery compared to earlier flowsheets, thereby opening up the whole flowsheet. Results of leaching several different laterites are presented, and of continuous operation of the acid recovery unit operation. Preliminary capital and operating costs are presented showing that the chloride process is very attractive economically. The ability of the flowsheet to recover valuable by-products such as hematite, alumina and magnesia, along with minor elements, in particular scandium which is often associated with laterites, is highlighted.

STUDY OF CERTAIN PARAMETERS IN LABORATORY-SCALE PREREDUCTION OF SIVRIHISAR LATERITE ORES OF TURKEY

By

[1]Ender Keskinkilic, [2]Saeid Pournaderi, [2]Ahmet Geveci and [2]Yavuz A. Topkaya

[1]Atilim University, Department of Metallurgical and Materials Engineering, Turkey
[2]Middle East Technical University, Department of Metallurgical and Materials Engineering, Turkey

Presenter and Corresponding Author

Ender Keskinkilic
ekeskinkilic@atilim.edu.tr

ABSTRACT

This study investigated prereduction behavior of one of the Turkish laterite deposits, which was recently found in Sivrihisar region. Sivrihisar laterite ore (1.26% Ni) is a limonitic one with its high iron content and low MgO composition. Low arsenic content of the ore makes ferronickel smelting a suitable method for nickel extraction. In the scope of this study, calcined laterite samples were reduced with the addition of coal in a laboratory-scale horizontal tube furnace under argon atmosphere. Effect of temperature, time and the amount of coal addition on degree of reduction of nickel, iron and cobalt were studied. For the particle size used in the current work, optimum temperature, time and coal addition were determined for prereduction of Sivrihisar laterites.

THE AGATA NICKEL PROJECT – PROJECT UPDATE

A POTENTIAL LOW COST NICKEL PRODUCER IN THE SURIGAO DISTRICT OF NORTHERN MINDANAO, THE PHILIPPINES

By

[1]Boyd Willis, [2]Jon Dugdale and [3]Tony Climie,

[1]Principal Consultant, Boyd Willis Hydromet Consulting, Australia
[2]Mindoro Resources Ltd, Australia
[3]Mindoro Resources Ltd, Philippines

Presenter and Corresponding Author

Boyd Willis
hydromet@boydwillis.com

ABSTRACT

Mindoro Resources Ltd (MRL) is undertaking feasibility studies into the development of an integrated nickel-cobalt laterite project at Agata in the Surigao District of Mindanao, the Philippines. The Agata deposit has a National Instrument NI 43-101 Measured and Indicated Resource of 32.6 million DMT at 1.04% nickel and 0.05% cobalt, and an Inferred Resource of 1.7 million DMT at 1.04% nickel and 0.04% cobalt. An Exploration Target of an additional 50 to 70 million DMT grading 0.9 to 1.2 percent nickel has been identified for other Surigao District tenements within 30 km north of the Agata resource.

A scoping study completed in 2010 considered processing options employing a combination of high pressure acid leach (HPAL) and atmospheric leach (AL) technologies. Preliminary metallurgical testwork has been performed on selected ore blends, demonstrating excellent leaching performance for HPAL of limonite and transition ores and AL of saprolite ores.

The project is conveniently located about 47 km northwest of Butuan City and 73 km southwest of Surigao City. The Surigao District is an historic and established mining district for copper, gold and nickel and is a politically stable and supportive jurisdiction for mining in the Philippines. These strategically located resources and exploration targets have strong competitive advantages: close proximity to established infrastructure and deep ocean port sites, no inhabitants or forest in the resource area, large regional population base, close proximity to markets, abundant limestone for acid neutralisation on site and plentiful fresh water. These attributes, combined with the quality of the resource and outstanding metallurgical characteristics, offer high potential for the establishment of a world class nickel and cobalt processing operation.

This paper reports on the findings of the scoping study, the metallurgical testwork results to date, and the selection of plant capacity and configuration for the Pre-Feasibility Study.

WHY MAKE MHP?

By

Tony Treasure and Harald Muller

Metals Finance Limited, Australia

Presenter and Corresponding Author

Harald Muller
harald@metalsfinance.com

Important Notice

This presentation contains certain statements which may constitute 'forward looking statements". Such statements are only predictions and are subject to inherent risks and uncertainties which could cause actual values, results, performance or achievements to differ materially from those expressed, implied or projected in any forward looking statements.

No representation or warranty, express or implied, is made by Metals Finance Limited that the material contained in this presentation will be achieved or proved to be correct. Except for statutory liability which cannot be excluded, each of Metals Finance, its officers, employees and advisers expressly disclaims any responsibility for the accuracy or completeness of the material contained in this presentation and excludes all liability whatsoever (including in negligence) for any loss or damage which may be suffered by any person as a consequence of any information in this presentation or any error or omission there from. Metals Finance accepts no responsibility to update any person regarding any inaccuracy, omission or change in information in this presentation or any other information made available to a person nor any obligation to furnish the person with any further information

CHEMICAL ASPECTS OF MIXED NICKEL-COBALT HYDROXIDE PRECIPITATION AND REFINING

By

[1]James Vaughan, [1]William Hawker, [2]David White

[1]The University of Queensland, School of Chemical Engineering, Australia
[2]Metallurgical Consultant, Perth, Australia

Presenter and Corresponding Author

James Vaughan
james.vaughan@uq.edu.au

ABSTRACT

The precipitation of mixed hydroxide is increasingly being considered as an intermediate step in the hydrometallurgical processing of nickel and cobalt, particularly from nickel laterite ores. Mixed hydroxide precipitation reaction equilibrium and kinetics are discussed. Hydrometallurgical MHP refining is briefly reviewed. A new method of leaching MHP is discussed that involves the fast and efficient separation of nickel from cobalt and manganese, yielding a concentrated nickel solution suitable for direct recovery of a nickel metal by electrowinning, hydrogen reduction, or nickel sulfate by crystallization.

