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The Southern African Institute  
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## HYDROMETALLURGY CONFERENCE 2024

# Hydrometallurgy for the Future

1-3 SEPTEMBER 2024  
HAZENDAL WINE ESTATE, STELLENBOSCH,  
WESTERN CAPE, SOUTH AFRICA

### ABSTRACTS RECEIVED

#### The recovery of gold from a copper rich Zimbabwean low-grade gold ore by cold stripping

H.M. Muchada<sup>1</sup>, E.K. Chiwandika<sup>1</sup>, and L.S. Mapamba<sup>2</sup>  
<sup>1</sup>Harare Institute of Technology and <sup>2</sup>Urumaya Resources,  
Zimbabwe

#### A facile co-precipitation approach for the synthesis of high-pure magnesium titanate using sea water bitterns and titanium tetrachloride

N.D. Solomon Godwin Babu<sup>1</sup>, V. Ponnani<sup>1</sup>, S. Sharmila<sup>2</sup>,  
S. Tondepu<sup>1</sup>, and R.V.S. Nagesh Chaganti<sup>3</sup>, <sup>1</sup>VFSTR University,  
<sup>2</sup>CSIR India and <sup>3</sup>Defence Research and Development Organisation, India

#### The use of ultrasonic assisted extraction of lithium from Zimbabwean spodumene ore

L.T. Hlerema and E.K. Chiwandika, Harare Institute of Technology,  
Zimbabwe

#### Vanadium extraction with the salt roast process and other novel liquids from a titanomagnetite vanadium ore

D. Nkhoea<sup>1</sup> and J.H. Potgieter<sup>1,2</sup>, <sup>1</sup>The University of the Witwatersrand,  
South Africa and <sup>2</sup>Manchester Metropolitan University, United Kingdom

#### An investigation into the breakdown of pyrite to release encapsulated gold in sulphide minerals using deep eutectic solvents

W. Chabalala and J.H. Potgieter, The University of the Witwatersrand, South Africa

#### Extraction of Iron, Titanium and Vanadium from a titaniferrous ore

N.Mbhamali<sup>1</sup> and J.H. Potgieter<sup>1,2</sup>, <sup>1</sup>The University of the Witwatersrand,  
South Africa and <sup>2</sup>Manchester Metropolitan University, United Kingdom

#### Tantalum and tin extraction from virgin ore with ILs and DESs

C. Nsakabwebwe<sup>1</sup> and J.H. Potgieter<sup>1,2</sup>, <sup>1</sup>The University of the  
Witwatersrand, South Africa and <sup>2</sup>Manchester Metropolitan University,  
United Kingdom

#### Leaching of metals from printed circuit boards by carboxylic acid-based deep eutectic solvents

E.A. Okea<sup>1</sup> and J.H. Potgieter<sup>1,2</sup>, <sup>1</sup>The University of the Witwatersrand, South Africa and <sup>2</sup>Manchester Metropolitan University, United Kingdom

#### Investigating the leach kinetics of Glencore's Cu-Co Ore in organic media

F. Mondlane<sup>1</sup>, K.J. Nyembwe<sup>2</sup>, and J.H. Potgieter<sup>1,2</sup>, <sup>1</sup>The University of the  
Witwatersrand, South Africa and <sup>2</sup>Manchester Metropolitan University,  
United Kingdom

#### Early lithium recovery: Sustainable strategies and innovative approaches for enhanced recycling of nmc batteries in electric vehicle technology

L.N. Mettke, Clausthal University of Technology, Germany

#### Enhancing nickel recovery: Advanced separation methods and anti-solvent crystallization for sustainable NMC battery recycling

L.N. Mettke, Clausthal University of Technology, Germany

#### Data driven strategies to optimise hydrometallurgy plants - the power of visualization and machine learning in data mining

N. Mthembu<sup>1</sup>, P. Maphosa<sup>1</sup>, P. Olawoore<sup>1</sup>, and T. Ncube<sup>2</sup>, <sup>1</sup>Industrial Data Analytics Optima Pty Ltd, South Africa and <sup>2</sup>Murdoch University, Australia

#### The benefits of using Aachen™ high shear reactors in gold tailings reprocessing from laboratory and plant evaluations

