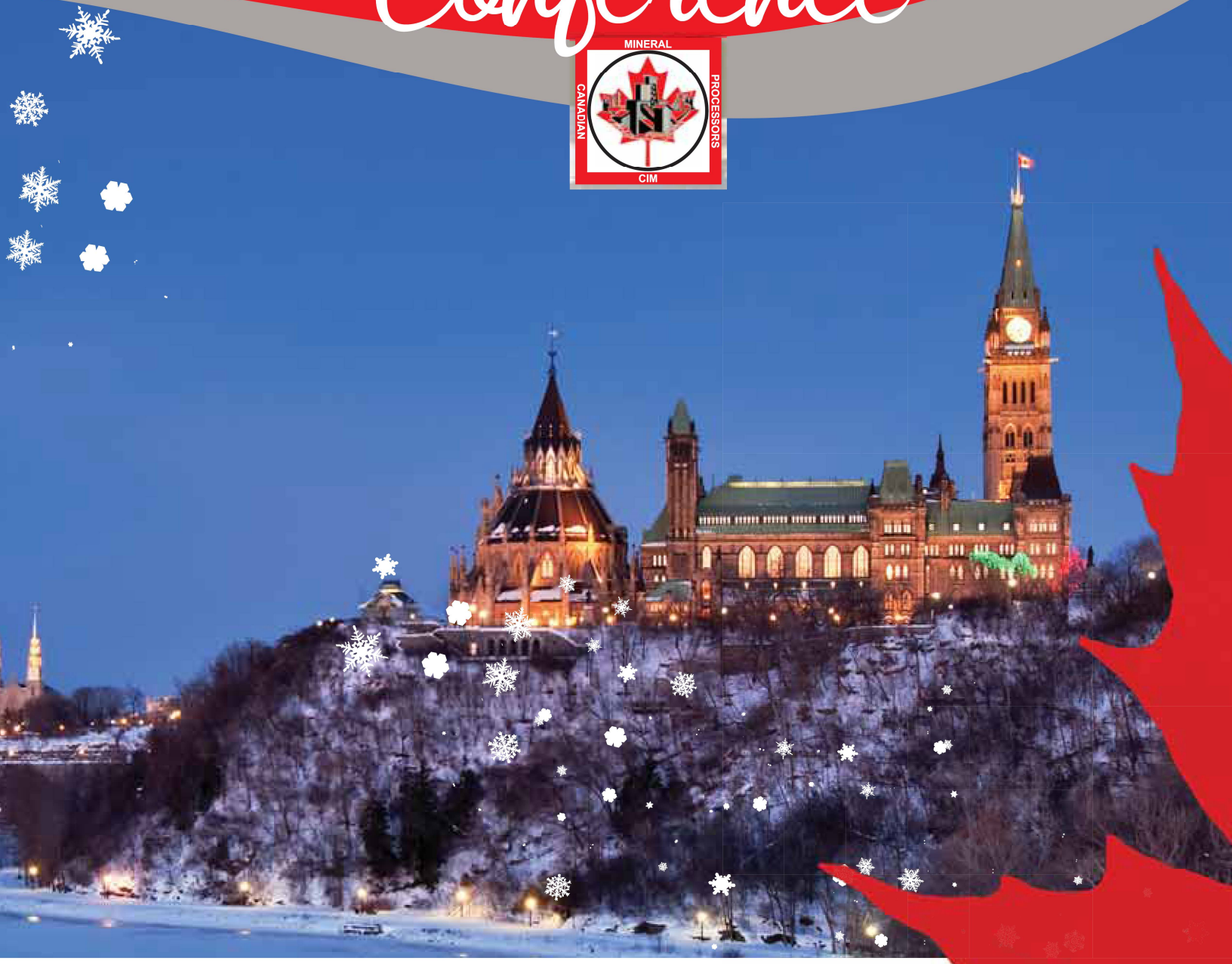
CANADIAN MINERAL PROCESSORS

2016 Conference



www.cmpsoc.ca

January 19-21, 2016
The Westin Hotel
Ottawa, Canada

Technical Program at a Glance

TUESDAY

8:30

OPENING REMARKS
Paul Blatter

PLENARY PRESENTATION

8:45

Economic and Financial Market Prospects
Earl Sweet, Managing Director BMO Capital Markets

COMMINUTION

9:30

Beneficiation of Low Grade Ore at the Detour Lake Mine
Jean-Francois Dupont

9:55

Towards a Better Understanding of Stirred Milling Technologies - An Overview of Scale-Up Methodologies
Peter Radziszewski

Break

10:50

Cyanidation in Grinding Circuit: Evaluation of Leaching Parameters in Grinding and Cyanidation Addition Strategy
Driss Mrabet

11:15

Geometallurgical Modeling of the Dumont Deposit
Johnna Muinonen

11:40

Evolution of Direct Coupled Pinion Drive Technology for Grinding Mills
Josh Sobil

Networking Luncheon (provided)

PROJECTS

13:35

Development of the Rainy River Gold Project and Processing Plant
David Hall

14:00

Reducing CIP Tails Solution Losses at Goldcorp's Campbell Processing Facilities
Jeet Basi

14:25

Introduction to the Meliadine Project
Martin Gaumont

Break

15:20

Constancia Project Process Plant Design and Start Up
Steve Klohn

15:45

Achieving a Great Start-up: Action Plan to Maximise Your Chances of Success
Steve Bellec

16:10

Commissioning of a Brownfield CDS Plant: Victories and Pitfalls
Jean-Claude Milot

Day 1 Concludes 16:35

WEDNESDAY

PROCESS CONTROL

8:30

Recent Developments of Laser-Induced Breakdown Spectroscopy for Real-Time Measurement and Control of Mineral Processing
Paul Bouchard

8:55

Continuous Real Time Pulp Chemistry Measurements and What They Tell Us About Metallurgical Performance
Christopher Greet

9:20

A Contribution for the Improvement of a Rotary Sample Divider for Iron Ore Concentrate Sampling
Jean Hilaire

Break

10:15

Carbon Dioxide Used for pH Control at Greens Creek Mill
Dave Tahija

10:40

A Re-Examination of the Sacred Cows in the SART Process
Chris Fleming

11:05

Optimising Plant Feed Quality and Process Performance Using Geoscan Elemental Analysis
Henry Kurth

CMP AGM and Luncheon (provided)

FLOTATION FUNDAMENTALS

13:00

Application of the Woodgrove Staged Flotation Reactor (SFR) Technology at the New Afton Concentrator
Kevin Swedburg - Mike Samuels

13:25

Performance of the TankCell® e500 at the Kevitsa Mine
Antti Rinne

13:50

Improved Cleaner Circuit Performance at DeGrussa Copper Mine with in-situ Column Sparging System
John Knoblauch

Break

FLOTATION DEVELOPMENT

14:45

Flotation of the Major Copper Sulphide Minerals – An Electrochemical Viewpoint
Norman Lotter

15:10

Typical Reproducibility of Metal Balances in Flotation Plants
Luc Lachance

15:35

Reflectance Spectroscopy with X-ray Fluorescence for Rapid Slurry Analysis
Juha Timperi

16:00

Improvement in Copper Flotation-In Terms of Recovery and Concentrate with the use of Specialty Chemical- FLEX 31
Suresh Thirunagari

Day 2 Concludes 16:25

THURSDAY

PROJECT OPTIMIZATION

8:30

Increasing SAG Mill Capacity at the Copper Mountain Mine Through the Addition of a Pre-Crushing Circuit
Dave Rose

8:55

Extension of the Comminution Energy Curves and Application to Stirred Milling Performance
Grant Ballantyne

9:20

The Challenges and Ramp Up of Filtered Tails in a Modern Production Plant – Éléonore Project Experience
Simon Hille

Break 9:45

10:15

Magnetic Conditioning of Sphalerite at Red Dog Mine
Jasmine Oliver

10:40

Balancing and Estimating the Ore Mineral Contents from Daily Production Samples
Claude Bazin

11:05

Promoting Energy Efficiency Studies During Mineral Processing Plant Design
Svetlana Loif

Lunch 11:30

MINERALOGY AND HYDROMETALLURGY

13:00

Where Did That Ear Bud Come From? Current Rare Earth Production Facilities
John Goode

13:25

Fluid Flow in a Hydrocyclone in the Absence of an Air Core
John Furlan

13:50

Dense Medium Separation-An Effective and Robust Pre-Concentration Technology
Erin Legault-Seguin

Break 14:15

14:45

Sulphur-Burning Sulphur Dioxide Gas Plants for Hydrometallurgical Processes
Kyle Loutet

15:10

Operating Experience and Developments of G-Rex and AuRIX®100 Resin Exchange Technology
Anastasia Plishka

15:35

Effect of Lead Nitrate in the Leaching of a Sulfur Bearing Gold Ore (Student Technical Report Winner)
David Georges-Filteau (Laval)

Conference Concludes 16:00

CHAIRMAN'S WELCOME

On behalf of the CMP Executive and CanmetMINING, it is my pleasure to welcome all delegates to the 48th Annual Meeting of the Canadian Mineral Processors. This meeting and conference provides an opportunity for members of the mineral processing community to exchange and engage in a balanced technical and social program covering all aspects of mineral processing.

