Table of Contents

Hydrometallurgy 2014
Volume I

Foreword .......................................................................................................................... v
Editors' Biographies ....................................................................................................... vii

PLENARY

Kinetics in Hydrometallurgy – Models, Mechanisms and Mystery ...................................... 3
M. Nicol

Agile Process Development and Early Use of Solvent Extraction in the Mining Industry ..................... 5
N. Hazen

Hydrometallurgical Developments in the Zinc Industry in China .................................................. 17
K. Jiang, H. Wang and L. Li

A Changing Environment: Reflections on 50 Years of Hydrometallurgy ........................................... 33
J. Monhemius

From Hydrometallurgy to Advanced Energy Material and Environmental Technology Development: An Odyssey of Research Risks and Opportunities .................................................. 35
G.P. Demopoulos

EXTRACTION (SULFIDES)

Integration of Copper Concentrate Pressure Oxidation Process with Copper Heap Leaching for Improving Overall Metallurgical Performance ....................................................... 39
Q. Wang and P. Kondos

Pyrite Leaching Behaviour Under CESL Process Conditions ....................................................... 57
H. Salomon-de-Friedberg

Bio-hydrometallurgy: An Alternative to Pyrometallurgy for Copper Recovery in a Polymineral Concentrate .................................................................................................................. 67
A.G. Guézennec, M. Hanke, A. Chmielarz, C. Joulian, Y. Ménard and P. d'Hugas

Alkaline Sulfide Leaching Technology: Just the Facts ................................................................. 77
C.G. Anderson

Extraction Behavior of Arsenic And Copper From an Enargite Concentrate in Catalyzed Atmospheric Leaching Conditions .................................................................................................. 89
L.S. Quiroz-Castillo, O.G. Olvera, P.J. Valenzuela-Guerrero, L. Dyer and D.G. Dixon

Investigation into Oxidative Dissolution of Enargite with Chlorine Dioxide .................................... 101
G.A. Moldoveanu, G.W. Norval and V.G. Papangelakis
Thermal Behaviour of Medium Temperature Sulphide Concentrate Leach Residues ............................................ 113
T. Javed and E. Asselin

Bioleaching of Copper Sulphides in the Presence Fluoride-containing Gangue Minerals ................................. 127

Bioleaching of Low Grade Sulphide Ore in Column Reactors ........................................................................... 139
S. Ilyas and J.-C Lee

The Use of Bioleaching Methods for the Recovery of Metals Contained in Sulphidic Mining Wastes .................. 151
A.G. Guezennec, M. Delclaud, F. Savreux, J. Jacob, S. Nanaa and P. D'Hugues

Base Metal Heap and Tank Leaching from a Platinum Flotation Concentrate Using Ammoniacal Solutions .......... 159
C. Mizawazi and J. Petersen

Making Use of Chloride Chemistry for Improved Metals Extraction Processes ............................................. 171
G.B. Harris

The Outotec Nickel Matte Chloride Leaching Process ......................................................................................... 185
K. Haavanlammi, K. Valkama, T. Kotiranta and J.-P. Lempainen

Oxidative Acid Leaching of a Nickel Sulphide Concentrate: Comparison of Options .................................. 197
G. Wren, G. Senanayake and M. Hourn

Silica and Sodium Chloride Assisted Leaching of Chalcopyrite ....................................................................... 211
G. Senanayake, H. Miki and S. Wheatley

Dissolution of Copper From Low-grade Chalcopyritic Ores with Polar Organic Solvents in Acid Media ............ 225
O.J. Solis-Marcial and G.T. Lapidus

Selective Leaching of Lead From a Lead-silver-zinc Concentrate with Hydrogen Peroxide in Citrate Solutions .......................................................... 235
R. Zárate-Gutiérrez and G.T. Lapidus

Removal of Fluoride and Chloride From Direct Lead Smelting Dust by Alkaline Washing ............................... 245
B. Jin, Y. Zhang and X. Yang

Leaching Kinetics of Iron in Atmospheric Direct Leaching of Marmatite ......................................................... 253
Z. Xu, H. Zhu, Q. Jiang and C. Wang

A Factorial Study of the Effects of Polytetrafluoroethylene Addition, Pulp Density and Oxygen Pressure on the Performance of Pressure Oxidation of Chalcopyrite Under Conditions Similar to Those of the CESL Process ...................................................... 265
L. Fernandes, M. Uceda and E. Guerra