W.J. Botes, Maelgwyn Mineral Services Africa, South Africa

#### Evaluation of the nanofiltration membrane technology for copper removal from copper mine effluents stream

M. Ramabulana<sup>1</sup>, O. Bazhko<sup>1</sup>, and I.D.I. Ramaite<sup>2</sup>, <sup>1</sup>Mintek and <sup>2</sup>University of Venda, South Africa

#### Separation and recovery of cobalt and aluminum from spent gas to liquid catalysts using Cyanex272

M. Kruger, H.M. Krieg and D.J. van der Westhuizen, North-West University, South Africa

#### Removal of iron from vanadium electrolyte using ion exchange

M. Makonese and K.C. Sole, University of Pretoria, South Africa

#### Investigation on the synergetic behaviour of NMC-LFP black mass mixture for improved hydrometallurgical processing

M. Müller, Technical University of Clausthal, Germany

#### The hydrometallurgical processing of a low-grade manganese ore from the Northern Cape, South Africa

L. Mukumbi<sup>1</sup>, C. Saguru<sup>1</sup>, and C.J.N. Dempers<sup>2</sup>, <sup>1</sup>CM Solutions and <sup>2</sup>PRODEO Consulting, South Africa

#### Rare earth metal recovery from permanent magnet waste

T. Punt, K. Forsberg, and M. Svård, KTH Royal Institute of Technology, Sweden

#### Leaching of a copper-nickel flotation concentrate in choline chloride based deep eutectic solvents

B.T. Kalake<sup>1,2</sup>, S. Ndlovu<sup>1</sup>, and M.M. Mapolelo<sup>2</sup>, <sup>1</sup>University of the Witwatersrand, South Africa and <sup>2</sup>Botswana Institute of Technology, Botswana

#### The free-ligand model to describe and design cobalt extraction and nickel scrubbing in a base metal refinery

M.J. Matsela<sup>1</sup>, O.S.L. Bruinsma<sup>2</sup>, and D.J. van der Westhuizen<sup>1</sup>, <sup>1</sup>North-West University and <sup>2</sup>Bruinsma Solutions (Pty) Ltd, South Africa

#### Evaluation of a chemical pre-treatment alternative for PGM extraction from flotation tailings

B.A.K. K Gibson<sup>1,4</sup>, G. Nwaila<sup>1</sup>, Y. Ghorbani<sup>2</sup>, S. Ndlovu<sup>1</sup>, and J. Petersen<sup>3</sup>, <sup>1</sup>University of the Witwatersrand, South Africa, <sup>2</sup>University of Lincoln, United Kingdom and <sup>3</sup>University of Cape Town, South Africa and <sup>4</sup>University of Liberia, Liberia



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#### Cobalt extraction from manganese and nickel metal ions using novel extractants

N. Matinise, C. Ineza, and R.C. Luckay, *Stellenbosch University, South Africa*

#### Extraction of gold from tailings using deep eutectic solvent

M.J. Khuduwe and S. Ndlovu, *University of the Witwatersrand, South Africa*

#### Crystallization of battery grade vanadyl Ssulphate from Bayer liquor

C. Mangunda, M. Svård, and K. Forsberg, *KTH Royal Institute of Technology, Sweden*

#### Enhancing selective lithium recovery: Testing and modelling ion exchange resins for efficient purification

A. van Niekerk<sup>1</sup>, O.S.L. Bruinsma<sup>2</sup>, F. van der Merwe<sup>1</sup>, and D.J. van der Westhuizen<sup>1</sup>, <sup>1</sup>North-West University and <sup>2</sup>Bruinsma Solutions (Pty) Ltd, South Africa

#### Innovations in Lithium Ion Battery Materials: From Industrial Source to Battery-Grade Li<sub>2</sub>CO<sub>3</sub>

R.G. Blenkers<sup>1</sup>, H. Bijzet, O.S.L. Bruinsma<sup>2</sup>, and D.J. van der Westhuizen<sup>1</sup>, <sup>1</sup>North-West University and <sup>2</sup>Bruinsma Solutions (Pty) Ltd, South Africa

#### Platinum, palladium, and rhodium recovery from acidic chloride solutions using chelating ion exchange resin Puromet MTS9600

M. Hosseinzadeh and J. Petersen, *University of Cape Town, South Africa*

#### Estimation of mass transfer characteristics in multiple flow regimes of various static mixers during Co/Ni solvent extraction