This year we have continued the tradition of a Short Course Program, with a variety of courses covering a range of subjects including rare earths, flotation chemistry, cyclone optimisation and comminution optimisation.

Scott Martin, this year's first Vice Chair, has put together an excellent technical program with 37 delegate presentations plus a plenary presentation from the managing director of BMO capital markets. The sessions for this year are Comminution, Projects, flotation sessions covering Flotation Fundamentals and Development, Project Optimization, Mineralogy, Hydrometallurgy and Process Control.

I would also like to invite you to participate in this year's social program which includes the student mixer for sponsors of the student program on Monday evening, the Networking lunch Tuesday, the Chairman's Reception Tuesday evening (I can tell you will be an eye opener), the business meeting lunch on Wednesday, finally the banquet and reception on Wednesday evening. As well, the CMP hosts the annual East vs. West *Ray MacDonald Memorial Hockey Game* to whom the famed Kilborn Cup will be hoisted in triumph.

For those feeling up to it, or needing some fresh air on Wednesday morning you are welcome to join me for a short jog in and around Ottawa (rain-snow-cold, it's a go!).

Paul Blatter
CMP 2016, Chairman

Québec City, Canada

IMPC 2016

XXVIII International Mineral Processing Congress

September 11–15, Québec City Convention Center

Canadian Institute of Mining, Metallurgy and Petroleum

IMPC INTERNATIONAL MINERAL PROCESSING COUNCIL

Plan to attend IMPC 2016, September 11-15, Québec, Canada

The Canadian Institute of Mining, Metallurgy and Petroleum (CIM) is honoured to be hosting the **XXVIII International Mineral Processing Congress** (IMPC) in Québec City, Québec, Canada. In September 2016, over 1,000 mineral processing experts, academics and industry professionals from more than 60 countries will gather to explore and discuss the important issues and trends currently shaping our industry and its future. Canada last hosted the IMPC in 1982 and is proud to do so again.

What to expect at IMPC 2016?

FOUR-DAY CONGRESS

DAILY THEMED PLENARIES

16 TECHNICAL TOPICS + 8 SHORT COURSES + INDUSTRIAL TOURS

600 ORAL PRESENTATIONS

150 POSTERS

70 EXHIBITORS

1000 PARTICIPANTS

VAST NETWORKING & BUSINESS OPPORTUNITIES

NETWORK WITH PEERS AND PARTNERS

IMPC 2016 IS HOSTING THE 55TH ANNUAL CONFERENCE OF METALLURGISTS

TECHNICAL STREAMS

Characterization: Mineralogy, Geometallurgy

Process Control: Instrumentation, Modelling, Simulation

Flotation: From Chemistry to Machines

Extractive Metallurgy: Hydro and Pyrometallurgy

Comminution: AG/SAG, Crushers, HPGR, Tumbling and Stirred Mills

Physical Separation: Gravity, Magnetic, Electrostatic, Ore Sorting, Upgrading (physical and chemical)

Plant Design: Complex Ores, Integrated Flowsheets

Asset Management: Sampling, Metal Accounting, Surveys and Flowsheet Improvement

New Frontiers: Harsh Environments Including Arctic, Undersea, Space and Beyond

Environment, Recycling and Social Responsibility

Dewatering: Thickening, Filtering, Drying

SYMPOSIA

4th International Symposium on Iron Control in Hydrometallurgy

Electrometallurgy 2016

Rare Earth Elements

Lightweight Metals and Composites: Production, Processing and Applications

IMPC Commissions: Education, Mineral Processing for the Future

Registration opens early February 2016

IMPC2016.ORG

INFO@IMPC2016.ORG

McGill · Queen's University · Norman B. Keevil Institute of Mining Engineering, The University of British Columbia · Université Laval · University of Alberta

CONFERENCE OVERVIEW

Sunday, January 17th

8:00 - 17:00 Short Courses, Westin Hotel, 4th Floor

• 8:00 – registration and breakfast

- Rare Earth Production Beneficiation and Hydrometallurgy
  - John Goode et al., Sunday (17th),
  - Nova Scotia/Newfoundland, 4th Floor

- A Strategic Approach to Set Operational Variables on Comminution Equipment to Deal Better with Ore Variability
  - Ben Steyn, Minerality, Sunday (17th) and Monday (18th)
  - Quebec Room, 4th Floor

Monday, January 18th

8:00 - 17:00 Short Courses, Westin Hotel, 4th Floor

• 8:00 – registration and breakfast

- Chemistry of Flotation
  - Akira Otsuki, Monday (18th)
  - Nova Scotia/Newfoundland, 4th Fl.

- Classification Cyclones
  - Ernst Bekker, Multotec, Monday (18th)
  - New Brunswick, 4th Floor

- A Strategic Approach to Set Operational Variables on Comminution Equipment to Deal Better with Ore Variability
  - Ben Steyn, Minerality, Sunday (17th) and Monday (18th)
  - Quebec Room, 4th Floor

8:30 - 16:00 Board of Directors Meeting
Rideau Suite, 22nd Floor

19:00 - 22:00 Early Conference Registration
4th Floor Westin Hotel

19:30 - 21:30 Student Round Table
Governor General I, 4th Floor
Invitation Only

21:30 - 23:30 Student Mixer
Governor General I, 4th Floor
All Welcome

Tuesday, January 19th

7:00 - 8:15 Authors' Breakfast
Quebec Room, 4th Floor

7:00 - 15:15 Registration
4th Floor Westin Hotel

8:30 - 16:35 Technical Program
Confederation Ballroom

12:05 - 13:35 Tuesday Networking Luncheon
Governor General Ballroom

19:00 - 21:00 Ray MacDonald Hockey Challenge
Carleton University

21:00 - 24:00 Chairman's Reception
Governor General Ballroom I

Wednesday, January 20th

7:00 - 8:15 Authors' Breakfast
Quebec Room, 4th Floor

7:30 - 15:15 Registration
4th Floor Westin Hotel

8:30 - 16:25 Technical Program
Confederation Ballroom

11:30 - 13:00 Wednesday Luncheon
Governor General Ballroom

12:15 - 12:40 Annual Business Meeting
Governor General Ballroom

18:00 - 19:30 Executive Reception
Rideau Suite, 22nd Floor
Invitation only

18:30 - 19:30 Banquet Reception
4th Floor, Ballroom Foyer

19:30 - 22:00 Annual Banquet
Confederation Ballroom, 4th Floor

22:00 - 24:00 Post Banquet Reception
Governor General I, 4th Floor

Thursday, January 21st

7:00 - 8:15 Authors' Breakfast
Quebec Room, 4th Floor

7:45 - 15:15 Registration
4th Floor Westin Hotel

8:30 - 16:00 Technical Program
Confederation Ballroom

11:30 – 13:00 Student Luncheon
Governor General I, 4th Floor
Invitation Only

17:00 - 20:00 Board of Directors Meeting
Rideau, 22nd Floor

20:00 – 23:00 Board of Directors Dinner
Daly's, 3rd Floor

TUESDAY, JANUARY 19th
Morning Session

07:30 - CONTINENTAL BREAKFAST – PROVINCES BALLROOM

08:30 – Opening Remarks
Paul Blatter, Chair CMP 2016

PLENARY PRESENTATION

08:45 - PAPER 1
Economic and Financial Market Prospects
Earl Sweet, Managing Director and Senior Economist, BMO Capital Markets

This overview of economic and financial market prospects examines the current and future state of the global and Canadian economies with a focus on commodities. Housing prices and global conflicts all have effects on the overall economy and metal prices and mining developments in particular. This presentation outlines where we are today and where the author and BMO see the economy moving over the next few years.

NOTES:

COMMINUTION

09:30 - PAPER 2
Beneficiation of Low Grade Ore at the Detour Lake Mine
J.-F. Dupont - Detour Gold Corporation

The Detour Lake Mine is located in northeastern, Ontario, approximately 300 kilometres northest of Timmins and 185 kilometres by road northeast of Cochrane.

The mill processes a free milling gold ore using both gravity circuit and leaching with a state-of-the-art carbon-in-pulp circuit. The grinding circuit is a conventional SABC circuit with a tonnage of 55,000 mtpd at 95 microns with the addition of pre-crushing upstream of the SAG mill.

