

Table of Contents

Hydrometallurgy 2014 Volume I

Foreword	v
Editors' Biographies	vii

PLENARY

Kinetics in Hydrometallurgy – Models, Mechanisms and Mystery	3
<i>M. Nicol</i>	
Agile Process Development and Early Use of Solvent Extraction in the Mining Industry	5
<i>N. Hazen</i>	
Hydrometallurgical Developments in the Zinc Industry in China	17
<i>K. Jiang, H. Wang and L. Li</i>	
A Changing Environment: Reflections on 50 Years of Hydrometallurgy	33
<i>J. Monhemius</i>	
From Hydrometallurgy to Advanced Energy Material and Environmental Technology Development: An Odyssey of Research Risks and Opportunities	35
<i>G.P. Demopoulos</i>	

EXTRACTION (SULFIDES)

Integration of Copper Concentrate Pressure Oxidation Process with Copper Heap Leaching for Improving Overall Metallurgical Performance	39
<i>Q. Wang and P. Kondos</i>	
Pyrite Leaching Behaviour Under CESL Process Conditions	57
<i>H. Salomon-de-Friedberg</i>	
Bio-hydrometallurgy: An Alternative to Pyrometallurgy for Copper Recovery in a Polymimetal Concentrate	67
<i>A.G. Guézennec, M. Hanke, A. Chmielarz, C. Joulian, Y. Ménard and P. d'Hugues</i>	
Alkaline Sulfide Leaching Technology; Just the Facts	77
<i>C.G. Anderson</i>	
Extraction Behavior of Arsenic And Copper From an Enargite Concentrate in Catalyzed Atmospheric Leaching Conditions	89
<i>L.S. Quiroz-Castillo, O.G. Olvera, P.J. Valenzuela-Guerrero, L. Dyer and D.G. Dixon</i>	
Investigation into Oxidative Dissolution of Enargite with Chlorine Dioxide	101
<i>G.A. Moldoveanu, G.W. Norval and V.G. Papangelakis</i>	

Thermal Behaviour of Medium Temperature Sulphide Concentrate Leach Residues	113
<i>T. Javed and E. Asselin</i>	
Bioleaching of Copper Sulphides in the Presence Fluoride-containing Gangue Minerals	127
<i>V.A. Leão, I.C.B. Rodrigues, L.C. Sicupira, M.L.M. Rodrigues and T.C. Veloso</i>	
Bioleaching of Low Grade Sulphide Ore in Column Reactors	139
<i>S. Ilyas and J.-C Lee</i>	
The Use of Bioleaching Methods for the Recovery of Metals Contained in Sulphidic Mining Wastes.....	151
<i>A.G. Guézennec, M. Delclaud, F. Savreux, J. Jacob, S. Nanaa and P. D'Hugues</i>	
Base Metal Heap and Tank Leaching from a Platreef Flotation Concentrate Using Ammoniacal Solutions	159
<i>C. Muzawazi and J. Petersen</i>	
Making Use of Chloride Chemistry for Improved Metals Extraction Processes	171
<i>G.B. Harris</i>	
The Outotec Nickel Matte Chloride Leaching Process.....	185
<i>K. Haavanlammi, K. Valkama, T. Kotiranta and J.-P. Lempainen</i>	
Oxidative Acid Leaching of a Nickel Sulphide Concentrate: Comparison of Options	197
<i>G. Wren, G. Senanayake and M. Hourn</i>	
Silica and Sodium Chloride Assisted Leaching of Chalcopyrite	211
<i>G. Senanayake, H. Miki and S. Wheatley</i>	
Dissolution of Copper From Low-grade Chalcopyritic Ores with Polar Organic Solvents in Acid Media	225
<i>O.J. Solís-Marcial and G.T. Lapidus</i>	
Selective Leaching of Lead From a Lead-silver-zinc Concentrate with Hydrogen Peroxide in Citrate Solutions	235
<i>R. Zárate-Gutiérrez and G.T. Lapidus</i>	
Removal of Fluoride and Chloride From Direct Lead Smelting Dust by Alkaline Washing	245
<i>B. Jin, Y. Zhang and X. Yang</i>	
Leaching Kinetics of Iron in Atmospheric Direct Leaching of Marmatite	253
<i>Z. Xu, H. Zhu, Q. Jiang and C. Wang</i>	
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
<i>L. Fernandes, M. Uceda and E. Guerra</i>	
RARE EARTHS	
Hydrometallurgical Process for Rare Earth Elements Recovery From Spent Ni-HM Batteries	277
<i>A.R. Alonso, E.A. Pérez, G.T. Lapidus and R.M. Luna-Sánchez</i>	
Electrodeposition of Nd: Fe Alloys From Aqueous Chloride Solutions	291
<i>A. Raygani, G. Sidhu, A.J. Dussault and F.M. Doyle</i>	