J.W. Bezuidenout and D.J. van der Westhuizen, *North-West University, South Africa*

#### The selective recovery of li from lithium-ion batteries using solvent extraction and precipitation

S. Roopa, H.M. Krieg, and D.J. van der Westhuizen, *North-West University, South Africa*

#### Evaluation of solvent swelling pre-treatment for copper recovery from waste printed circuit boards

T.D. Kondo, *University of Cape Town, South Africa*

#### A baseline study of the ammonia leaching of a sphalerite concentrate

S. Shabalala and J. Petersen, *University of Cape Town, South Africa*

#### Upsaling gallium extraction from bayer liquor during aluminium production

E. Balomenos<sup>1,2</sup>, C. Dittrich<sup>2</sup>, E. Peters<sup>2</sup>, P. Davris<sup>1</sup>, E. Seftel<sup>3</sup>, D. Vangeneugden<sup>3</sup>, B. Orberger<sup>4</sup>, C. Mangunda<sup>1,2,5</sup>, <sup>1</sup>MYTILINEOS Energy & Metals, Ag. Nikolas Plant, Greece, <sup>2</sup>MEAB Chemie Technik, Germany, <sup>3</sup>VITO Flemish Institute for Technological Research, Belgium, <sup>4</sup>Catura Geoprojects, France and <sup>5</sup>KTH Royal Institute of Technology, Sweden

#### Scandium concentrate and AISc production from bauxite residues

E. Balomenos<sup>1,2</sup>, D. Marinos<sup>1</sup>, D. Panias<sup>1</sup>, P. Davris<sup>2</sup>, C. Dittrich<sup>3</sup>, R. Scharfenberg<sup>3</sup>, P. Feydi<sup>4</sup>, K. Forsberg<sup>5</sup>, C. Mangunda<sup>5</sup>, S. Mullen<sup>6</sup>, K. Papadimitrou<sup>7</sup>, A. Kladis<sup>7</sup>, A. Prebeniou<sup>7</sup>, B. Orberger<sup>8</sup>, and H. van der Laan<sup>9</sup>, <sup>1</sup>MYTILINEOS Energy & Metals, Ag. Nikolas Plant, Greece, <sup>2</sup>National Technical University, Greece, <sup>3</sup>MEAB Chemie Technik, Germany, <sup>4</sup>ORANO Mining, France, <sup>5</sup>KTH, Sweden, <sup>6</sup>VITO Flemish Institute for Technological Research, Belgium, <sup>7</sup>Admiris, Greece, <sup>8</sup>Catura Geoprojects, France and <sup>9</sup>Van der Laan International, The Netherlands

#### High-grade scandium hydroxide production for the european market

C. Dittrich<sup>1</sup>, R. Scharfenberg<sup>1</sup>, P. Feydi<sup>2</sup>, E. Mikeli<sup>3</sup>, E. Balomenos<sup>3</sup>, D. Panias<sup>3</sup>, R. Schneider<sup>4</sup>, B. Orberger<sup>5</sup>, H. van der Laan<sup>6</sup>, Y. Baria<sup>7</sup>, P. Letmathe<sup>7</sup>, C. Georgopolous<sup>8</sup>, and C. Mangunda<sup>9</sup>, <sup>1</sup>MEAB Chemie Technik, Germany, <sup>2</sup>ORANO Mining, France, <sup>3</sup>National Technical University, Greece, <sup>4</sup>RWTH Aachen University-IME, Germany, <sup>5</sup>Catura Geoprojects, France, <sup>6</sup>Van der Laan International, The Netherlands, <sup>7</sup>RWTH Aachen University, Germany, <sup>8</sup>ENALOS, Greece and <sup>9</sup>KTH, Sweden

#### Transition elements, silver and tantalum sustainable recycling from waste of tantalum capacitors

M.C. Hespanhol<sup>1</sup>, N. Schaeffer<sup>2</sup>, A.M. Ferreira<sup>2</sup>, F.N. Braga<sup>2,3</sup>, H. Passos<sup>3</sup>, and J.A.P. Coutinho<sup>3</sup>, <sup>1</sup>Federal University of Vicosa, Brazil, <sup>2</sup>University of Aveiro, Portugal and <sup>3</sup>University of Porto, Portugal