The present paper will describe the methodology used to successfully prove that gold of the Detour Lake Mine ore is mostly concentrated into the fine size fraction of the blasted rocks. It will describe the various options possible to create value from this ore property.

NOTES:

09:55 – PAPER 3

Towards a Better Understanding of Stirred Milling Technologies - An Overview of Scale-Up Methodologies

Peter Radziszewski, Adam Moore, Matt Gallimore - Metso Minerals

Stirred mill technology dates back to 1928 where the idea to use “an agitator and spherical grinding media” was presented. In the context of the mining industry, interest in stirred milling technologies has grown over the last 20 years where the typical observation reported in the literature is that in certain circumstances stirred milling is significantly more efficient than ball milling.

Despite these developments, the tumbling mills are continuing to be used in fine and ultrafine grinding applications. The main reason for this, as communicated at the Canadian Mineral Processors roundtable discussion in 2013, is that the comfort level in understanding stirred milling technologies is not at the level of that of tumbling mills.

At CMP 2014, one contribution was made to explore how mill design affects power and energy in a stirred mill. While the 2015 CMP paper explored the application of one scale-up methodology to the Gibraltar case, for the CMP 2016, the aim of this paper is to contribute to increasing the general comfort level with stirred milling technologies by developing a better understanding of the different scale-up methodologies used. This will be accomplished by first completing an overview of the scale-up models found in the literature followed by a review of the different testing and scale-up procedures. This review will be supported by a number of case studies found in the literature. The paper will close with a discussion on some of the challenges that these models and methodologies have and how future research might contribute to overcoming them.

NOTES:

10:20 BREAK – PROVINCES BALLROOM

10:50 – Paper 4

Cyanidation in Grinding Circuit: Evaluation of Leaching Parameters in Grinding and Cyanidation Addition Strategy

D. Mrabet, C. Gagnon, C. Olsen - COREM and R. Dupéré, J. Châteauneuf - Canadian Malartic

In gold processing plants, it is common to start gold cyanidation in the grinding circuit by simple cyanide addition or as a result of recycling residual cyanide. In such cases, advantages such as a decrease in gold lockup and reduced leach time have been noticed. The prevailing conditions in grinding circuits such as intense mixing, particle breakage and friction or high temperature are quite different from those found in tanks and so is the resulting cyanidation behaviour. To gain a better understanding of the cyanidation behaviour in mills and of the pertinence of cyanide addition in grinding circuits, lab tests were conducted using an industrial ore from Canadian Malartic mine. In this study, the effects of different parameters on cyanidation in grinding circuits were examined; parameters such as such as temperature, dissolved oxygen, cyanide concentration and pH. The results showed that the kinetic benefits of high temperature in the mill can overcome the low dissolved oxygen concentration thus leading to an overall gold dissolution kinetics improvement for temperatures up to 50°C. However, gold leach in the studied grinding circuit at lab scale caused an increase in cyanide consumption with a higher generation of iron cyanide and SCN-. These results were confirmed by tests in the Canadian Malartic plant where the cyanide addition was moved from the SAG mill to the leaching tanks resulting in a 20% savings in cyanide consumption.

NOTES:

11:15 – PAPER 5

Geometallurgical Modeling of the Dumont Deposit

K. Nasrallah, J. Muinonen - Royal Nickel Corporation

The Dumont deposit is a large (1,179 Mt proven and probable reserve) low grade (0.27% nickel), nickel sulphide project located in the Abitibi region 25km west of Amos, Quebec. Royal Nickel Corporation acquired the project in 2007 and has since taken the project from a scoping study in 2010 through to completing the feasibility study in July 2013.

The Dumont deposit in a nickel deposit with the recoverable nickel contained in three minerals; pentlandite, haezlewoodite and awaruite. The minerals are recovered by a combination of flotation and magnetic separation. Over the course of the studies many flowsheet design decisions and changes were made. This paper outlines an overview of the project, flowsheet design including the comminution circuit, desliming and awaruite recovery. The overall resulting flowsheet that was used for the feasibility study is then presented along with the confirmatory locked cycle testing that showed the feasibility design basis was able to produce the predicted concentrate grade and recovery.

NOTES:

11:40 – PAPER 6

Evolution of Direct Coupled Pinion Drive Technology for Grinding Mills

F. Tozlu, K. Lim - Metso Minerals, and L. Galarza Castillo, J. Sobil - Siemens

For mining operations globally, the scale and criticality of the grinding mill drive has meant that selection of the correct mill drive technology is paramount. With so much depending on the successful implementation of the electrical drive system— safety operation, timely installation, availability, energy efficiency, minimum maintenance and extend its use as tool to assist during mill liner exchange—customers are justified in their scrutiny and slow adoption of new drive technology. From the first installation of low, fixed speed synchronous motors to the introduction of the current source and further voltage source variable frequency drive, innovations require long periods of time and mining customers willing to push the industry forward. In recent years, the variable frequency drive has been the stepping stone for a new generation of mill drive technology. In use for decades in other heavy industrial applications, the drives allow for system optimization in a myriad of ways. The most dramatic of changes is in the design of the motor. Where in the past motor design was bound by line frequency, today the designer can optimize machine size and, more importantly, eliminate the need entirely for the synchronous motor. Induction motor design has now progressed to the point where low speed operation is possible at efficiency levels nearing those of the synchronous design. Moreover, the simplicity of the squirrel cage design means that availability, reliability and spare part requirements are greatly improved. As the next step in the evolution of large pinion driven grinding mills, the low speed induction drive offers a new reliable and robust system to the market.

NOTES:

12:05 – NETWORKING LUNCH – GOVERNOR GENERAL BALLROOM

TUESDAY, JANUARY 19th
Afternoon Session

PROJECTS

13:35 - PAPER 7

Development of The Rainy River Gold Project and Processing Plant

Dave Hall, - New Gold Rainy River Project and Paolo Toscano - Ausenco Engineering

This paper discusses the project history, process design and layout of the Rainy River Gold Project mill. The circuit consists of a 55 x 83 primary crusher, 15 MW SAG mill and 15 MW ball mill. Both mills are twin pinion with LSS and VFD drives. A pebble crusher is located in the process plant with bypass and stockpile options. Gravity concentration followed by 30 hours of leach residence, carousel CIP, carbon recovery, cyanide destruction and tails disposal in a 1,428 hectare tailings management area (TMA).

NOTES:

14:00 - PAPER 8

Reducing CIP Tails Solution Losses at Goldcorp's Campbell Processing Facilities

Jeet Basi, Monique Pharand, Simon Hille - Goldcorp

High quality activated carbon is essential in the recovery of gold in Carbon-in-Leach (CIL), Carbon-in-Pulp (CIP), and Carbon-in-Column (CIC) circuits. Goldcorp's Campbell complex at Red Lake Gold Mines (RLGM) experienced a period of low soluble gold (Au) recoveries during Q3 2013, during which time the processing plant saw higher than typical Au grades in the CIP tails solution stream. A technical review identified that the CIP circuit may be experiencing a carbon-fouling issue. To further understand the degree of fouling, and to troubleshoot the low recovery problem, samples of carbon were collected from the CIP, elution, acid wash, and regeneration circuits, and submitted for characterization test work. This paper summarizes the steps taken to remedy the carbon-fouling problem at RLGM resulting in increased overall Au recovery.

NOTES:

14:25 - PAPER 9

Introduction to the Meliadine Project

M. Gaumont, F. Robichaud - Agnico Eagle Mines

Agnico Eagle Mines Limited (AEM) is a Canadian-based gold producer with operations in Canada, Finland and Mexico. In 2010, AEM produced its first gold bar in Nunavut, Canada as it started its Meadowbank operation. It is also in 2010 that AEM acquired the Meliadine property, which is located 25 Km North of Rankin Inlet, Nunavut, Canada. The Meliadine gold project is an advanced exploration and development project, comprising of workers camp, underground and open mines, a processing plant and all the services facilities and infrastructures required to sustain operation in a remote arctic environment.

Pending formal board approval, production start-up is planned for Q3 2019 and the process flowsheet is based on an ore processing rate of 1.1 million dry tonnes per year (3,000 dry tonnes per day from underground mining) for the first three years, and 1.98 million dry tonnes per year (5,000 dry tonnes per day from both underground and open pit mining) for the remaining years at 92% process plant availability.

To the end of 2015, more than 45 metallurgical test programs have been conducted on the Meliadine deposits. Based on the results of these programs, an optimal gold circuit was designed, comprising of crushing, grinding, gravity separation and cyanide leaching with a carbon-in-leach circuit (CIL), followed by cyanide destruction and filtration of the tails for dry stacking. The assumed gold recovery for the reserves averages 96.0% at a 7.44-g/t gold average mill feed grade.