RARE EARTHS

Hydrometallurgical Process for Rare Earth Elements Recovery From Spent Ni-HM Batteries .................... 277

Electrodeposition of Nd: Fe Alloys From Aqueous Chloride Solutions .......................................................... 291
A. Raygani, G. Sidhu, A.J. Dussault and F.M. Doyle
Recovery of Cerium From Chloride Solution by Oxidation with Sodium Hypochlorite ........................................ 303
   E. Ho, D. Wilkins and K. Soldenhoff

Rare Earth Metal Ion Solubility in Acidic Sulphate-phosphate Solutions .................................................. 313
   G. Senanayake, S. Jayasekera, A.M.T.S. Bandara, E. Koenigsberger, L. Koenigsberger and J. Kyle

Precipitation of Calcium Phosphate From Hydrochloric Acid Leach Liquor of a Rare Earth Concentrate .................................................. 325

Recovery of Rare Earths From By-products in Phosphoric Acid Manufacturing Process .................................. 339
   J. Shibata and N. Murayama

RESEARCH AND FUNDAMENTALS

The Semiconductor Mechanism of Dissolution and the Pseudo-Passivation of Chalcopyrite .......................... 351
   F.K. Crundwell

Kinetics of the Galvanic Reduction of Chalcopyrite Concentrates by Copper ........................................... 363
   M. Novak, J. Hiskey and R. Dunne

An Electrochemical Study of the Dissolution of Chalcopyrite in Ammonia-Ammonium Sulphate Solutions ........................................... 375
   T. Moyo, J. Petersen, J-P. Franzidis and M.J. Nicol

New Insights into Electrochemical Processes at the Chalcopyrite Electrode/Solution Interface .......................... 385
   A. Ghahremaninezhad, D.G. Dixon and E. Asselin

Spectroelectrochemistry of Enargite II: Reactivity in Acidic Solutions .................................................. 397
   R.N. Gow, C. Young, H. Huang and G. Hope

The Dissolution Rate of Fresh and Passivated Chalcopyrite Electrodes in the Presence of Pyrite .................. 409
   O.G. Olvera, L.S. Quiroz, D.G. Dixon and E. Asselin

A Novel Experimental Approach to Measure Particle Concentration Distributions in Leaching Tanks .......... 421
   O. Olvera, D. Rival and E. Asselin

Incorporating Mineral Associations, Comminution, Agglomeration, and Loading in Heap Leach Modeling .......... 431
   M.L. Free

Heap Fluid Flow Studies Based on Liquid Holdup and Novel Dispersion Measurements .......................... 443
   I.M. Saman, K. Ilankoon and S.J. Neethling

Investigation of Hydrodynamic Flow in Heap Leaching Using a CFD Computational Model .......................... 455
   D. McBride, J.E. Gebhardt and M. Cross

EDUCATION

Hydrometallurgy Teaching Tools to Help Prepare Students for Employment ........................................... 471
   M.L. Free
Teaching and Training of Hydrometallurgy at UCT ................................................................. 479
J. Petersen

GOLD HYDROMETALLURGY

Pressure Leaching Tests on Aphrodite Refractory Gold Concentrate ............................................. 491
D. Connelly

Specifics of Double Refractory Gold Concentrates Pressure Oxidation in the Presence of Chlorides ................................................................................................................................. 501
P.V. Zaytsev, I.V. Fomenko, Y.M. Shneerso and M.A. Pleshkov

Pretreatment of a Gold Refractory Concentrate: Pressure Oxidation vs Fine Grinding ...................... 515
G. Fuentes, A. Garcés and S. Romo

Biopolymer Addition to Boost Recovery and Throughput in Gold Leaching Processes. A Case Study From Antam Pongkor, Indonesia .................................................................................. 527
H. Sitanggang, A. Pratomo, R.A. Lauten and D. Ramdani

Removal of Copper, Zinc and Iron Complexes From Cyanide Solutions by Solvent Extraction Using a Quaternary Ammonium Salt ................................................................................. 539

Lead, Cadmium and Copper Ions Elimination in Cyanidation Process .................................................. 547
J.R. Parga, J.L. Valenzuela, S. Aguayo and H. Moreno