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
--	-----

G. Senanayake, J. Kyle, S. Hunt, K. Stone, N. Perera and S. Jayasekera

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..... <i>J. Petersen</i>	479
--	-----

GOLD HYDROMETALLURGY

Pressure Leaching Tests on Aphrodite Refractory Gold Concentrate	491
<i>D. Connolly</i>	
Specifics of Double Refractory Gold Concentrates Pressure Oxidation in the Presence of Chlorides	501
<i>P.V. Zaytsev, I.V. Fomenko, Y.M. Shneerso and M.A. Pleshkov</i>	
Pretreatment of a Gold Refractory Concentrate: Pressure Oxidation vs Fine Grinding.....	515
<i>G. Fuentes, A. Garcés and S. Romo</i>	
Biopolymer Addition to Boost Recovery and Throughput in Gold Leaching Processes. A Case Study From Antam Pongkor, Indonesia	527
<i>H. Sitanggang, A. Pratomo, R.A. Lauten and D. Ramdani</i>	
Removal of Copper, Zinc and Iron Complexes From Cyanide Solutions by Solvent Extraction Using a Quaternary Ammonium Salt	539
<i>O. Alonso-González, F. Alvarado-Hernandez, J.A. González-Anaya, C. Jimenez-Velasco, F. Nava-Alonso and A. Uribe-Salas</i>	
Lead ,Cadmium and Copper Ions Elimination in Cyanidation Process	547
<i>J.R. Parga, J.L. Valenzuela, S. Aguayo and H. Moreno</i>	
Complete Refractory Gold Solutions.....	559
<i>J.A. van Niekerk, C.B. Van Buuren and C. Van Den Heuvel</i>	
Improved Gold Extraction From a Refractory Arsenopyritic Ore by Chemical Pretreatments	573
<i>S. Liliana Mesa-Espitia and G.T. Lapidus-Lavine</i>	
Treatment of a Gold Refractory Concentrate with Halogens.....	581
<i>D. Lemieux, J.-M. Lalancette and B. Dubreuil</i>	
Preg-robbing in Gold-Ores in Antioquia-Colombia	591
<i>O.J. Restrepo-Baena and L. Rojas-Mendoza</i>	
Pilot Plant Pressure Oxidation of Refractory Gold-silver Concentrate From Eldorado Gold Corporation's Certej Project in Romania	601
<i>T. Chan, M. Collins, J. Dennett, J. Stiksma, J. Ji, R. Kalanchey and R. Berezowsky</i>	
Copper Sulfide Precipitation in Cyanide Solutions	613
<i>C. Jimenez-Velasco, F. Nava-Alonso, A. Uribe-Salas, R. Pérez-Garibay and O. Alonso-Gonzalez</i>	
Biooxidation of a High-arsenic-bearing Refractory Gold Ore.....	623
<i>H. Yang, X. Song, L. Tong, G. Chen and Z. Jin</i>	
Water and Lixiviant Recycle for Gold Recovery Using Non-cyanide Lixiviants.....	631
<i>Y. Choi and S.R. La Brooy</i>	
A Factorial Study of Gold Leaching in Temperature Controlled Thiosulfate Solutions Containing Copper and Meso-2,3-Dimercaptosuccinic Acid	643
<i>M. Uceda, L. Fernandes, E. Guerra and J.L. Shepherd</i>	