SEQUENTIAL LEACHING OF NICKEL LATERITE ORES

By

[1,2]Nicole Botsis, [2]Wilhelm van Bronswijk and [1]Helen Watling

[1]Parker CRC for Integrated Hydrometallurgy Solutions, CSIRO Minerals Down Under National Research Flagship, CSIRO Process Science and Engineering, Australia
[2]Department of Chemistry, Curtin University, Australia

Presenter and Corresponding Author

Nicole Botsis
nicole.botsis@csiro.au

ABSTRACT

Sequential extractions are used to study element speciation in ore bodies. The extraction methodology consists of a series of successive chemical treatments of a sample and the metals removed help determine the different levels of substitution present in these minerals. This study was performed to assess whether the sequential leaching methodology could be applied to nickel laterite ores. Three samples were chosen, a saprolite, nontronite and limonite ore, and a five-step leaching protocol was developed.

In the first step, which removes the water soluble fraction, no minerals were leached from the saprolite and nontronite ores. However, for the limonite ore, the halite was completely removed and was nickel-barren. No minerals were leached in the second step, which removes the exchangeable fraction, although 40% of the magnesium present in the nontronite was removed. The crystal structure of the nontronite was altered indicating that magnesium existed between the layers of the nontronite structure. Step three, which removes the amorphous material, indicated that no mineral leached from either the nontronite or limonite ores. However, the asbolane present in the saprolite ore was leached, with 7% of the nickel associated with this mineral. There were different extents of nickel leaching in step four, which removed the adsorbed nickel on the oxides and silicates. In the final leach step, which breaks the oxide/silicate crystalline lattice, the lizardite, nontronite and goethite were completely leached along with all the remaining nickel. The only minerals remaining were nickel-barren.

Application of the leaching protocol enabled the determination of different nickel-containing and nickel-barren minerals. It also allowed for the distinction to be made between nickel in amorphous or crystalline material. The use of this technique does not allow for the leaching of goethite independently of lizardite and/or nontronite. However, the leaching methodology is rapid and uses simple solution analysis and therefore it is an affordable method to determine whether nickel is present in minerals that are difficult to leach (i.e. spinels), amorphous phases and/or leachable crystalline phases.

ALTA 2011
NICKEL/COBALT/COPPER

HEAP & BIOLEACHING

OPTIMIZING NICKEL LATERITE AGGLOMERATION FOR ENHANCED HEAP LEACHING

By

[1]Jonas Addai-Mensah, [1]Ishmael Quaicoe, [1]Ataollah Nosrati, [2]George Franks, [2]Liza Forbes, [3]Lian Liu, [4]David J. Robinson and [4]John Farrow,

[1]Ian Wark Research Institute, University of South Australia, Australia

[2]Dept. Chemical and Bimolecular Engineering, University of Melbourne, Australia

[3]School of Chemical Engineering, University of Queensland, Australia

[4]CSIRO Process Science and Engineering & Minerals Down Under National Research Flagship Australian Minerals Research Centre, Australia

Presenter

Jonas Addai-Mensah
Jonas.addai-mensah@unisa.edu.au

ABSTRACT

Although about 60 % of the world's nickel (Ni) mineralization occurs as nickel laterite ore, processing of complex, low grade laterite ores by conventional physical unit operations (e.g. magnetic, electrostatic and flotation) is still intractable. Due to their mineralogical and chemical complexity, low grade nickel laterite ores require more aggressive chemical and hydrometallurgical techniques (e.g., acidic lixiviant heap leaching) for value metal (Ni and Co) extraction. To process such ores, agglomeration of the feed particles into robust and porous granules as a precursor to heap leaching of 4-10 m permeable bed, is desirable. In the present work, we investigate agglomeration behaviour of siliceous goethite Ni laterite ore and selected oxides and clay minerals (hematite, quartz and kaolinite) which constitute the predominant host gangue phases of typical low grade nickel laterite ores. Fundamental knowledge and understanding of the agglomeration mechanisms and kinetics which are essential for producing robust real ore granules, and pivotal to the subsequent heap leaching process, are gleaned. Isothermal, batch agglomeration tests involving 30 and 44 wt.% sulphuric acid solution as a binder indicated that 5 – 40 mm granules of differing roughness and morphologies were produced in 8-14 min.

The results clearly showed feed characteristics (such as mineralogy and primary particle size distribution) and binder content (15-25 wt.%) dependent agglomeration behaviour. Slow induction type nucleation and growth agglomeration were displayed by the kaolinite clay mineral whilst the oxides exhibited fast nucleation and growth agglomeration processes. Siliceous goethite feed ore fine/coarse ratio, H_2SO_4 binder dosage and acidity, post-agglomeration drying temperature and aging conditions, all showed significant impact on controlling agglomeration mechanism (e.g., particle wetting, nucleation and growth processes) and granule attributes (e.g., size, density and strength). Agglomerates strength and density increased with increasing fine/coarse particle ratio.