NOTES:

14:50 BREAK – PROVINCES BALLROOM

15:20 - PAPER 10

Constancia Project Process Plant Design and Start Up

Steven Klohn, David Stephenson - Ausenco Services Canada and Hugo Granados - HudBay Minerals

HudBay's Constancia project is a copper molybdenum concentrator located in southern Peru. In 2010 Ausenco was contracted to perform a feasibility study optimization review which resulted in an improved design with significantly increased throughput capacity at a minimal increase in capital cost. Construction began in 2012 with commercial operation commencing in May 2015. This paper outlines the process plant design as well as describing the plant's major equipment selections, start-up and early operations experiences.

NOTES:

15:45 - PAPER 11

Achieving a Great Start-Up: Action Plan to Maximise your Chances of Success

A. Berton - Soutex, J. Châteauneuf - Canadian Malartic, S. Bellec - Soutex, P. Champagne - Canadian Malartic, S. Fortier - Soutex

The start-up of new plants, extending from the commissioning of equipment to the production ramp-up, is a critical period where the processing circuit operation must be done in a structured and well controlled way to enable the gradual, safe and rapid achievement of production targets. The magnitude of the many risks associated with this pivotal period is accentuated in the actual context of low commodity prices. However, the implementation of a method that analyzes risks associated with a start-up, their probability of occurrence and their impacts leads to the identification of a series of preventive actions that can be applied in order to reduce potential negative impacts.

Soutex has been involved in numerous start-ups over the last few years and has developed a structured methodology to assess this crucial period, maximize the pre-start-up preparation, ensure a smoother and safer ramp-up period and minimize the time needed before reaching commercial production.

This paper describes a method to identify preventive actions to apply in order to reduce risks related to a plant start-up. Then, the various steps of the method are demonstrated using the industrial case study of the Canadian Malartic gold plant situated in Abitibi, Québec. The specific preventive actions, during start-up, the organisational measures and the ramp-up plan are detailed as they were effectively achieved. Finally, the post start-up actions are presented as well as some key results illustrating the achievement of their prior defined objectives.

NOTES:

16:10 – PAPER 12

Commissioning of a Brownfield CDS Plant: Victories and Pitfalls

N. Romani, R. Provost, J.C. Milot - Hatch

Commissioning of a circulating dry scrubber (CDS) plant was recently completed at an existing facility in Québec, Canada. The CDS plant treats the sulphur dioxide off-gas emitted from rotary kilns in order to meet increasingly stringent environmental requirements. This installation enables the existing facility to reduce their sulphur emissions by over 90%.

Proper planning of the different commissioning stages and staffing an integrated team are the most important factors required for a successful plant start-up. A strong Operational Readiness plan must be in place as early as the start of construction in order to ensure a smooth transition from commissioning to operations. Plant performance can meet or exceed performance criteria within the required timeframe if the proper group dynamic and good communication is established between construction, commissioning and operations teams.

The road blocks encountered are often from systems that one assumes will operate without trouble such as air-conditioning, or design assumptions that were taken years earlier in feasibility process stages, namely the capacity of existing systems that will connect the new plant to the existing facilities. The challenges associated with rectifying these issues in addition to the requirements to properly start-up and operate a new plant without impacting production are great, and it is imperative to have the necessary resources to react quickly to any problems.

NOTES:

WEDNESDAY, JANUARY 20th
Morning Session

07:30 - CONTINENTAL BREAKFAST – PROVINCES BALLROOM

PROCESS CONTROL

08:30 – PAPER 13

Recent Developments of Laser-Induced Breakdown Spectroscopy for Real-Time Measurement and Control of Mineral Processing

M. Sabsabi, G. Lithgow, P. Bouchard, A. Harhira, A. Blouin - National Research Council Canada

The objective of this study was to demonstrate the application of Laser-Induced Breakdown Spectroscopy (LIBS) to the continuous analysis of online monitoring of Al, Mg, Ni, Mn, Si and Fe in nickel ore limonite and saprolite slurry samples. Analysis was performed on slurry samples in air at atmospheric pressure. Two pure samples of limonite and saprolite were used. Mixtures of the two samples in varying proportions were used to build calibration curves, study the influence of solid/liquid ratio, and evaluate short and long term reproducibility. The LIBS measurement of these elements is independent of the water content (from 70-85%, the range allowed by our setup). Repeatability of the measurement and long term reproducibility (from day-to-day) were below 1.2 % and 2% respectively for all the elements studied in our conditions. The results obtained showed that an industrial LIBS analyzer could provide the chemical composition of the six elements Al, Mg, Ni, Mn, Si and Fe within 1-2 minutes.

NOTES:

8:55 – PAPER 14

Continuous, Real Time Pulp Chemistry Measurements and What They Tell Us About Metallurgical Performance

Christopher J Greet and Kyle Selga - Magotteaux Australia Pty Ltd.

The Pulp Chemistry Monitor (PCM) has been installed and operated in a number of concentrators in Australasia, and has produced some very interesting results. PCM measures the pH, Eh, dissolved oxygen, temperature and oxygen demand of process streams within a concentrator continuously and in real time.

In the example presented in the paper the cleaner feed pulp chemistry is measured, and related back to changes in the mineralogy as well as variations in metallurgical response. For example, a decrease in Eh and dissolved oxygen as well as an increase in the oxygen demand. These changes in the pulp chemistry appear to coincide with increases in the feed grades, probably higher pyrite grades. Further, these variations in pulp chemistry and feed mineralogy have a negative impact on the concentrate grade and recovery.

The implication is that if the pulp chemistry is monitored it is possible to predict changes in the mineralogy of the system, and from this the metallurgical response. Further, the changes in pulp chemistry can be used in a control system to counter the changes in mineralogy and maintain the metallurgy.

NOTES:

9:20 - PAPER 15

A Contribution for the Improvement of a Rotary Sample Divider for Iron Ore Concentrates Sampling

J.H. Mbouche, M. Poirier - CEGEP de Sept-Îles

The research question of the present work is the following: at which speed should a rotary sample divider operate in order to produce representative samples of iron ore concentrate? In order to solve this problem, the representativity of a rotary sample divider treating iron ore concentrate from Iron Ore Company (IOC) Carol Lake mine in Labrador City was studied in the laboratory of mineral processing of "CEGEP de Sept-Îles". The rotary sample divider speeds tested are: 20, 40, 50, 60, 80 and 100%. The results show differences in both weight and particles sizes distributions with respect to the various rotation speed used. 20% has shown to be the speed that generates an almost normally distributed samples for both weight and particle size. As the speed of the rotary sample divider increases, the polygon of frequency for weight distribution progressively becomes a two modal distribution curve. 40, 50 and 100% speeds generate normal samples distribution curves with respect to particles size only. 60 and 80% are the speed to be avoided since they generate multiple modal distribution curves for both weight and particles size.

NOTES:

09:45 BREAK – PROVINCES BALLROOM

10:15 - PAPER 16

Carbon Dioxide use for pH Control at Greens Creek Mill

D. Tahija, T. Martin - Hecla Greens Creek Mining

In April, 2014, Hecla's Greens Creek mill, near Juneau, Alaska, switched from sulphuric acid to the use of dissolved carbon dioxide for lead flotation circuit pH control. The Greens Creek mine uses paste backfill, in which mill tailings are mixed with cement and used to fill mined areas. Some backfill inevitably becomes part of mill feed during subsequent mining cycles, resulting in high feed pH levels and increased dissolved calcium in the lead flotation circuit. Sulphuric acid is traditionally used to lower pH in such cases but it produces undesirable side effects, including poorer lead-zinc separation and unstable froth. The amount of sulphuric acid used at Greens Creek was limited due to these effects, resulting in higher than target pHs when feed backfill content was high. Dissolved carbon dioxide can be added without these limitations so pH levels have been under much better control since the switch. Additionally, lead-zinc separation and froth characteristics have significantly improved.