Complete Refractory Gold Solutions .................................................................................................. 559
J.A. van Niekerk, C.B. Van Buuren and C. Van Den Heuvel

Improved Gold Extraction From a Refractory Arsenopyritic Ore by Chemical Pretreatments ............... 573
S. Liliana Mesa-Espitia and G.T. Lapidus-Lavine

Treatment of a Gold Refractory Concentrate with Halogens ............................................................. 581
D. Lemieux, J.-M. Lalancette and B. Dubreuil

Preg-robbing in Gold-Ores in Antioquia-Colombia .............................................................................. 591
O.J. Restrepo-Baena and L. Rojas-Mendoza

Pilot Plant Pressure Oxidation of Refractory Gold-silver Concentrate From Eldorado Gold Corporation’s Certej Project in Romania .................................................................................... 601
T. Chan, M. Collins, J. Dennett, J. Stiksma, J. Ji, R. Kalanchey and R. Berezowsky

Copper Sulfide Precipitation in Cyanide Solutions ............................................................................. 613
C. Jimenez-Velasco, F. Nava-Alonso, A. Uribe-Salas, R. Pérez-Garihay and O. Alonso-Gonzalez

Biooxidation of a High-arsenic-bearing Refractory Gold Ore ................................................................ 623
H. Yang, X. Song, L. Tong, G. Chen and Z. Jin

Water and Lixiviant Recycle for Gold Recovery Using Non-cyanide Lixiviants ............................... 631
Y. Choi and S.R. LaBrooy

A Factorial Study of Gold Leaching in Temperature Controlled Thiosulfate Solutions Containing Copper and Meso-2,3-Dimercaptosuccinic Acid ................................................................. 643
M. Uceda, L. Fernandes, E. Guerra and J.L. Shepherd
Unintentional Cementation in Thiourea Leaching

C.A. Urbano, Jr. and G.T. Lapidus

647

Electrochemical Corrosion Behavior of Stainless Steel in Thiosulfate Solutions
Relevant to Gold Leaching

L. Choudhary and A. Alfantazi

655

A Fundamental Investigation of the Caro’s Acid Cyanide Destruction Process

D.M. Hewitt, A.M. Simons and P.L. Breuer

665

New Developments in Ion Exchange Resins for the Recovery of Gold From
Complex Ores

J. van Deventer

677

Selectivity of Lix\textsuperscript{R}79, Guanidine Based Reagent, for Gold Solvent Extraction From
Cyanide Solutions

J.L. Valenzuela, J.R. Parga, S. Aguayo, R.G. Lewis and M. Encinas

689

OPERATIONS

ZINCEX\textsuperscript{TM} Technology: Recent Industrial Operations

G. Díaz, A.B. Mejias, D. Martin and F. Cubeddu

703

Leach Residue Filtration Studies at the Hudbay Zinc Pressure Leach Plant

S. Shairp

715

Process Water Changes and Challenges for a Gold Mine in West Africa

M. Thorpe and W. de Klerk

725

Capacity Enhancement at Newmont Mining Corporation’s Twin Creeks Whole
Ore Pressure Oxidation Facility

M. Eichhorn, T. Krumins, L. Zunti and F.C. Ruff

735

Development of Autoclave Processing POX Technology for Olimpiada Sulphide
Concentrates and Biooxidation Feedstocks

B.A. Zaharov, J.M. Slmeerson, L.V. Chugaev, M.T. Zhumusov, S.V. Drosdov
and A.M. Marketov

751

Maboumine Process: A Promising Process for Developing a Polymetallic Ore Deposit –
Focus on the Upstream Part of the Process

L. Donati, B. Courtaud and V. Weigel

763

Processing of Polymetallic Sulphides From Iberian Pyrite Belt

C. Frias, E. Delgado and J. Gotor

771

Phoenix Copper Leach - Cathode Eight Years in the Making

A.R. House and G.W. Shepherd

783

The Operation of a 30kt/a Copper L-SZ-EW Plant Project in the DR Congo

W. Wang

795

Development of Central Asia Metals’ Kounrad Copper Project

H.M. Nicholson, A. Moe, D. Kan, N. Shirley and P.A. Crane

807

Corrosion of Stainless Steels Associated with Nitric Acid Dissolution of Metallic
Nickel and/or Cobalt

J. Budac, R. Koflik and S. Mankasingh

819

Author Index

827