PROPHECY RESOURCES CORP. LYNN LAKE PROJECT

Nickel Bioleach Development
Mintek Laboratory Test Work Program Update

By

Andrew J. Carter

Tetra Tech , UK

Presenter and Corresponding Author

Andrew J. Carter
Andy.Carter@wardrop.com

ABSTRACT

A description of the Prophecy Resources Corp. Lynn Lake Nickel project is provided together with an update of the Nickel Bioleach laboratory test work currently underway at Mintek, Randburg, South Africa. The results achieved to date and their implications for further development are further discussed

The current test work and development program has demonstrated that bioleaching may be used to successfully extract Nickel, Copper and Cobalt from low grade Lynn Lake concentrates. Also that the costs of recovery are comparable to existent processes. Further that there are a number of options that can be further developed in order to optimise the process and significantly reduce costs

TALVIVAARA SOTKAMO MINE – BIOHEAPLEACHING OF A POLYMETALLIC NICKEL ORE IN SUBARCTIC CONDITIONS

By

Marja Riekkola-Vanhanen

Talvivaara Mining Company Ltd., Finland

Presenter and Corresponding Author

Marja Riekkola-Vanhanen
marja.riekkola-vanhanen@talvivaara.com

ABSTRACT

Talvivaara deposits, Kuusilampi and Kolmisoppi, comprise one of the largest sulfide nickel resources in the world with 1121 Mt in measured and indicated resource categories, sufficient to support an anticipated production for 46 years. Production at the mine started in October 2008 with the precipitation of the first metal sulfides. The planned annual nickel production of 50,000 tonnes is anticipated to be reached in 2012. As by-products the mine will also produce approximately 90,000 tonnes of zinc, 15,000 tonnes of copper and 1,800 tonnes of cobalt.

The process consists of mining, crushing, bioheapleaching and metals recovery. Crushing is done in four stages. The crushed material is agglomerated with sulfuric acid in order to consolidate the fines with coarser ore particles. The agglomerated material is conveyed and stacked eight meters high on the primary pad for bioheapleaching. After one and a half years leaching on the primary pad, the leached ore is reclaimed and restacked onto the secondary pad, where it is leached further in order to raise the metal recovery. In metals recovery copper, zinc, nickel and cobalt are precipitated as sulfides from the pregnant leaching solution. These metal intermediates are supplied to companies with metal refining operations.

The Talvivaara deposits are well-suited for open pit mining due to the thin overburden, favorable resource geometry and low waste to ore ratio. The ore is relatively low grade, but well suited to bioheapleaching due to its high sulfide content.

A STUDY INTO THE POSSIBLE APPLICATION OF BIOHEAP TECHNOLOGY TO FORRESTANIA

By

Jason Fewings

Western Areas NL, Australia

Presenter and Corresponding Author

Jason Fewings
jfewings@westernareas.com.au

ABSTRACT

Western Areas NL is an Australian based nickel miner, with core high grade nickel assets in the Forrestania region of Western Australia. Aside from the high grade Flying Fox and Spotted Quoll deposits, Western Areas has interests in a number of deposits in the area, and overseas, and are currently investigating methods for extracting maximum value from those deposits.

The most advanced of those deposits are the Digger Rocks/Diggers South mine and the New Morning deposit. One of the alternatives being investigated is a potential bacterial leach utilizing the BioHeap™ technology that the company acquired in 2009.

This paper outlines the main nickel assets owned by Western Areas and reports on a scoping study investigating the bacterial leaching of Forrestania ores, with an emphasis on the New Morning case study.

ALTA 2011
NICKEL/COBALT/COPPER

SOLID-LIQUID SEPARATION

NOVEL AUTOMATIC PRESSURE FILTER FOR HYDROMETALLURGICAL AND FLOTATION CONCENTRATE DEWATERING APPLICATIONS

By

D. Pepper and P Jay,

FLSmidth, Australia/USA

Presenter and Corresponding Author

Patrick Jay
Patrick.Jay@flsmidth.com

ABSTRACT

Pneumapress Automatic Pressure Filters have unique features for use in minerals applications, such as dewatering of flotation concentrate and washing and dewatering in a plethora of applications in hydrometallurgy. The Pneumapress operation cycle which follows classical cake dewatering phases, without the use of membranes, is discussed and various features and benefits are highlighted and compared to traditional tower press filters which utilize membranes.

Two new applications in hydrometallurgical circuits are described, followed by a case study on Pneumapress filters dewatering hot, corrosive, abrasive slurry at a hydro thermal power plant, which is similar to many hydrometallurgical flow sheets. Two Copper flotation concentrates concentrate dewatering applications are discussed, one at an existing operation, that has a relatively course particle size distribution, and one at an undisclosed source with a relatively fine PSD. The effect of variable and versatile cake formation conditions on the subsequent cake drying stage is demonstrated.

ALTA 2011
NICKEL/COBALT/COPPER

SX/IX/EW

OXIDATION IN COPPER SX PROCESSES

By

Troy Bednarski, Matthew Soderstrom and Shane Wiggett
Cytec Industries Inc.

Presenter and Corresponding Author

Shane Wiggett
shane.wiggett@cytec.com

ABSTRACT

Manganese present in the electrolyte solution of the copper SX-EW process can be oxidized in the tankhouse during electrowinning. This can cause formation of permanganate or other high oxidation states of manganese in the electrolyte and oxidize the organic during the strip stage of the SX process. Once the permanganate ion is contacted with the organic phase during the SX operation the organic components are oxidized and the permanganate is reduced resulting in lower electrolyte ORP values. Oxidation of the organic phase may result in oxime degradation and often forms products that are interfacially active. The oxidation products can affect the metallurgical and physical properties of the organic, resulting in lower copper transfer, decreased reagent kinetics, and extended phase disengagement time.

Cytec Industries Inc. latest reagent development is the ACORGA™ OR series of extractants. The ACORGA™ OR reagents (ACORGA™ OR15 and ACORGA™ OR25) are specifically formulated to provide an extra level of oxidative degradation protection for use at operations where the likelihood of solutions having a high oxidation-reduction potential exists.