NOTES:

10:40 – PAPER 17

A Re-Examination of the Sacred Cows in the SART Process

C.A.Fleming, M. Melashvili - SGS Minerals

The SART Process was introduced to the gold mining industry in the late 1990s and several commercial plants were built over the following 10 to 15 years. Most of these plants have operated well and enjoyed plant performance in line with expectations based on the underlying chemistry of the process. However, two of the plants have consistently suffered from high reagent consumption and poor product quality, which has motivated a re-examination of the process fundamentals in the hope of understanding the reasons for poor performance when it occurs, and developing mitigating strategies. This testwork along with a review of the relevant literature has demonstrated that the amount of sulphide added to the primary reactor, relative to the copper concentration, is the most critical parameter dictating plant performance, with pH and residence time important secondary factors. The primary product in the SART Process is synthetic chalcocite, Cu2S, and the stoichiometric requirement for sulphide addition is therefore 0.5 moles per mole of copper in solution. Testwork shows that when sulphide is added in excess of this amount (generally with the express purpose of lowering residual copper in solution) it not only fails in its intended purpose, but can have a negative impact on the settling and filtration characteristics of the copper sulphide product, as well as the final product quality. Moreover, these problems are exacerbated the higher the selected operating pH in the pH 3 to 5 range, and the longer the residence time of slurry in this pH range. Freshly precipitated copper sulphide compounds are known to be very fine and slimy, with poor settling and filtration characteristics. It is therefore important to engineer the SART Process in such a way as to encourage growth in the average particle size of the precipitate crystals. This was the rationale for recycling a portion of the thickener underflow to the primary reactor when the SART Process was developed. The theory of crystallization predicts that compounds of extremely low solubility, such as chalcocite (Cu2S: KSP = 10-48), are likely to experience growth in crystal particle size through aggregation rather than heterogeneous nucleation. On this basis, the SART practice of recycling a portion of thickener underflow to the primary reactor in the commercial plants is unlikely to lead to crystal growth via nucleation, and could in fact promote breakage of the aggregates that formed in the thickener. Recycling thickener underflow could therefore have the opposite of the desired outcome. The result of testwork that is reported here lends credence to this theory and questions the wisdom of recycling in the SART process. There is evidence to suggest that operating the copper sulphide thickener in the SART Process without flocculants may be beneficial. Thickener underflow densities could improve from the current 10 - 15% range to 40 - 50%. This will not only reduce the flowrate of slurry to the filter, but the filtration properties of the slurry (filtration rate, filter cake moisture content) will also improve. This is one of the most critical engineering and design aspects of the SART Process, and the achievement of high solids density in the thickener underflow will not only improve the health and safety aspects of the operation, but also has the potential to lower capital costs and improve the quality of the final product.

11:05 – PAPER 18

Optimising Plant Feed Quality and Process Performance Using Geoscan Elemental Analysis

H. Kurth - Scantech International Pty Ltd

Geoscan is used for multi-elemental analysis of conveyed bulk materials in the minerals industry with proven performance and demonstrated paybacks of weeks or months in iron ore, manganese, copper, zinc-lead and phosphate industries. Geoscan-M measures continuously through the full bed depth and is unaffected by belt speed, particle size, layering, mineralogy and dust levels. Increments of typically two minutes are accurately measured and provide the plant operators with tonnage weighted results of contained elements. Measurement of the composition in real time enables prompt feedback to the mining operators and also feed forward to the process operators. Crushed ore increments can be diverted based on composition, such as diverting waste for disposal or marginal material to a stockpile for separate processing. Bulk sorting allows material to be placed into relevant stockpiles for subsequent blending to achieve consistency for process feed. Parameters used for decisions may be primary metal content, deleterious component content, other process parameter, or a combination of these. Process parameter may be the elemental ratio between critical components, e.g. Cu:S ratio, basicity, or the content of an “indicator” element (such as Si indicating material hardness). Benefits will be discussed based on case studies in copper and iron ore.

NOTES:

11:30 – LUNCH – GOVERNOR GENERAL BALLROOM

WEDNESDAY, JANUARY 20th
Afternoon Session

FLOTATION FUNDAMENTALS

13:00 – PAPER 19

Application of the Woodgrove Staged Flotation Reactor (SFR) Technology at the New Afton Concentrator

K. Swedburg - New Afton Mine, C. Bennett - Woodgrove Technologies Inc., M. Samuels - New Gold Inc.

The New Afton concentrator was commissioned in June 2012, reaching the design milling rate in September 2012. By late 2013, through a campaign of optimization and de-bottlenecking, it was recognized that the installed plant was capable of greatly exceeding the design throughput of 11,700 tpd. Because the value of the metal contained (by increasing the plant feed rate) exceeded the offsetting losses of copper and gold recovery (as the operation moved to a coarser grind), the concentrator feed rate was strategically increased with support of New Gold, while the operations team was given a mandate to evaluate, and then implement, flow sheet options that could re-establish the original design criterion grind target and achieve the corresponding improved recovery. Broadly, the two options implemented were the addition of a tertiary grinding stage consisting of Metso Vertimill® prior to rougher flotation (in order to address the grinding required at increasing throughput by increasing the power), and the addition of three Woodgrove Staged Flotation Reactors (SFR) added to the cleaner circuit after regrind of the rougher concentrate (to address the increased mineral loading to the cleaner circuit). Through test work, it was anticipated that the SFRs would be capable of achieving final concentrate grade in a single pass without the integration of recirculating loads, a strategy sometimes referred to pre-cleaning. This paper describes the expectations generated for the Woodgrove SFR unit operation through pilot plant testing on site, and compares those results with the performance of the expanded circuit that exceeded the original design criterion of P80 160 µm, which was commissioned in the second quarter of 2015.

NOTES:

13:25 – PAPER 20

Performance of the TankCell® e500 at the Kevitsa Mine

Ben Murphy, Toni Mattsson - Outotec, Tomi Maksimainen, Ishmael Muzinda - FQML Kevitsa Mine, Antti Rinne – Outotec

A 500m^3 flotation cell was commissioned during 2014 at the Kevitsa Mine in northern Finland working as the first rougher in the copper flotation circuit. Treating around 850tph with an average grade of 0.3% Cu, the TankCell® e500 has run with an average copper recovery of 71% and an average enrichment ratio of 50 during early optimization test work. In addition the cell has proved to be very energy efficient, being operating with a specific energy of around 0.4kW/m^3 under production conditions.

A review of the installation and operation of the TankCell® e500 at Kevitsa will be presented. Metallurgical performance of the cell during the operating period will be discussed on the basis of on-line analysis and the metallurgical samples collected during early optimization campaigns.

NOTES:

13:50 – PAPER 21

Improved Cleaner Circuit Performance at the Degrussa Copper Mine with an In Situ Column Sparging System

J. Knoblauch - Sandfire Resources, H. Thanasekaran, E. Wasmund - Eriez Flotation

Sandfire's DeGrussa Copper-Gold operation in West Australia is a new high grade copper sulfide mine, which includes a 1.5 Mtpa concentrator which was completed in 2013.

Early after commissioning, it was identified that the flotation capacity in the all-mechanical cleaner circuit was not sufficient. In order to improve recovery, the tail from the cleaner scavenger was sent back to feed the rougher scavengers. Test-work was done on-site to evaluate the possibility of using a flotation column as a pre-cleaner. A CavTube™ sparging system was selected, which is especially effective for fine ore particle flotation. Test-work was conducted at site using a 150 mm diameter unit, and then confirmed on a 500 mm diameter unit. A 4250 mm diameter full scale unit was installed in Q4 2014 and commissioned in Q1 2015. This unit gave some significant advantages including a reduction in re-grinding requirements, elimination of a circulating load and increase in the recovery of copper in the cleaner circuit and overall circuit.

In this presentation, the benefits of columns and cavitation sparging for floating fine particles and rejecting fine entrained gangue will be explained. Also, the results from a lab unit and a pilot unit will be compared against the results of the full-scale unit. The paper will demonstrate the scalability of flotation columns, and which phenomena and scale-up criteria must be considered to be successful. Finally, some general observations will be made about the importance of columns in copper cleaning circuits.

NOTES:

14:15 BREAK – PROVINCES BALLROOM

FLOTATION DEVELOPMENT

14:45 – PAPER 22

Flotation of the Major Copper Sulphide Minerals – An Electrochemical Viewpoint

N.O. Lotter - Flowsheets Metallurgical Consulting, D.J. Bradshaw - University of Queensland, A.R. Barnes - XPS

Recoverable economic copper sulphide minerals such as chalcopyrite, bornite, chalcocite and covellite often occur together in varying proportions in the major copper-bearing ores, and have individual flotation requirements and characteristics. Pyrite also occurs in these ores to varying extents as the sulphide gangue, and is problematic because of its natural tendency to float quickly and easily. In a bulk sulphide float, selectivity against pyrite is desirable, particularly if it does not host other paymetals such as gold or silver. At the same time it is a requirement to float all of the copper sulphides despite their electrochemical differences. The electrochemistry and semiconductor properties of these minerals are reviewed, together with implications for flotation with and without collector addition. Mixed collector systems for the improved flotation of these sulphides are proposed as a solution. The use of xanthate and dithiophosphate in the collector suite allows the co-existence of dixanthogen and free dithiophosphate radical because the latter has a higher redox potential requirement than xanthate to oxidise to the dithiolate. Because some of these minerals require dixanthogen, and others, free thiolate, to generate surface hydrophobicity, a bulk flotation of all the species becomes possible in the overlapping area of Eh and pH between the two dithiolate equilibrium lines on the Pourbaix diagram. The arsenic-signature copper minerals are added to the study, since many copper operations encounter arsenic as a penalty element in the saleable concentrate. It is shown that the addition of arsenic to the copper and iron sulphides alters the semiconductor and electrochemistry properties, and in turn, its flotation characteristics. The degree of mineral association and liberation between these minerals can be a complicating factor due to textural associations, and should also be considered in the process as a next step.