Unintentional Cementation in Thiourea Leaching..... <i>C.A. Urbano, Jr. and G.T. Lapidus</i>	647
Electrochemical Corrosion Behavior of Stainless Steel in Thiosulfate Solutions Relevant to Gold Leaching <i>L. Choudhary and A. Alfantazi</i>	655
A Fundamental Investigation of the Caro's Acid Cyanide Destruction Process..... <i>D.M. Hewitt, A.M. Simons and P.L. Breuer</i>	665
New Developments in Ion Exchange Resins for the Recovery of Gold From Complex Ores <i>J. van Deventer</i>	677
Selectivity of Lix ^R 79, Guanidine Based Reagent, for Gold Solvent Extraction From Cyanide Solutions..... <i>J.L. Valenzuela, J.R. Parga, S. Aguayo, R.G. Lewis and M. Encinas</i>	689
OPERATIONS	
ZINCEX TM Technology: Recent Industrial Operations <i>G. Diaz, A.B. Mejias, D. Martin and F. Cubeddu</i>	703
Leach Residue Filtration Studies at the Hudbay Zinc Pressure Leach Plant	715
<i>S. Shairp</i>	
Process Water Changes and Challenges for a Gold Mine in West Africa	725
<i>M. Thorpe and W. de Klerk</i>	
Capacity Enhancement at Newmont Mining Corporation's Twin Creeks Whole Ore Pressure Oxidation Facility..... <i>M. Eichhorn, T. Krumins, L. Zunti and F.C. Ruff</i>	735
Development of Autoclave Processing POX Technology for Olimpiada Sulphide Concentrates and Biooxidation Feedstocks	751
<i>B.A. Zaharov, J.M. Shneerson, L.V. Chugaev, M.T. Zhunusov, S.V. Drosdov and A.M. Markelov</i>	
Maboumine Process: A Promising Process for Developing a Polymetallic Ore Deposit – Focus on the Upstream Part of the Process..... <i>L. Donati, B. Courtaud and V. Weigel</i>	763
Processing of Polymetallic Sulphides From Iberian Pyrite Belt	771
<i>C. Frias, E. Delgado and J. Gotor</i>	
Phoenix Copper Leach - Cathode Eight Years in the Making	783
<i>A.R. House and G.W. Shepherd</i>	
The Operation of a 30kt/a Copper L-SZ-EW Plant Project in the DR Congo	795
<i>W. Wang</i>	
Development of Central Asia Metals' Kounrad Copper Project..... <i>H.M. Nicholson, A. Moe, D. Kan, N. Shirley and P.A. Crane</i>	807
Corrosion of Stainless Steels Associated with Nitric Acid Dissolution of Metallic Nickel and/or Cobalt	819
<i>J. Budac, R. Kofluk and S. Mankasingh</i>	
Author Index.....	827

Table of Contents

Hydrometallurgy 2014 Volume II

Foreword	v
Editors' Biographies	vii

PROCESS DESIGN AND SIMULATION

Influence of Reactor Design to Process Performance in Hydrometallurgical Applications.....	3
<i>M. Latva-Kokko, T. Hirsi, M. Lindgren and T. Ritasalo</i>	
Design of Agitators for Storage and Surge Tanks with High Yield Stress Fluids	15
<i>J. Jung, W. Keller and N. Rohn</i>	
Defining the Level of Detail for Process	29
Models and the Impact on Project Financials	
<i>S. Thakurdin and E. Minnaar</i>	
Sulphur-Burning Sulphur Dioxide Gas Plants for Reducing Agent Supply to Hydrometallurgical Processes – The Economic Advantage	41
<i>K. Nikolaisen, K. Marte and A. Guenkel</i>	
Incorporating Radiant Heat Exchange into Finite Element Models of Hydrometallurgical Process Equipment.....	55
<i>D. McMullen</i>	