MANGANESE IN SX-EW PLANTS

Gabriel Zárate

Anglo American, Chile

Presenter and Corresponding Author

Gabriel Zárate
gzarate@anglochile.cl

ABSTRACT

The published information about manganese behavior in SX/EW plants has been reviewed and its application to a number of Chilean plants has been analyzed. It is usually recommended to keep the manganese concentration in the electrolyte below 0.05 g/l, because under certain conditions, manganese can cause a number of problems, among them: reduction in the extractant loading capacity and extraction kinetics, chlorine generation in electrolytic cells, stainless steel cathode pitting corrosion, accelerated anode corrosion and precipitation of amorphous MnO_2.

The measures usually proposed to keep the manganese concentration in the electrolyte under control are mainly focused on reducing PLS entrainment and keeping it as Mn+2 by maintaining a minimum iron concentration of 1 g/l and/or a Fe/Mn ratio of 10:1 or 8:1 in the electrolyte.

The operating data of several electrowinning tankhouses has been collected and analyzed in relation to the recommendations mentioned above. This data includes the redox potential and the concentrations of manganese, total iron, ferrous iron and chloride in the electrolyte.

The data analysis carried out, as well as the conclusions and recommendations obtained, are discussed in this paper.

CONTAMINATION MANAGEMENT IN SOLVENT EXTRACTION PLANTS

By

Graeme Miller

Miller Metallurgical Services, Australia

Presenter and Corresponding Author

Graeme Miller
gmiller@millermet.com

ABSTRACT

Most solvent extraction plants are used to remove contaminants and to concentrate the ion species of interest for further processing. This activity can be significantly impaired by the cross contamination of the process streams with other species that can be transferred across the phases. These species can have significant impacts on the operation of the SX plant itself, operation and chemical contamination of the concentrated stream and further impacts on the process applied to the raffinate stream.

The minimisation of this cross contamination is a major driver for: PLS treatment, SX circuit design, reagent selection, internal SX plant unit operations for contamination minimisation, reagent regeneration systems, and subsequent treatment of the concentrated stream and raffinate. A wide variety of these systems is available to the plant designer and operator. The selection and use of them is not straight forward or obvious until (generally) after an upset event has occurred.

The paper describes many of the methods of contamination control as well as criteria for their selection. Management of one level of contamination often introduces a further upset condition that also has to be addressed for a successful implementation to be achieved. A hierarchy of such issues has been developed to allow practitioners to understand these interactions and to successfully implement programmes of contamination management.

CYANEX™ 272 EXTRACTANT PROCESS MODELLING UPDATE

By

Matthew Soderstrom, Cyril Bourget, Boban Jakovljevic

Cytec Industries Inc., USA

Presenter and Corresponding Author

Cyril Bourget
cyril.bourget@Cytec.com

ABSTRACT

The Minchem program for predicting the expected metallurgical performance of CYANEX 272 circuits is continually being enhanced. To overcome the challenges of non-convergence, a methodology has been developed for quicker assessment of circuit conditions.

The optimum configuration of a plant will vary depending on the specific feed conditions and targeted separations. The program allows a quick assessment of these variables and provides data to enable capex / opex calculations to be made. The program supports quick assess when the addition of staging has reached the point of diminishing returns and also allows an operator to focus on the optimum pH to achieve high reagent utilization while maximizing metal separations.

Much time has been spent to develop base data, a simulation approach and program the logic. This automation requires expert management and some manual work to provide the output. The system will be further developed over the next year to improve ease of use although it is fully effective in its current form.

THE DEVELOPMENT OF A NEW DSX PROCESS FOR THE SEPARATION OF NICKEL AND COBALT FROM IRON AND ALUMINIUM AND OTHER IMPURITIES

By

C.Y. Cheng, Z. Zhu and Y. Pranolo

The Parker Centre / CSIRO Process Science and Engineering /
CSIRO Minerals Down Under National Research Flagship, Australia,

Presenter and Corresponding Author

Chu Yong Cheng
chu.cheng@csiro.au

ABSTRACT

A new synergistic solvent extraction (SSX) system has been developed in CSIRO recently to separate nickel and cobalt from iron and aluminium and other impurities. A new CSIRO DSX process has been created using the new SSX technology to directly recover nickel and cobalt from laterite leach solutions without intermediate precipitation and re-leach steps. This is a significant development for the recovery of nickel and cobalt from laterite leach solutions, especially from heap leaching (HL) and atmospheric leaching (AL) solutions. The new CSIRO DSX process has the following advantages:

- Making the direct recovery of nickel and cobalt from HL, AL and HPAL solutions possible without the removal of iron and aluminium,
- Separation of nickel and cobalt from iron, aluminium and other impurities in low pH to avoid nickel and cobalt losses in neutralisation or precipitation steps,
- Possible savings in capital and operating costs if applied to HPAL processes since the CCD system for neutralisation, precipitation and solid/liquid separation can be simplified,
- All organic reagents are commercially available and in reasonable prices,
- The process flowsheet is much simplified to save capital and operating costs.
- The new CSIRO DSX process can be readily coupled with nickel hydrolysis, electrowinning and hydrogen reduction to obtain different nickel products.

SELECTIVE SEPARATIONS IN THE COBALT, URANIUM AND SULFURIC ACID INDUSTRIES

By

Steven R. Izatt, Neil E. Izatt, and Ronald L. Bruening

IBC Advanced Technologies, Inc., USA

Presenter and Corresponding Author

Neil E. Izatt
nizatt@ibcmrt.com

ABSTRACT

IBC Advanced Technologies' Molecular Recognition Technology (MRT) SuperLig® products selectively and rapidly bind with target metal ions to remove them from solution. The MRT process can produce a high purity separation product of maximum added value at low cost. This paper discusses applications for MRT in the cobalt industry, including removal of Cd, Cu, Pb, and Ni. Additional separations of interest to the Australian mining industry will also be discussed, including Hg removal from sulfuric acid and uranium separations.