#### Flowsheet synthesis and analysis of copper and gold recovery from waste printed circuit boards

A. de Wet and J. Petersen, *University of Cape Town, South Africa*

#### Key considerations for the dissolution of metals and alloys in the production of battery grade metal sulphates

J. Jang, T. Plikas, A. Khera, U. Shah, S. Bedrossian, S. Armistead, and M. Naghizadeh, *Hatch, Canada*

#### Precipitation of chromium from ferrochrome leach solutions

T.V. Nyangadzayi and F. Ntuli, *Botswana international University of Science and Technology, Botswana*

#### Life cycle assessment of hydrometallurgical lithium-ion battery recycling processes – evaluating geographical location sensitivity

R.F. Maritz, G. Akdogan, and C. Dorfling, *Stellenbosch University, South Africa*

#### Investigating the opportunities for improving circularity and carbon neutrality of the zinc roast-leach-electrowinning refining process

N. Uys, M. Becker, and J. Petersen, *University of Cape Town, South Africa*

#### Comparing the recovery of rare earth elements from ion-adsorption clay leach solutions using various precipitants

J. Chivavava, J. Petersen and A.E. Lewis, *University of Cape Town, South Africa*



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#### Electrophoretic responses toward a selective predictive foam floatation from leachate in different surfactants

G. Kasembele, E.N. Malenga, and M.E. Makhatha, *University of Johannesburg, South Africa*

#### Complexing leaching of oxidized copper-cobalt ore in an alkaline medium

E.N. Malenga<sup>1</sup>, A.F. Mulaba-Bafubiandi<sup>1,2</sup>, and W. Nheta<sup>1</sup>, *University of Johannesburg, South Africa* and <sup>2</sup>*University of Mbuji-Mayi, Congo*

#### Implementation of an oxidative solvleaching to recover copper from a sulfide ore characterized by a high silica content

R. Kishiko, E.N. Malenga, and W. Nheta, *University of Johannesburg, South Africa*

#### Selective dissolution of Pd, Pt, and Rh from metallic mixtures: A sustainable resource recovery approach

S. Jeong Song, *POSCO holdings, South Korea*

#### Phase transformations during extraction of vanadium and titanium from titaniferous slag using a roast-leach process

S. Nkosi<sup>1,2</sup>, X.C. Goso<sup>1</sup>, T. Mokone<sup>2</sup>, and J. Petersen<sup>2</sup>, *Mintek* and <sup>2</sup>*University of Cape Town, South Africa*

#### A review of the vanadium primary production process chemistry

X.C. Goso<sup>1</sup>, C. Grobler<sup>2</sup>, O. Bazhko<sup>1</sup>, S.B.N. Nkosi<sup>1</sup>, G.M. Tawane<sup>1</sup>, and F. Jantjies<sup>1</sup>, *Mintek* and <sup>2</sup>*X-Group, South Africa*

#### Hydrometallurgical extraction of rhenium from molybdenite roasting dust

M. Hosseinzadeh<sup>1,2,3</sup>, J. Petersen<sup>1</sup>, M. Ranjbar<sup>2</sup>, and M. Alizadeh<sup>4</sup>, *University of Cape Town, South Africa* <sup>2</sup>*Shahid Bahonar University of Kerman, Iran*, <sup>3</sup>*Materials and Energy Research Center, Iran* and <sup>4</sup>*Isfahan University of Technology, Iran*

#### Ammonium thiosulfate leaching of gold from electronic printed circuit boards - effect of solution copper concentration

D. Maharaj<sup>1</sup>, T. Moyo<sup>2</sup> and J. Petersen<sup>1</sup>, *University of Cape Town, South Africa* and <sup>2</sup>*Penn State University, USA*

#### The importance of hydrodynamics in the heap leaching of low grade ores

S.W. Robertson, *Mintek, South Africa*

#### Artificial Neural Networks (ANN) for optimisation and prediction of chromite roast leaching to produce Sodium dichromate

M.J. Mvita, N.G. Zulu, and B. Thethwayo, *University of Johannesburg, South Africa*