NOTES:

15:10 – PAPER 23

Typical Reproducibility of Metal Balances in Flotation Plants

L. Lachance, D. Leroux - Triple Point Technology

Each and every flotation plant must produce daily/weekly/monthly production reports in which metal balances for payable and penalising elements are presented. Several factors including ore heterogeneity and harsh production environment affect the reproducibility of the reported data. Best practices of metal accounting thus prescribe that production reports be accompanied by measurement quality reports quantifying the reproducibility (a data quality metric often expressed as a relative standard deviation) of each data reported. Ignoring the irreproducibility of measurements may lead to the perception that random errors have been totally eliminated through statistical data reconciliation, which is wrong. This paper aims at explaining the full lifecycle management of reproducibility estimation from the outset at the measurement process to its reporting after having been through the statistical data reconciliation process. Indeed, the reproducibility of reported data can be obtained by performing a sensitivity analysis. Necessary conditions for obtaining a truly representative assessment of measurement reproducibility are stated. Typical levels of measurement reproducibility found in operating flotation plants are also reported. These numbers can be used as benchmarks for reproducibility levels that can be realistically expected.

NOTES:

15:35 – PAPER 24

Reflectance Spectroscopy with X-Ray Fluorescence for Rapid Slurry Analysis

O. Haavisto, J. Timperi - Outotec (Finland) Oy

Accurate on-line assays of mineral slurries are the basis for effective operation of flotation circuits. Typically the elemental content measurements are obtained by an X-ray fluorescence (XRF) analyzer, which samples the process lines and performs the analysis concurrently line-by-line. For a more frequent measurement of each slurry line the XRF measurements can be complemented with reflectance spectrum information. In reflectance spectroscopy the absorbance properties of the slurry in the visible and near-infrared wavelength range are analyzed. The advantage of reflectance spectroscopy is that measurements can be obtained quickly and simultaneously from several slurry lines. However, since the shape of the spectrum is only indirectly affected by the slurry elemental contents, frequent calibration of the measurement against the XRF analyzer is necessary. This study elaborates the combination of reflectance spectrum analysis with XRF. Results of laboratory tests for different slurries are presented and the operation of the system in a copper-zinc flotation plant is demonstrated.

NOTES:

16:00 – PAPER 25

Improvement in Copper Flotation-In Terms of Recovery and Concentrate with the use of Specialty Chemical- FLEX 31

S. Thirunagari, K. Amarasingham, R.S. MacPhail - Charles Tennant & Company (Canada) Ltd, Y. Kapai, D. Mukelebai, A. Kabamba, C. Henry, C. Leonard, B. Victor - Konkola Copper Mines Plc

FLEX 31 is a chemically enhanced sodium isopropyl xanthate. Developed by Charles Tennant & Co (Canada) Ltd and has shown improved collection properties over SIPX for sulphide minerals flotation. Improvement of recoveries, grades, faster kinetics, lower dosages, high pyrite and pyrrhotite rejection capabilities have all been exhibited by FLEX 31. Recent plant trial carried out in the copper circuit at one of the largest copper mine in Zambia shown over US $ 2.00 Million annual improvement on the bottom line over SIPX at current copper prices. Data produced also showed superior grade and recoveries from rougher concentrates that previously had not been attainable with other reagents effectively. Flex 31 has also shown positive outcomes with zinc, Copper/Zinc, arsenopyrite and copper/molybdenum ores.

NOTES:

6:30 BANQUET RECEPTION, BALLROOM FOYER

7:30 BANQUET CONFEDERATION BALLROOM

THURSDAY, JANUARY 21st
Morning Session

07:30 - CONTINENTAL BREAKFAST – PROVINCES BALLROOM

PROJECT OPTIMIZATION

8:30 - PAPER 26

Increasing SAG Mill Capacity at the Copper Mountain Mine through the Addition of a Pre-Crushing Circuit

D. Rose, D.G. Meadows - FLSmidth USA Inc.
M. Westendorf - Copper Mountain Mine

Copper Mountain's concentrator was commissioned in May 2011. The circuit consists of a 34' x 20' EGL SAG mill, a Raptor 900 pebble crusher and two 24' x 39'6" ball mills. Each mill is equipped with a 2 x 8500 HP dual pinion drive system. The plant was designed to process 1585 mtph of SAG feed. From startup, the mill struggled to meet the required production rates. Over time, a major initiative that involved blasting and fragmentation, optimization of the SAG mill in terms of discharge grates, ball size and slurry density, and operation of up to three mobile pre-crushing plants resulted in significant increases in throughput. In parallel, a number of modeling tools, including JK SimMet, were run based on plant benchmarking exercises. Samples collected at the mine site during ramp up confirmed the very competent nature of the ore with drop weight - A*b values of less than 24 being recorded on a variety of plant feeds and lithologies. After due consideration including demonstration of proof of concept, a new pre-crushing circuit incorporating an XL2000 cone crusher and associated screening equipment was designed, constructed and commissioned at the site in August 2014. This paper reviews the history of the original circuit design, the various optimization steps taken and impacts, together with the final pre-crushing circuit and net results.

NOTES:

08:55 – PAPER 27

Extension of the Comminution Energy Curves and Application to Stirred Milling Performance

G. R. Ballantyne - University of Queensland, M. S. Powell - CEEC: The Coalition for Energy-Efficient Comminution, P. Radziszewski - Metso Minerals Canada

The comminution energy curve is a profoundly simple graphical technique that displays detailed operating efficiency information for industrial comminution processes. The database underlying the methodology has recently more than doubled, to now contain a substantial fraction of the international comminution output (1.7 billion tonnes of rock per year) across more than 8 major commodities. This increase has deepened the analytical capabilities and effectiveness for assessing comminution circuit performance in relation to comparable operating mines. This paper will explore how the energy curve methodology can be used to examine the ability of stirred mill technologies to increase efficiency.

Specifically, this paper explores how the energy curves methodology can be used to present energy efficiency gains achieved at three mines employing a stirred mill technology under different duties. The first of these cases studies was conducted by Rosa (2014) who compared the performance of two ball mills operating in parallel with a Vertimill in the regrinding circuit at the Samarco Iron project in South East Brazil. The Vertimill was found to achieve the same product specification while consuming 40% less energy. Brissette (2010) investigated the impact of grinding media on the performance of both ball mills and Vertimills. The energy savings achieved varied from 10% to 40% for the ball mills and 30% to 60% for the Vertimills. Lastly, Bergerman (2012) investigated the operating conditions of the Sossego regrind circuit from 2006 to 2011 against design specifications and laboratory testing. The operating work index of this circuit varied from 5.2 kWh/t to 44 kWh/t over this 5 year period. The full suite of energy curves have been used to visualise the energy efficiency improvements highlighted within these three case studies.

NOTES:

09:20 – PAPER 28

The Challenges and Ramp Up of Filtered Tails in a Modern Production Plant – Éléonore Project Experience

A. Fortin – Goldcorp, Éléonore Mine, S. Hille, J. Basi -Technical Services – Metallurgy & Processing, Goldcorp

Goldcorp's Éléonore mine is situated in Ell Lake area in the northeastern part of the Opinaca reservoir in the James Bay region of Quebec. The design of the 7000 t/d process plant includes crushing, grinding, bulk sulphide flotation, separate concentrate and tails leaching and detoxification circuits and residue handling. Detoxified flotation tails are thickened and filtered. A portion of the filtered tails is blended with the thickened detoxified sulphide concentration for paste backfill. The remaining filtered tails are trucked to the waste management facility. This presentation will describe the challenges faced with the commissioning and subsequent ramp-up of the flotation tails filter plant and the successes achieved by the multi-discipline team at Éléonore.