DEVELOPMENT OF A NOVEL SMART ANODE FOR ENVIRONMENTALLY FRIENDLY ELECTROWINNING PROCESS

By

Masatsugu Morimitsu

Department of Environmental Systems Science, Doshisha University, Japan

Presenter and Corresponding Author

Masatsugu Morimitsu
mmorimit@mail.doshisha.ac.jp

ABSTRACT

This paper presents performance data of a novel smart anode, MSA$^{TM(1)}$, for electrowinning of non-ferrous metals such as copper, zinc, nickel, and cobalt. The smart anode consists of a titanium substrate coated with a catalytic oxide layer prepared by thermal decomposition of a precursor solution at 400 ^{o}C or less. Such a low temperature decomposition produces amorphous or less crystalline oxide coatings comprising iridium oxide-based mixture or ruthenium oxide-based mixture. The application of the smart anode in electrowinning with constant current results in a remarkable reduction in cell voltage compared to other anodes, *e.g.*, commercially available coated titanium electrodes and lead alloy electrodes. The test data has demonstrated that a maximum voltage reduction by *ca.* 30% is possible compared to lead alloy anodes for copper electrowinning. The smart anode also gives some additional merits in suppressing unwanted deposits on the anode; *i.e.*, deposition of MnOOH, PbO_2, or CoOOH. The electrowinning with the smart anode is possible to be an environmentally friendly process with less energy consumption and less anode deposits.

DEVELOPMENT OF ANODE BAG TECHNOLOGY IN NICKEL ELECTROWINNING

By

[1]Ville Nieminen, [2]Noora Kaakkolammi, [1]Henri Virtanen, [1]Eero Tuuppa, [2]Rauno Luoma

[1]Outotec, Finland
[2]Norilsk Nickel Harjavalta Oy, Finland

Presenter and Corresponding Author

Ville Nieminen
ville.nieminen@outotec.com

ABSTRACT

In 2008 Outotec and Norilsk Nickel Harjavalta started a joint effort to develop anode bag technology to be used in sulfate based nickel electrowinning (Ni EW). Using anode bags instead of cathode bags is an efficient way to suppress acid mist and nickel emissions in the tankhouse environment. Furthermore, anode bags enable other process possibilities, such as recirculation of the electrolyte and recovery of anodically evolved oxygen. The aim of the development work was to obtain a high anolyte sulfuric acid concentration of 80 g/l, in other words, a high ΔNi, the difference in nickel concentration between rich electrolyte and anolyte, without a negative impact on cathode quality. The high acid and low nickel concentrations in anolyte are economic when it is recirculated in the leaching stage. A further aim was to find good and efficient tankhouse practices with anode bag technology.

Electrolyte flow control through the diaphragm inside the anode bags was first studied in laboratory scale Ni EW experiments. At a current density of 200 Am^{-2} a high anolyte sulfuric acid concentration, up to 120 g/l, was obtained. A commercial scale pilot cell containing anodes in specially designed bags was operated for over two years. Easily operated bag frames were developed in the course of the campaign. The new bag system enabled good control of the electrolyte flow. A small amount of sodium lauryl sulfate was used as an additive to obtain smooth cathode surfaces. Catholyte overflow from the cell was circulated and pH was controlled by neutralization with caustic. Anolyte and anode gas were withdrawn from the bags by suction using dip tubes located below the catholyte level. The anolyte acid concentration and ΔNi were maximized by carefully controlling the catholyte flow through the diaphragm inside the anode bags; a sulfuric acid concentration of 80 g/l in anolyte and a ΔNi of 50 g/l were obtained. The current efficiency was very high, typically 98%. The gas contents inside the bags were measured indicating that the gas mixture contained high amounts of oxygen, around 98% by volume, which is highly suitable for the oxygen recovery to be used in the leaching stage. CellSense™, an automatic cell monitoring system, was used to detect changes in cell voltage and temperature. The monitoring system made it possible to detect short circuits as a drop and fluctuation in the cell voltage as much as a day before removing the shorts was actually needed. A higher current efficiency and a lower number of torn bags were obtained as a result. The stable operation of the anode bag cell was achieved.

ALTA 2011
NICKEL/COBALT/COPPER

LEACHING OF SULPHIDES

RECOVERING COPPER AND GOLD IN CHLORIDE SYSTEM BY NIKKO CHLORIDE PROCESS

By

Kazuaki Takebayashi, Kazuhiro Hatano, Hiroshi Hosaka, Yoshifumi Abe

JX Nippon Mining and Metals Corporation, Japan

Presenter and Corresponding Author

Yoshifumi Abe
yoshifumi.abe@nmm.jx-group.co.jp

ABSTRACT

JX Nippon Mining & Metals Corporation (NMM) has been developing a process which makes copper and gold recovery easy and effective. The process, named Nikko Chloride Process, employs sodium chloride media and is composed of copper leaching and copper recovery, gold leaching and gold recovery and silver recovery. Leaching of copper and gold is performed under ambient pressure with only aeration. Nikko Chloride Process recovers copper by solvent extraction, then produces copper cathode from sulphate solution. Some bromide helps gold leaching from gold bearing copper concentrate. Gold is recovered on activated carbon or by solvent extraction. Silver is recovered by solvent extraction.

NMM built a pilot plant for the process in Perth. The pilot plant has operated well. More than 98% of copper is leached and high quality copper cathode is produced. More than 90% of gold is leached. Applying floatation could recover 5% more of the gold from the gold leach residue. NMM is trying to apply gold recovery by solvent extraction.