ELECTROWINNING

Modeling and Measuring Electrodeposition Parameters Near Electrode Surfaces to Facilitate Cell Performance Optimization.....	67
<i>A. Shukla and M.L. Free</i>	
Evaluating Operating Parameters Effects on Silver Recovery from Cylinder Electrowinning Cells	79
<i>A. Janwong and M.S. Moats</i>	
High Current Density Silver Electrorefining Process: Technology, Equipment, Automation and Outotec's Silver Refinery Plants	91
<i>M. Maliarik, K.Å. Johansson, B. Ögren, G. Berg, C-D. Johansson, R. Lindh and B.M. Ludvigsson</i>	
Examination of Selected Copper Electrowinning Additives.....	101
<i>M.S. Moats, A. Luyima and T. Oliveira</i>	
Selection of Copper Electrowinning Harvesting Methods and Impacts on Copper Product Quality.....	115
<i>G. Miller, R. Clark, S. Williams, G. Heferan and N. Aslin</i>	

Data Reconciliation of Current Efficiency in Zinc Electrowinning..... <i>M. Mahon and A. Alfantazi</i>	131
Development and Evaluation of Polarization Parameters as Quality Predictors for Zinc Electroplated from Acid Sulphate Electrolytes..... <i>E. Chiyangwa, R.F. Sandenbergh and L. Schoeman</i>	141
Role of Some Organic Impurities in Zinc Electrowinning: Adverse Effects on Current Efficiency and Product Quality <i>D. Majuste, V.S.T. Ciminelli, E.L.C. Martins, A.D. Souza and M.J. Nicol</i>	153
The Role of Anode Chemical Composition on the MnO ₂ Layer Formation in Zinc Electrowinning <i>M. Mohammadi, G. Houlachi and A. Alfantazi</i>	163
Electrowinning of Manganese From Sulphate Solutions in the Presence of Organic Additives..... <i>S.K. Padhy, B.C. Tripathy, I.N. Bhattacharya and B.K. Mishra</i>	173
Substrate Effect on the Structural and Electrochemical Properties of Electrolytic Manganese Dioxide Deposited from Sulphate Solutions..... <i>A. Biswal, A. Singh, B.C. Tripathy, K. Sanjay, T. Subbaiah and B.K. Mishra</i>	183
Cobalt Electrowinning From Sulphate Solutions: Effect of Quaternary Amines..... <i>P. Patnaik, B.C. Tripathy, I.N. Bhattacharya and B.K. Mishra</i>	191
Recovery of Tin From Used Lead-free Solder by Electro-refining in Sulfuric Acid Solutions <i>M.S. Kim, J.C. Lee, B.S. Kim and B.D. Pandey</i>	199
ION EXCHANGE	
Decoupling Intra-Particle Diffusion from Lumped Parameters to Determine In-service Decay of an Acid Ion Exchange Resins..... <i>A. Nesbitt, J. Petersen and J.-P. Franzidis</i>	213
Selective Separations in the Metals Industry..... <i>S.R. Izatt, R.L. Bruening and N.E. Izatt</i>	223
Recent Advances in the Design and Operation of Continuous Ion Exchange Equipment in the Mining Industry..... <i>B.K. Ahlgren and R.U. Seneviratne</i>	235
Synthesis of Magnetic Shell/Core Composites for Applications in Hydrometallurgy: Pyrite/Magnetite <i>G. Viramontes-Gamboa, S. Velázquez-Roque, A. Encinas-Oropesa and L.A. Ibarra-Bracamontes</i>	247
Magnetic Ion Exchange (MIEX) Resin for the Removal of Chromium(VI), Molybdenum(VI), Vanadium(V) and Arsenic(V) Ions From Aqueous Solutions – A Preliminary Batch Study..... <i>R. Hans and G. Senanayake</i>	257
Novel Application of a Gold Cyanide Selective Resin in the PGMs Industry..... <i>V. Yahorava and M.H. Kotze</i>	269