NOTES:

09:45 BREAK – PROVINCES BALLROOM

10:15 – PAPER 29

Magnetic Conditioning of Sphalerite at Red Dog Mine

B. Lacouture, J. Oliver – Teck, B. Lumsden - Ausmetec Pty Ltd.

Red Dog is one of the largest zinc mines in the world both in terms of reserves and annual production. In 2013, Red Dog produced 551,300 mt of contained zinc and 96,700 mt of contained lead. The mine, which is located in Northwest Alaska, is a partnership between Teck Alaska Incorporated, the operator of the mine and NANA Regional Corporation Inc, the local land owner. The Aqqaluk deposit, which is the current source of ore, has an average grade of 15.8% Zn, 4.1% Pb and 73 g/t Ag with the main minerals being sphalerite, galena, pyrite, barite and quartz. Surveys of the zinc flotation circuit at Red Dog identified that a substantial amount of fully liberated, sub 20 micron sphalerite particles were being lost to final tailings. As a means of improving fine sphalerite recovery, a four month plant trial of magnetic conditioning was conducted in the zinc retreat circuit. Magnetic conditioning technology has already been commissioned in several concentrators around the world to agglomerate fine paramagnetic minerals, increasing their probability of bubble collision and recovery in a flotation cell. The results of the four month plant trial at Red Dog showed that at a high level of confidence, a 1% increase in zinc recovery or zinc recovery and zinc concentrate grade combined was achieved with magnetic conditioning. The resulting economic benefit, which is also at a high level of confidence, is significant to Red Dog and therefore, magnetic conditioning has been permanently incorporated into the Red Dog zinc flotation circuit.

NOTES:

10:40 – PAPER 30

Balancing and Estimating the Ore Mineral Contents from Daily Production Samples

C. Bazin, M. Sadeghi, J. Roy - Laval University

The operation of mineral processing equipment is intimately related to the mineral composition of the ore. However unit performances are usually characterized in terms of metal contents or recoveries as this data is easier to obtain than the mineral contents. This paper describes a method that combines the operations of material balancing and estimation of the mineral contents of the ore. The estimated mineral contents can be used for process analysis and diagnosis of operating problems.

NOTES:

11:05 – PAPER 31

Promoting Energy Efficiency Studies During Mineral Processing Plant Design

C. Shook, A. Tylczak, S. Loif, A. Doogan-Smith, B. Hilscher, P. Nayak - Sacré-Davey Engineering

This paper discusses how to effectively conduct energy efficiency studies during the design of new mineral processing plants and plant expansions. Energy management studies for new plants are ideally conducted as part of the feasibility study, but can also be done at the detailed design stage prior to the purchasing of equipment. Energy management engineers work as part of the mineral processing plant design team.

Such studies usually result in energy savings of approximately 3-8% of the predicted plant's energy consumption and energy demand. Potential cost savings can be significant. A variety of mineral processing systems – crushing/grinding, pumping, materials handling, fans/blowers, compressed air, and others – are assessed within this study.

Energy Management Information System (EMIS) studies can also be performed for the new plant or plant expansion, as an independent study. EMIS can be incorporated into the electrical and controls design of the plant.

Most Canadian Utility companies fund new plant design studies and provide financial incentives based on the predicted energy savings and incremental cost of the more energy-efficient design. A new plant energy efficiency study improves the potential for energy reduction because only the incremental equipment cost is included in the project return-on-investment calculation. After the design and construction phases, energy efficiency projects must justify the entire cost of the upgrade, which is significantly higher than the incremental cost alone.

This paper outlines the major steps of a new plant/plant expansion energy efficiency study, the available utility company incentives, and the areas yielding the largest potential energy savings.

NOTES:

11:30 – LUNCH BREAK

THURSDAY, JANUARY 21st
Afternoon Session

MINERALOGY AND HYDROMETALLURGY

13:00 – PAPER 32

Where Did That Earbud Come From? Current Rare Earth Production Facilities

J.R. Goode - J.R. Goode and Associates

Rare earth elements (REE) and their compounds are critical ingredients in numerous necessities of modern life including: the permanent magnets used in electric motors, generators, speaker and hard drives; high performance automobile tires; catalysts; phosphors; optical glass; etc. World production of REE in 2014 was about 110,000 t with about 98,000 t/a being "Light" (LREE) and the balance "Heavy" (HREE). Unlike other mined commodities, the majority of the LREE produced in the world is a by-product and that from a single iron ore mine in China. The balance of the LREE production comes from four REE-only mines, two in China, one in Australia and one in the USA (now on Care and Maintenance basis). The LREE operations comprise very unusual flotation processes and complex hydrometallurgical plants. In contrast, most of the HREE come from a multitude of small in-situ leach operations exploiting a single, dispersed deposit in China using hydrometallurgy alone. All of the current REE operations produce an intermediate mixed REE product that must be separated to yield the high purity, individual, REE required by the market. This paper describes the processes being used to produce LREE and HREE intermediate products and the separation plants used to make the high purity REE compounds that are key ingredients in the magnets in earbuds, turbines, and automobiles; catalysts used in the production of gasoline, and so on.

NOTES:

13:25 – PAPER 33

Fluid Flow in a Hydrocyclone in the Absence of an Air Core

E. Kucukal - Case Western Reserve University, J. Furlan - GIW Industries, R. Visintainer - GIW Industries, J.R. Kadambi - Case Western Reserve University

Hydrocyclone separators are used in various industrial applications, including mining milling and tailings systems, in order to separate or classify solid particles and liquid droplets from multiphase systems. The flow within a hydrocyclone commonly used in the mineral processing industry was investigated numerically and experimentally using Particle Image Velocimetry (PIV) and refractive index matching techniques. The computational simulations were performed using a commercially available CFD package, STAR CCM+. Two turbulence models were used in the numerical calculations: the k□□ model and the Reynolds Stress Model (RSM). In both cases, the first order discretization scheme was unable to resolve the flow characteristics accurately due to the high levels of numerical dissipation. PIV measurements were taken at various spatial locations along the cyclone. Both the numerical simulations and PIV data demonstrate that tangential velocities tend to increase when going radially inward from the cyclone wall towards the vortex finder, and reach a maximum value before they begin to decline rapidly and eventually become zero at the wall. The results also demonstrate the utility of non-axisymmetric approaches in cyclone flow simulations for a greater understanding of the fluid mechanics. The computational results were validated globally using pressure and flow rate readings at the boundaries and locally by comparison to the PIV velocity vector maps and profiles. The comparisons demonstrated good agreement between the two models.

NOTES:

13:50 – PAPER 34

Dense Medium Separation – An Effective and Robust Pre-Concentration Technology

E. Legault-Seguin, C. Mohns - SGS Canada Inc., M. Rylatt - Independent Consultant

With energy costs increasing and ore grades diminishing, the role of pre-concentration in hard rock mining operations has been gaining greater interest. To maximize energy conservation, the pre-concentration process should be conducted at as coarse a crush size as possible while minimizing losses of pay metals. Dense medium separation (DMS) is a robust process that can be conducted at particle sizes as coarse as 300 mm and as fine as 500 µm with high separation efficiency, depending on liberation characteristics of the value minerals. The DMS process involves three steps: feed preparation, dense medium separation, and ferrous-based media recovery. This paper discusses each of these processing steps, but focus will be given to the dense medium separation stage. Various types of DMS equipment are reviewed. Pilot plant campaign case studies conducted at the SGS Lakefield site are presented, which have included a variety of mineral systems such as spodumene, sulphide-bearing gold ores, and complex sulphide ores. These case studies demonstrate that for amenable ores, mass rejection of 20-60% is possible while maintaining recoveries of greater than 90% in most cases.

NOTES:

14:15 BREAK – PROVINCES BALLROOM

14:45 – PAPER 35

Sulphur-Burning Sulphur Dioxide Gas Plants For Hydrometallurgical Processes

K. Nikolaisen, K. Loutet, A. Guenkel - Noram Engineering & Constructors Ltd.

The INCO SO_2/air process was patented by INCO in 1985. Well over 80 mining operations worldwide are using this process to oxidize cyanides to cyanates in the tailings from gold, silver and copper mining operations. The sulphur dioxide (SO_2) for this process can be supplied either as liquid SO_2, SO_2 gas or as a sulphite-based salt. The majority of SO_2/air operations have used sulphite-based salts as the 'SO_2' equivalent probably due to low capital cost. Liquid SO_2 has also been used frequently, but due to concerns with safety and availability, this option is often not preferred. The solid salt sodium meta-bisulphite (SMBS) is commonly employed, but its cost is an order of magnitude higher than that of sulphur. Due to the high cost of SMBS, the increased capital cost for a sulphur-burning SO_2 gas plant (green field or retrofit) usually has a pay-back of less than three years. In addition, a SO_2 gas plant offers potential for significant heat recovery from the sulphur burning process. In terms of safety, the SO_2 gas plant only requires the storage of relatively benign sulphur and the site inventory of SO_2 will be limited to the plant gas volume. Therefore, a SO_2 gas plant will not trigger the Canadian Environmental Protection Act (CEPA) E2 Regulations or the US Clean Air Act Section 112(r) accident prevention regulations, as may be the case for liquid SO_2.

Most existing mining operations using 'SO_2' are gold operations, but in recent years there has been an increased interest in larger sulphur dioxide gas plants for hydrometallurgical facilities that employ leaching of cobalt/manganese minerals or precipitation of manganese/iron (e.g. Tenke Fungurume and El Boleo).