IMPROVING CASH FLOW FROM LOW GRADE NICKEL CONCENTRATES

By

David Jones

Teck Resources Ltd/CESL, Canada

Presenter and Corresponding Author

David Jones
David.Jones@teck.com

INTRODUCTION

ALTA 2011
NICKEL/COBALT/COPPER

NEW PROJECTS

ASSAREL MEDET JSC Cu SX-TF-EW PROJECT IN BULGARIA

By

Hannu Laitala, and Marko Lampi

Outotec Oyj, Finland

Presenter and Corresponding Author

Hannu Laitala
hannu.laitala@outotec.com

ABSTRACT

Assarel Medet JSC owns and operates a copper mine and concentrator in Panagyurishte, Bulgaria. The concentrator produces about 50 000 t/a copper in concentrate. Side rock and concentrator waste is dumped into a heap, where copper is leached with the aid of acidic liquid and microbiological activity. Particle size of the leached material can vary from coarse (50 – 100 mm) to very fine (< 10 µm). The material contains both oxidized and sulfidic copper compounds. From the produced solution copper was cemented with the aid of scrap iron. The copper product contained about 60 – 80 % copper, the remainder being mainly iron. Cemented copper was sold to different copper smelters.

Price for the cemented copper was low and Assarel started to investigate different process routes to produce pure copper. Process restrictions in Assarel are high solids concentration in the incoming feed (up to 1 - 2 g/L during wet season), diluted copper concentration in the feed (< 1 g/L), small capacity (2 000 t/a Cu) and harsh winter conditions. The target for the new Cu process was to produce copper in an economically viable way under these process conditions. Assarel Medet JSC's new Cu SX-TF-EW process was successfully started in December 2010. First cathode was produced 19th December, 2010.

LADY ANNIE OPERATIONS – CST RESTART 2010

By

Anissa Horner

CST Minerals, Lady Annie, Australia

Presenter and Corresponding Author

Anissa Horner
ahorner@ladyannie.com.au

ABSTRACT

CST Minerals Lady Annie started producing copper again in November 2010 after being under care and maintenance since November 2008.

The startup was relatively trouble free thanks to a thorough overhaul of the entire processing area from crushing and stacking to SX and EW.

This paper will outline the timeline for CST Lady Annie operation so far, including mining, crushing and processing. Mining commenced in August, crushing in September and first copper metal on the 25th November 2010.

Included in the paper is stacking data, PLS grade and cathode data. There is also information on future plans for expansion and forced aeration heap leaching. All of these plans will ensure the longevity of the Lady Annie operation in NW Queensland.

ATMOSPHERIC ACID LEACHING OF NKAMOUNA ASBOLINIC COBALT CONCENTRATE WITH PYRITE AS THE REDUCTANT

By

[1]Herman Schwarzer, [1]Alastair Holden, [1]Brett Crossley, [2]Roman Berezowsky and [3]Brian Briggs

[1]Lycopodium Minerals, Australia
[2]Hydrometallurgical Consultant to Geovic Cameroon, Canada
[3]Geovic Mining Corporation, USA

Presenter and Corresponding Author

Herman Schwarzer
herman.schwarzer@lycopodium.com.au

ABSTRACT

Geovic Mining Corporation's Nkamouna Cobalt-Nickel-Manganese Project is a greenfields project, located in the East Province of Cameroon in Africa. The company proposes to produce a high grade, high purity mixed cobalt nickel sulphide (MSP), as well as a manganese carbonate (MnCP) by-product for sale to third parties.

The deposit under investigation is a cobalt rich nickeliferous laterite and is unique in its mineralogy due to the high concentrations of cobalt and manganese relative to nickel. Mining will be performed using strip mining techniques. Physical upgrading of the run of mine ore will be achieved by attritioning and size separation to recover the valuable asbolinic mineral as a coarse fraction.

The resulting concentrate will contain approximately 1% cobalt, 0.85% nickel and 5.4% manganese, and about 8% aluminium and 37% iron. The concentrate will be milled in an open circuit ball mill (P_{80} of 106 µm) and leached under reducing atmospheric conditions with sulphuric acid at 95ºC in a sodium sulphate-containing solution. The leach temperature will be sustained by the exothermic leach reactions and augmented by the heat of dilution from the sulphuric acid. Ultra fine pyrite (P_{80} of 10 µm) will be utilised as the reductant in the leaching process.

The process chemistry is complex as two processes occur simultaneously in the leaching circuit:

- cobalt (95%), manganese (93%), and nickel (60%) are dissolved, as the asbolinic minerals react under the reducing acidic conditions, and
- a portion of the aluminium and a lesser amount of iron are also dissolved, but under the prevailing conditions they are largely hydrolysed and precipitated as alunite and jarosite respectively.

By judicious selection of the leaching conditions, high extractions of the value metals are able to be achieved in a single stage of atmospheric leaching, while consuming approximately 180 kg/t of sulphuric acid. The resulting pregnant leach solution contains 12 g/L Co, <1 g/L Fe, and about 6 g/L Al, and has a low terminal acidity (<5 g/L).

The Bankable Feasibility Study for the Project was concluded in April 2011 and is currently undergoing review by a number of financial institutions.

ALTA 2011
NICKEL/COBALT/COPPER

EQUIPMENT & MATERIALS

A – Z OF AUTOCLAVE ISOLATION

By

Pete Smith
MOGAS Industries, USA

Presenter and Corresponding Author

Pete Smith
psmith@mogas.com

ABSTRACT

This paper presents a review of practical issues along with a summary of trends encountered in autoclave isolation. This review is presented from the perspective of an equipment maintainer, equipment supplier and package engineer.