Removal of Copper and Zinc from a Cobalt Electrolyte by Ion Exchange at Kamoto Copper Company's Luilu Plant	281
<i>Y. Jurrius, K.C. Sole and E. Hardwick</i>	
Study of Kinetics of Fe (II) Loading onto Iminodiacetic Ion Exchange Resin	295
<i>P. Abbasi, B. McKevitt and D. Dreisinger</i>	
Selen-IX TM : Selenium Removal from Mining Affected Runoff Using Ion Exchange Based Technology	307
<i>F. Mohammadi, P. Littlejohn, A. West and A. Hall</i>	
Economic Recovery of Uranium From Low-grade Pulps Via Resin-in-pulp	319
<i>T. Udayar, D. Auerswald, V. Yahorava and M. Kotze</i>	
SOLVENT EXTRACTION	
Improvements at Solvent Extraction Plants of AngloAmerican Copper.....	333
<i>J. Nuñez, J. Cueto, J. Fernandez, C. Salgado, M. Torres and G. Zarate</i>	
Integrated Design Considerations of Copper Solvent Extraction and Electrowinning Plants to Maintain High Quality Electrowon Copper	339
<i>G. Miller and B. Currie</i>	
CuPRO MEX(TM) Extractants as Equivalent Alternatives for Copper Recovery	353
<i>M. Torres B., M. Torres M., C. Salgado Q., H. Bravo P., J. Fernández O., R.B. Sudderth and A. Quiroz G.</i>	
A Review of the Modified ZINCEX® Process From Skorpion to Horsehead	367
<i>M.S. Moats, W.J. Cashwell and A. Staley</i>	
Optimized Process for Secondary and Low Grade Zinc Raw Material Treatment	377
<i>P. Salonen, A. Oja, M. Lahtinen and B. Saxen</i>	
Extraction of Rhodium With Amide-containing Tertiary Amine Compounds: Effect of N-Substituents on Extraction Properties	389
<i>H. Narita, K. Morisaku, M. Tanaka, K. Nagao, T. Fuchikami, T. Yoshida and K. Kuroda</i>	
LiSX TM a New SX Technology for Lithium Recovery.....	395
<i>J. Lipp</i>	
Separation of Nickel and Cobalt From a Sulfuric Liquor with Synergistic Solvent Extraction	403
<i>G.F.R. Oliveira, M.M.C. Jiménez, J.A.S. Ténorio, D.C.R. Espinosa and D.C. Buzzi</i>	
High Selectivity for Cobalt / Magnesium Separation by Solvent Extraction in a Pilot Plant	409
<i>M.E. Moraes Castanho de Almeida and A. Ribeiro Cotrim</i>	
Extraction of Nickel From Qqueous Solutions by Emulsion Liquid Membranes Using Tributylphosphate (TBP) as Extractant	415
<i>F. Xie, X. Zhai, T.A. Zhang and C. Jiang</i>	
Hydrometallurgical Process Development for Recovery of the Dysprosium From Permanent Magnet Scrap Leach Liquor Using 2-Ethylhexyl Phosphonic Acid Mono-2-Ethylhexyl Ester (PC 88A) as an Extractant System	423
<i>J.R. Kumar, C-J. Kim, K.W. Chung, S-D. Kim and H-S. Yoon</i>	