#### Surface changes in the dissolution of chalcopyrite in different media

M. Gonte, *Thandazile Moyo-Mahlangu, Pennsylvania State University, USA*

#### Metalate anion extraction for separation of cobalt(II) from nickel(II) and manganese(II)

K. Oosthuizen, *Stellenbosch University, South Africa*

#### The use of amino acids in the leaching of gold; gold leaching and electrochemical approach

A. Tapfuma, M. Tadie, and G. Akdogan, *Stellenbosch University, South Africa*

#### Lithium recovery from montmorillonite clays by sulphate roasting and water leaching

C. Haller and C. Dorfling, *Stellenbosch University, South Africa*

#### Innovative membrane separation processes in Hydrometallurgy

T. Coetzee, *Memcon, South Africa*

#### Optimizing biogenic cyanide production for enhanced bio-recovery of precious metals using mine indigenous microorganisms

A. Kumar, A. Shemi, L. Chipise, S. Moodley, C.S. Yah, G.S. Simate, and S. Ndlovu, *University of the Witwatersrand, South Africa*

#### The contribution of non-ideality in deep eutectic solvents towards their application in lanthanide separation

N. Schaeffer<sup>1</sup>, U.G. Favero<sup>2</sup>, M.C. Hespanhol<sup>2</sup>, and J.A. P. Coutinho<sup>1</sup>, <sup>1</sup>*University of Aveiro, Portugal*, <sup>2</sup>*Federal University of Vicosa, Brazil* and <sup>3</sup>*University of Porto, Portugal*

#### Oxalic acid cleaning of aluminum dross for a sustainable recycling

M.M. Kalenga<sup>1</sup> and A.F. Mulaba-Bafubiandi<sup>1,2</sup>, *University of Johannesburg, South Africa* and <sup>2</sup>*University of Mbuji-Mayi, Congo*

#### Cyanide destruction in gold mining effluents through a photocatalysis process

P. Pilane<sup>1</sup>, D. Ashiegbu<sup>1</sup>, J.H. Potgieter<sup>1,2</sup>, <sup>1</sup>*The University of the Witwatersrand, South Africa* and <sup>2</sup>*Manchester Metropolitan University, United Kingdom*

#### Investigation and optimization of leaching parameters for rare earth element extraction from south african coal fly ash

H.S. Beyers, J. Bunt, and D.J. van der Westhuizen, *North-West University, South Africa*

#### Gas phase extraction of vanadium from ore

J.H. Potgieter<sup>1,2</sup> and L. Mokwena<sup>1</sup>, <sup>1</sup>*The University of the Witwatersrand, South Africa* and <sup>2</sup>*Manchester Metropolitan University, United Kingdom*

#### Kinetic study of tantalum extraction using beta-diketones

S. Babae<sup>1</sup>, Y. Isa<sup>1</sup>, L. Chuma<sup>1</sup>, and J.H. Potgieter<sup>1,2</sup>  
<sup>1</sup>*University of the Witwatersrand, South Africa* and <sup>2</sup>*Manchester Metropolitan University, UK*

#### Sustainable magnesium production from metallurgical residues

D. Runciman<sup>1</sup>, M. Dey<sup>1</sup>, C. Dittrich, E. Peters<sup>2</sup>, M. Dreiseitel<sup>3</sup>, A. Rupnik<sup>4</sup>, B. Likozar<sup>4</sup>, D. Skentzou<sup>5</sup>, K. Sakkas<sup>5</sup>, H. van der Laan<sup>6</sup>, B. Orberger<sup>7</sup>, and C. Mangunda<sup>8</sup>, <sup>1</sup>*Mures Magnesium (MMg), Romania*, <sup>2</sup>*MEAB Chemie Technik, Germany*, <sup>3</sup>*F&R Worldwide SRL, Romania*, <sup>4</sup>*National Institute of Chemistry of Slovenia, Slovenia*, <sup>5</sup>*SEC, Greece*, <sup>6</sup>*Van der Laan International Consultancy B.V, The Netherlands*, <sup>7</sup>*Catura Geoprojects, France* and <sup>8</sup>*KTH, Stockholm, Sweden*



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#### Feasibility study of construction and demolition waste to sequester carbon dioxide through direct aqueous mineral carbon capture