HIGH PRESSURE AUTOCLAVE FEEDING AT MAXIMUM SOLIDS CONCENTRATION AND EFFICIENCY

By

Heinz M. Naegel
FELUWA Pumpen GmbH, Germany

Presenter and Corresponding Author

Heinz M. Naegel, CEO
naegel@feluwa.de

ABSTRACT

Handling of mining slurries and tailings in general and high pressure autoclave feeding in Pressure Acid Leach (PAL) facilities of hydrometallurgical projects in particular can be an exceedingly challenging task for pumps. Hydraulically actuated double hose-diaphragm pumps do not only allow for high flow rates (max. 750 m³/h), working pressures (max. 320 bar) and pumping temperatures (max. 200°C), but offer decisive benefits compared to traditional diaphragm pumps that are typically applied for such duties.

With an ideal linear flow path they are especially conducive to the handling of paste and tailings at minimum wear, be they highly viscous, corrosive and/or erosive. Double hose-diaphragm pumps offer maximum efficiency and are almost exclusively of triplex upflow or downflow design, using crankshafts that are offset by 120 degrees. By this means, continuous slurry flow is ensured and sedimentation avoided. For high flow rates, single-acting quintuplex pumps provide for the further reduction of kinematic irregularities and waiving of pulsation dampeners.

AGITATOR START-UP IN SETTLED BED CONDITIONS

By

Jochen Jung and Wolfgang Keller

EKATO RMT GmbH, Germany

Presenter and Corresponding Author

Wolfgang Keller
wolfgang.keller@ekato.com

ABSTRACT

This paper discusses some aspects for the re-starting of agitators in settled bed conditions. As shown, physical correlations and design rules allow the safe design of agitators for such conditions. In any case, recommended designs or strategies can only be as good as product data available or rules of thumb applied, e.g. an assumption for the porosity of the settled solids bed.

CHARACTERISTICS AND FABRICATION QUALITY CONTROL OF LARGE PRESSURE LEACHING AUTOCLAVE

By

Hao Zhen-liang and Mao Lu-rong
Shanghai Morimatsu Pressure Vessel Co., Ltd, China

Presenter and Corresponding Author

Hao Zhen-liang
haozhenliang@morimatsu.cn

ABSTRACT

Hydrometallurgical pressure leaching technique, of which autoclave is the key equipment, has been increasingly applied in the extraction of zinc, gold, nickel, and uranium from ores and concentrates. Shanghai Morimatsu has been dedicating itself to the development of a series of autoclaves by continuous design improvement. Based on this, the structural characteristics of autoclaves in various processing conditions are reviewed here, and the fabrication, quality control, schedule management, hoisting and shipment of large-scale titanium clad autoclaves are summarized as well.

SELECTING SPECIALTY STAINLESS STEEL GRADES FOR SULPHURIC ACID LEACHING ENVIRONMENTS

By

Sophia Ekman

Outokumpu Stainless AB, Avesta Research Centre, Sweden

Presenter and Corresponding Author

Sophia Ekman
Sophia.Ekman@outokumpu.com

ABSTRACT

Treatment of metal-containing ores using sulphuric acid creates a corrosive environment and places high demands on the material used for construction of process equipment. Leaching (atmospheric or pressure) is considered the most aggressive stage, with higher acid concentrations and temperatures, as well as contamination (dissolved metal ions and chloride ions), compared to downstream processes. The combination of sulphuric acid, dissolved metal ions and chloride ions results in competing corrosion mechanisms and complicates the prediction of corrosion, making it difficult to select a suitable material. This paper contains results from laboratory corrosion tests performed on a variety of stainless steel grades at different temperatures. The tests have been performed in simulated leaching environments based on dilute sulphuric acid with addition of oxidative metal ions and different levels of chloride ions. The results have been compiled into a corrosion resistance diagram which seeks to provide a schematic guideline to the selection of specialty stainless steel grades for these environments. High alloyed austenitic stainless steel grades as well as high strength duplex grades are covered in the guideline.

ALTA 2011
NICKEL/COBALT/COPPER

PAL OF LATERITES FORUM

MURRIN MURRIN OPERATIONS PAST, PRESENT AND FUTURE

By

Matt Brown

Minara Resources, Australia

Presenter and Corresponding Author

Matt Brown
mbrown@minara.com.au

Important Notice

This presentation contains certain statements which may constitute "forward-looking statements". Such statements are only predictions and are subject to inherent risks and uncertainties which could cause actual values, results, performance or achievements to differ materially from those expressed, implied or projected in any forward-looking statements.

No representation or warranty, express or implied, is made by Minara that the material contained in this presentation will be achieved or prove to be correct.

Except for statutory liability which cannot be excluded, each of Minara, its officers, employees and advisers expressly disclaims any responsibility for the accuracy or completeness of the material contained in this presentation and excludes all liability whatsoever (including in negligence) for any loss or damage which may be suffered by any person as a consequence of any information in this presentation or any error or omission there from.

Minara accepts no responsibility to update any person regarding any inaccuracy, omission or change in information in this presentation or any other information made available to a person not any obligation to furnish the person with any further information.

CORAL BAY NICKEL HPP-2 PROJECT IN PALAWAN, PHILIPPINES

By

Shinichiro Yumoto, Tozo Otani, Tadashi Nagai and Isao Ikeda

JGC corporation, Japan

Presenter and Corresponding Author

Shinichiro Yumoto
Yumoto.shinichiro@jgc.co.jp

ABSTRACT

Coral Bay Nickel HPP-2 Project (CBNH-2 PJ.) conducted by Coral Bay Nickel Corporation (CBNC) in the Philippines was mechanically completed on February, 2009. CBNC achieved the name plate capacity operation on April, 2009. Ramp-up period was only a couple of months. This paper presents the Project overview of CBNH-2 PJ and refers to a previous project, Rio Tuba Nickel HPP-1 Project (RTNH-1 PJ), and presents a discussion of the keys to success of completing the project on schedule, within budget, with high quality and with early ramp-up, in terms of validated design, reliable EPC execution, competent operator and maintenance staff, and an EPC lump sum contract scheme. Thanks to the success of these two HPAL projects, JGC was selected as a main contractor for Taganito PJ which is underway in Philippines now.