Equilibrium Analysis for Solvent Extraction of Neodymium and Dysprosium with 2-Ethylhexylphosphonic Acid Mono-2-Ethylhexyl Ester.....	437
<i>M. Tanaka, Y. Sato, T. Ogata, H. Narita and S. Alam</i>	
Synergistic Solvent Extraction of Metals From a Sulfuric Acid Leach Liquor Recovered From Printed Circuit Boards From Computers.....	445
<i>M.M.C. Jiménez Correa, J.A.S. Ténorio and D.C.R. Espinosa</i>	
Liquid-liquid Extraction of Molybdenum, Nickel and Aluminum From Chloride Leach Liquor of Spent Hydrotreating Catalysts by Cyanex-923	451
<i>R. Srivastava, M-s. Kim, B-y. Kim, and J-c. Lee</i>	
Mixing Optimization Enables Increased SX Mixer / Settler Production Capacity	459
<i>R. Sheinman, Y.V. Kokotov, L.N. Braginsky and N. Dobrin</i>	
Metals Extraction Using Cyanex 272, Versatic 10 and Their Mixtures as Extractants	471
<i>A.J.M. Santanilla, A.S. Guimarães, R.A. Pini, M.B. Mansur, J.A.S. Tenório and D.C.R. Espinosa</i>	
ENVIRONMENTAL AND RECYCLING	
Recycling of Complex Materials at HYDROMETAL (Belgium)	481
<i>P. Henry</i>	
Environmentally Friendly Recycling of Automotive Catalysts in a Closed Hydrometallurgical Loop.....	489
<i>S. Steinlechner</i>	
Hydrometallurgical Processes for the Recovery of High Value Metals From Spent Li-ion Batteries.....	499
<i>M. Joulié, R. Laucournet and E. Billy</i>	
The Long-term Stability of the Iron(III)-Arsenate Coprecipitate: Effects of the Transformation of 2-Line Ferrihydrite on the Immobilization of Arsenate	507
<i>D. Zhang, S. Wang and Y. Jia</i>	
Conditions for Removal of Arsenic From Non-ferrous Metal Wastewater in the Form of Precipitates.....	517
<i>M. Czaplicka, K. Jaworek and L. Bratek</i>	
Crystalline Scorodite Synthesized in Fe(II) Solution Containing As(V)	527
<i>E. Shibata, N. Onodera, T. Nakamura and M. Abumiya</i>	
Development of a Process for the Treatment of Electric Arc Furnace Dust and Other Urban Mining Wastes	535
<i>C.W. White, B.G. Harris, M.J. Dry and T. Hoffbauer</i>	
Application of a Hydrometallurgical Process to Recover Zinc From CaO Treated EAF Dust.....	549
<i>R. Chairaksa-Fujimoto, K. Maruyama, T. Miki and T. Nagasaka</i>	
Chemical Thermodynamics of Mercury in the Bayer Process.....	559
<i>N. Bansal, J. Vaughan, P.T.W. Yin, T. Leong and A. Boullemand</i>	
Mercury Removal From Pressure Oxidation Vent Gas	571
<i>T. Krumins, L. Zunti and R. Frischmuth</i>	
Comparing Technologies for Sulphate Removal From Mine Waters	583
<i>V.A. Leão, D. Guimarães, S.M. Bertolino, B.C.S. Ferreira and A.M. Silva</i>	