K. Ramasena<sup>1,2</sup>, J. Petersen<sup>2</sup>, V.N. Katambwe<sup>3</sup>, B. Oladipo<sup>3</sup>, S. Gcasamba<sup>1</sup>, V. Vadapalli<sup>1</sup>, H. Coetzee<sup>1</sup>, S. Zide<sup>3,4</sup>, H.J. Ho<sup>4</sup>, A. Iizuka<sup>4</sup>, A. Horvat<sup>5</sup>, L. Petrik<sup>3</sup>, and T.V. Ojumu<sup>3</sup>, <sup>1</sup>Council for Geoscience, South Africa, <sup>2</sup>University of Cape Town, South Africa, <sup>3</sup>Cape Peninsula University of Technology, South Africa, <sup>4</sup>Tohoku University, Japan and <sup>5</sup>Carlos III University of Madrid, Spain

#### Predictive geometallurgy: Circular and eco-friendly recovery of gold in the Witwatersrand Goldfields (South Africa)

X.C. Simelane, S. Ndlovu, and G.T. Nwaila, *University of the Witwatersrand, South Africa*

#### Comparison of sulphate and chloride media for leaching of copper from waste printed circuit boards (WPCBs)

N. Nxumalo, *Mintek, South Africa*

#### Impact of the alkali pretreatment and microwave on the dissolution mechanism of Fe from Gold Bearing Calcined minerals

M.K. Valery<sup>1</sup>, E.N. Malenga<sup>1</sup>, and A.F. Mulaba-Bafubiandi<sup>1,2</sup>, <sup>1</sup>University of Johannesburg, South Africa and <sup>2</sup>University of Mbuji-Mayi, Congo

#### Investigation of the impact of microwave on the dissolution mechanism of Fe from gold-bearing calcined ore

A. Shamase<sup>1</sup>, E.N. Malenga<sup>1</sup>, and A.F. Mulaba-Bafubiandi<sup>1,2</sup>, <sup>1</sup>University of Johannesburg, South Africa and <sup>2</sup>University of Mbuji-Mayi, Congo

#### Optimising critical raw material recovery: A machine learning approach to metal accounting in mining

T. Mombe<sup>1</sup>, G.T. Nwaila<sup>1</sup>, and S.E. Zhang<sup>2</sup>, <sup>1</sup>University of the Witwatersrand, South Africa and <sup>2</sup>Geological Survey of Canada, Canada

#### Optimization of operational parameters for uranium leaching at South Uranium plant to respond to challenging economic conditions and mineralogy of uranium ores

D.W. Manana and R.E.L. Pobe, *Harmony Gold Mining Company, South Africa*

#### Incorporation of impurities during eutectic freeze crystallization for li-ion battery recycling

M. Akbarkermani, M. Svärd, and K. Forsberg, *KTH Royal Institute of Technology, Sweden*

#### Recovery of copper and gold from waste mobile phones printed circuit boards using delamination pre-processing and a simple hydrometallurgy route

S. Fashu, *University of KwaZulu-Natal, South Africa*

#### Enhancing rare earth element leaching efficiency through pretreatment of phosphogypsum

S.S. Nkabinde, *Mintek, South Africa*

#### Investigating early-stage process flow and reactor sequencing to maximise gold extraction in the thiosulphate leaching of waste printed circuit boards

M.G. Gonte<sup>1</sup>, T. Mahlangu-Moyo<sup>1</sup>, and J. Petersen<sup>2</sup>, <sup>1</sup>The Pennsylvania State University, USA and <sup>2</sup>University of Cape Town, South Africa

#### IDC participation in mineral beneficiation and battery value chain

I. Tlhako, *IDC, South Africa*

#### Flowsheet design and improvements in solvent extraction modeling using cyanex reagents

B. Mba<sup>1</sup>, L. Nsenga<sup>2</sup>, A. Argyn<sup>3</sup>, L. Moya<sup>4</sup>, and T. Mccallum<sup>4</sup>, <sup>1</sup>Syensqo, Zambia, <sup>2</sup>Syensqo, DRC, <sup>3</sup>Syensqo, Kazakhstan and <sup>4</sup>Syensqo, USA

#### Benefits of GTL G80 mining diluent in copper SX for low- and high-grade ores

M.R. Torrente, *Shell Global Solutions International B.V., The Netherlands*

#### Hydrometallurgy capacity and technology development for recycling of lithium-ion batteries

M. Lynch, *Enabled Future Limited, United Kingdom*