CORAL BAY NICKEL HPAL PLANT EXPANSION PROJECT

By

James Elson Llerin, Isao Nishikawa and Munekazu Kawata

Coral Bay Nickel Corporation (CBNC), Philippines

Presenter and Corresponding Author

James Elson Llerin

e.l.llerin@cbnc.com.ph

ABSTRACT

This Paper will present Coral Bay Nickel Corporation (CBNC) High Pressure Acid Leach (HPAL) Plant Project in the Philippines, mainly its Expansion activities. The original Plant was inaugurated on April 5, 2005 and has achieved its nameplate capacity of 10,000 Ni-Tons/Y in year 2007, where it produced 10, 078 Ni-tons. It was again achieved on the next year, where it produced 10,562 Ni-tons. The Expansion Plant was essentially designed to more than double the production capacity of CBNC HPAL Plant to 22,000 Ni-Tons and 1,500 Co-Tons in a year. Line-2 is basically a mirror-image of Line-1, where each major process circuit is duplicated. To increase Nickel throughput, the High Rate Ore Thickener type of Line-1 was replaced with a High Compression Thickener type in Line-2 to ensure higher %solids of ore slurry. Moreover, GEHO Pumps operation innovation was introduced by the use of Parallel method, which minimized operation down time. To achieve greater efficiency and high availability rate in the 2-Plant operation, tie-in lines were incorporated in the design, where vital solutions and slurries can be transferred from one Plant to another, depending on operational requirements.

The Construction of the Expansion plant was started in year 2006 and achieved its Mechanical Completion on February 20, 2009. After 6 months, Commissioning Completion was achieved on May 2009.

RAMU NICKEL PROJECT UPDATE

By

James Wang

Ramu NiCo Management (MCC) Ltd, PNG

Presenter and Corresponding Author

James Wang
wangchun@mccgrd.com

Ramu Nickel Project-Key Data

- **Total resources:**
  143 million tons
- **Main components:**
  - ✓ **open-pit mining and progressive re-habitation**
  - ✓ **slurry pipeline transport**
  - ✓ **HPAL Process**
  - ✓ **Deep Sea Tailing Placement**
- **Construction cost:**
  1.4 Billion USD
- **Project Life:**
  Over 20 years
- **Annual output**
  Intermediate Hydroxide product
  Nickel: 31,280 t
  Cobalt: 3,220 t

CARBON FRIENDLY NICKEL PROCESSING AND PRESSURE ACID LEACHING: REDUCED CARBON EMISSIONS AND MORE EFFICIENT ACID USE FOR HIGHER ECONOMIC RETURNS

By

S Willis, T Newton, and B Muller

Simulus Engineers, Australia

Presented by

Simon Willis
simon.willis@simulus.com.au

ABSTRACT

Simulus Engineers were awarded an AusIndustry grant in 2010 to co-fund the development of a novel process for the production of nickel metal from laterite ores. The Carbon Friendly Nickel Production (CFNP) process, involves membrane technology to recover sulphuric acid and reductive calcination to regenerate reactive magnesia from waste process liquor. The CFNP process is anticipated to reduce CO_2 emissions by over 60% from a base case conventional atmospheric leach / neutralisation / mixed hydroxide process (MHP) flowsheet. This is achieved through lower process emissions by avoiding the need for limestone and lime neutralisation of residual free acid, and reduced emissions from the transportation of reagents. Reagent costs for CFNP can be up to 75% lower than the base case flowsheet (including credits for excess magnesia and sulphuric acid production). The CFNP flowsheet can be applied to any sulphuric acid leach technology: PAL, atmospheric, or heap leach.

Operating costs are estimated to be 25 to 48% lower than the conventional flowsheet depending on the flowsheet scenario chosen. Capital costs are similar to the conventional atmospheric leach flowsheet, but can be 29% lower, or 24% higher, depending on the scenario. The optimum scenario will depend on the ore body and business strategy of any company seeking to implement the membrane and magnesia recovery technology.

Simulus Engineers will be operating a demonstration plant to showcase the new process in late 2011, in conjunction with further testwork to optimise two stage leach, iron removal, and magnesia recovery process parameters.

ALTA 2011
NICKEL/COBALT/COPPER

ADDITIONAL PAPER

(Not presented at conference)

RECENT DEVELOPMENTS IN NOVEL PHASE CONTACTING DEVICES/ASPECTS FOR HYDROMETALLURGICAL APPLICATIONS

By

Katragadda Sarveswara Rao

EEE, India

Presenter and Corresponding Author

Katragadda Sarveswara Rao
srvswr.rao@gmail.com

ABSTRACT

This paper attempts to provide an overview of novel phase contacting devices with regard to gas-liquid, liquid-liquid and solid-liquid systems including the effect of sonication as applicable to process intensification in hydrometallurgy. The leaching of complex materials by pressure autoclaves has led to benefits of having much more rapid reactions, more compact equipment, and a reduced environmental burden. However, designing of suitable pressure reactors is a difficult task because autoclave technology depends on factors like batch/continuous mode operation, suitable material of construction to withstand corrosive atmosphere at high temperature and pressure, ease of assembly and disassembly, provision for easy withdrawal of intermittent samples for process monitoring, and finally, overall safety management. The salient features associated with safety management of autoclave reactors are described with special emphasis on materials of construction. The challenges/limitations associated with the application of novel phase contacting devices for leaching of sulphide minerals are described as a case study.