Enhanced Ettringite Process - A Novel Solution for Sulfate Removal	593
<i>L.M. Nevatalo, T. van der Meer, M. Martikainen, A.E. Mäkinen and J. Tanninen</i>	
HCl Acid Regeneration for Chloride Based Hydrometallurgical Processes with Minimum Environmental Impact.....	607
<i>K. Adham and C. Harris</i>	
Fe-separation and HCl Regeneration Technologies for Ore Leaching Processes	619
<i>G. Frithum</i>	
A Contribution to Chloride Hydrometallurgy: Regeneration of Super-azeotropic Strength HCl Via Reactive Crystallization	629
<i>T. Feldmann and G.P. Demopoulos</i>	
Fundamental Studies in Selenium and Tellurium Removal From Copper Sulphate-sulphuric Acid Solutions with Application to Industrial Purification Circuits	643
<i>M. Mokmeli, D.B. Dreisinger and B. Wassink</i>	
Application of Sodium and Biogenic Sulfide for Copper Precipitation in a Continuous Reactor	657
<i>F.D. Reis, I.C.B. Rodrigues, R.M.F. Lima, and V.A. Leão</i>	
Raw Material Matters and Biohydrometallurgy Development.....	669
<i>J. Mäkinen, G. Szilvay, J. Salminen, P. Kinnunen, V. Miettinen and O. Salmi</i>	
Characteristics of Indium-Tin-Oxide (ITO) Nanoparticles Recovered From TFT-LCD Panel Scraps	679
<i>S.J. Hong, T.W. Hong, S.H. Cho, J.K. Lee, D. Choi and Y. Son</i>	
RECOVERY (PRECIPITATION)	
A Study of Sodium Oxalate Growth on Industrial Gibbsite with In-Situ Optical Microscopy	687
<i>W. Fu and J. Vaughan</i>	
Batch Tricalcium Aluminate Crystallisation and Particle Morphology	695
<i>R. Salimi and J. Vaughan</i>	
Preparation and Application of Basic Zinc Sulfate for Iron Precipitation as Jarosite: A Strategy to Reduce the Loss of Values in the Zinc Leaching Circuit	703
<i>R. Cruz, I. Lázaro, G. Sanchez, C. Beltrán and S. Castro</i>	
Mossbauer Studies on Synthetic Jarosites Doped with Copper	713
<i>B. Abdul, M. Pernechele, E. Asselin and D.H. Ryan</i>	
Phase Equilibria of Dicalcium Silicate in HCl and NaOH-NaAl(OH) ₄ -Na ₂ CO ₃ Aqueous Solutions Using the Bromley-Zemaitis Model	725
<i>L. Zeng and Z. Li</i>	
EXTRACTION (NON-SULFIDES)	
Reductive Leaching of Metal Oxides in Nickel Laterite Ores, Deep Sea Manganese Nodules and Spent Batteries / Catalysts	741
<i>G. Senanayake, A. Senaputra, L.C.S. Dharmasiri, D.J. Kim, S.M. Shin, J.S. Sohn, K.H. Park and J. Avraamides</i>	

Enhanced Nickel Extraction From Ultrabasic Silicate Ores Using Mineral Carbonation Pre-treatment	755
<i>R.M. Santos, A. Van Audenaerde, Y.W. Chiang, R.I. Jacobescu, P. Knops and T. Van Gerven</i>	
Bioleaching of Nickel From Olivine Using Chemoheterotrophic Fungi and Bacteria	769
<i>Y.W. Chiang, R.M. Santos, A. Van Audenaerde, A. Monballiu, T. Van Gerven, J. Martens and B. Meesschaert</i>	
Heap Leaching for Sustainable Development in the South African PGM Industry.....	779
<i>J.M. Mwase, J. Petersen and J.J. Eksteen</i>	
The Apparent Overall Oxidation Kinetics of Uranium(IV) by Oxygen Gas in Aqueous Perchloric Acid Solutions.....	789
<i>A. Burns and D. Dreisinger</i>	
Vanadium Oxides Leaching: An Overview	801
<i>M.R. Tavakoli and D.B. Dreisinger</i>	
Optimization of Microwave-Utrasound Assisted Leaching of Copper Anode Slime Based on Central Composite Design	813
<i>Z. Ma and H. Yang</i>	
Triethylenetetramine (TETA) – Powerful Leachant in Lead Recovery	827
<i>A. Chmielarz, Z. Szolomicki, R. Kurowski and J. Mrozowski</i>	
Reductive Leaching of Ilmenite in Hydrochloric Acid: A Preliminary Study Using a Rotating Synthetic Ilmenite Disc	837
<i>N.A. Jabit and G. Senanayake</i>	
Don't Give Up on the Greenfield Projects: The First 20 Years of Nickel Extraction From Cuban Laterites	849
<i>L.M. Southwick</i>	
A Technical and Economic Comparison of Different Copper Recovery Technologies For Small-scale Operations.....	871
<i>D.R. Shaw, N.C. Murray, S.N. Arnold and J. Illescas</i>	
Author Index.....	883