This paper focuses on the production of sulphur dioxide gas generated on site and on demand for the use in hydrometallurgical processes. The capital and operational costs of a SO_2 gas plant is compared to conventional process alternatives using sulphite-based salts or liquid SO_2.

NOTES:

15:10 – PAPER 36

Operating Experience And Developments of G-REX and AuRIX®100 Resin Exchange Technology

A. Lewis-Gray - Gekko Systems Pty Ltd, M. Davies - Castlemaine Goldfields, P. Richards - Gekko Systems Pty Ltd, N. Katsikaros - Gekko Systems Pty Ltd

Gekko Systems developed the Gekko Resin Exchange Column (G-REX) in order to optimise the recovery of gold in complex leach-to-electrowinning processes, as an intermediate step using a highly gold-selective resin to isolate contaminant metals. The AuRIX®100 resin produced by Purolite is licensed exclusively to Gekko, with the G-REX column designed specifically for this resin (Lewis-Gray et al, 2015). Operational experience has been gained at the CGT Ballarat Gold Plant in near continuous operation since 2008, treating unclarified concentrate leach solution. The extension of the technology to higher throughputs and more complex chemistry is discussed.

NOTES:

15:35 – PAPER 37

STUDENT TECHNICAL REPORT COMPETITION WINNER

Effect of Lead Nitrate in the Leaching of a Sulfur Bearing Gold Ore

David Georges-Filteau – Laval University

The Casa Berardi Mine in Quebec processes a gold bearing ore with high proportions of sulfide minerals. In fact, in the first half of 2015, the average sulfur grade in the tails was 7.4%. For the same period, the gold leaching recovery at the mill averaged 80%. A laboratory investigation and an in-line test were conducted to increase the cyanidation performance by adding lead nitrate. The laboratory results showed that an addition of 150 g/t of Pb(NO3)2 yielded on average an improvement of 1.19 % on gold recovery. The in-line test using 200 g/t of lead nitrate showed a decrease in cyanide consumption of approximately 0.15 kg/t. Therefore, the adding of lead nitrate represents a financial benefit of 1.5 M $ per year for the mine.

NOTES:

16:00 CONFERENCE CONCLUDES

AUTHORS AND SESSION CHAIRS

Authors and session chairs must register as conference delegates. A speaker's breakfast will be provided starting at 7:00 am on the day of their presentation/session in the in the **Quebec Room**. Authors, please contact John Chaulk john.chaulk@canada.ca for presentation information**.**

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Monday evening is the annual Student Mixer following the Student-Industry Roundtable. All are welcome.

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André Laplante Memorial Scholarship Winner	Graham Bonn (UBC)
Byron Knelson Memorial Scholarship Winner	Anthony Clapperton (Laval)

CMP 2016 – EXECUTIVE, REGIONAL and COMMITTEE REPRESENTATIVES

CMP EXECUTIVE

Chair	Paul Blatter, Greenstone Gold Mines, pblatter@premiergoldmines.com
1st Vice-Chair	Scott Martin, Outotec, scott.martin@outotec.com
2nd Vice-Chair	Johnna Muinonen, Royal Nickel Corporation, jmuinonen@royalnickel.com
Past Chair	Tad Crowie, Goldcorp, tad.crowie@goldcorp.com
Secretary	Janice Zinck, CanmetMINING, janice.zinck@canada.ca
Treasurer (elect)	Wesley Griffith, CanmetMINING, wesley.griffith@canada.ca

REGIONAL REPRESENTATIVES

Atlantic – Vacant
Côte Nord-Labrador - François Lavoie, BBA, francois.lavoie@bba.ca
Nord-Ouest Québécois – Mark Furlotte, Mine Matagami, mark.furlotte@glencore-ca.com
Quebec-Montreal-Ottawa – Stéfanie Vo, Hatch, svo@hatch.ca
North Eastern Ontario – Daphne Walsh, Goldcorp, daphne.walsh@goldcorp.com
Southern Ontario - Yves Breau, Kinross, yves.breau@Kinross.com
North Western Ontario - Matt Martin, CCC Chemicals, matt.martin@ccc-group.com
Central Ontario - Katherine Hopkins, Hatch, khopkins@hatch.ca
Manitoba / Saskatchewan - Lorne Schwartz, Amec Foster Wheeler, lorne.schwartz@amecfw.com
Alberta/NWT/Nunavut - Jennifer Hook, Hatch, jhook@ualberta.net
British Columbia/Yukon - Mark Adams, Outotec, mark.adams@outotec.com
Regional Coordinator - Donald Leroux, Triple Point Technology, donald.leroux@tpt.com

DIRECTORS

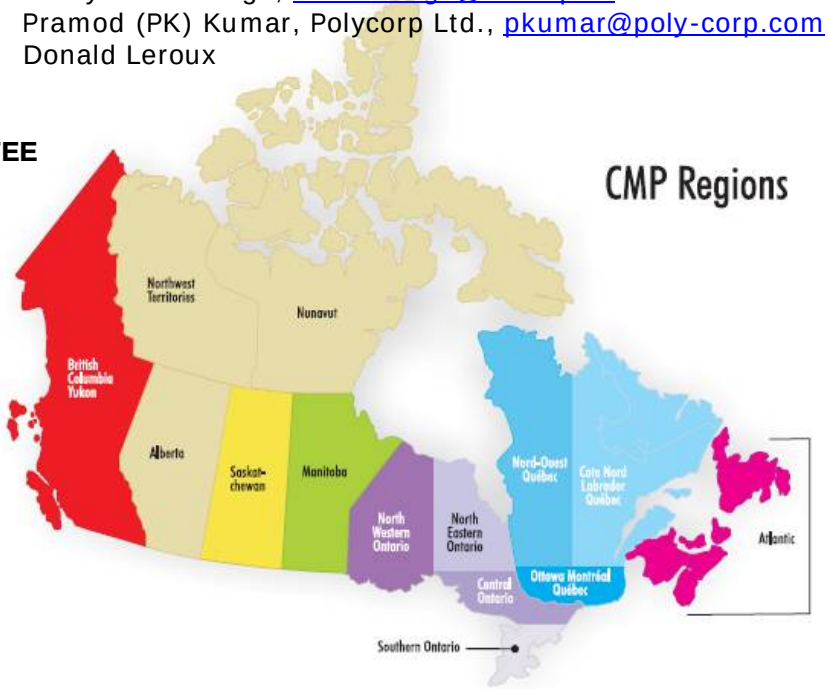
John Starkey, Stuart McTavish

REPRESENTATION ON CIM and CMP COMMITTEES

CIM Council Representative	Janice Zinck
Publications/CIM Journal	Michael Sue, Outotec, michael.sue@outotec.com
Education	Lucky Amaratunga, amaratunga@fibreop.ca
International Relations	Pramod (PK) Kumar, Polycorp Ltd., pkumar@poly-corp.com
IMPC 2016	Donald Leroux

LOCAL ORGANIZING COMMITTEE

Janice Zinck, Planner
Wesley Griffith, Registrar
John Chaulk, Audio-Visual
Dave Hardy, Students
Al Kuiper, Photography
Louise Madaire



CMP HOCKEY PLAYERS AND SPECTATORS!!!!

The Southern Ontario Branch of the Canadian Mineral Processors (CMP) is pleased to once again organize the CMP East versus West Hockey Game as a part of the social program of the annual CMP meeting in Ottawa.

To honour the late Ray MacDonald, who was instrumental in getting this annual event started, the game has been renamed the **'Ray MacDonald Memorial Hockey Game'**. The winning team will be awarded the 'Kilborn Cup'.

The 2016 game will be played on **Tuesday January 19th, 2016 at 7:00 pm at Carleton University**. Bus transportation to/from the Ottawa Westin Hotel will be provided for all players and spectators. The bus for players and spectators will depart the Westin hotel at 5:30 pm.

The hockey game is open to all registered members of the conference. Players (men and women) of all ages and skill levels are encouraged to participate in this great event of networking, recreation, and fun. Full hockey equipment including a helmet is required. Participants will also be required to sign a waiver form. Slap shots and body contact are not permitted. If interested in participating in this game, please contact Mark Griffiths at mark_griffiths@quadra.ca (289-321-1814).

FEEDBACK

Through this annual national conference and our regional events the Canadian Mineral Processors strives to provide an open and friendly forum for mineral processing operators across Canada and throughout the world to meet, network and exchange technical information.

We welcome your feedback on the conference programming, logistics or any other aspect in relation to the conference or the CMP association. Please send feedback to cmpsoc@outlook.com. Thanks.

CMP 2017 AWARDS NOMINATION INVITATION

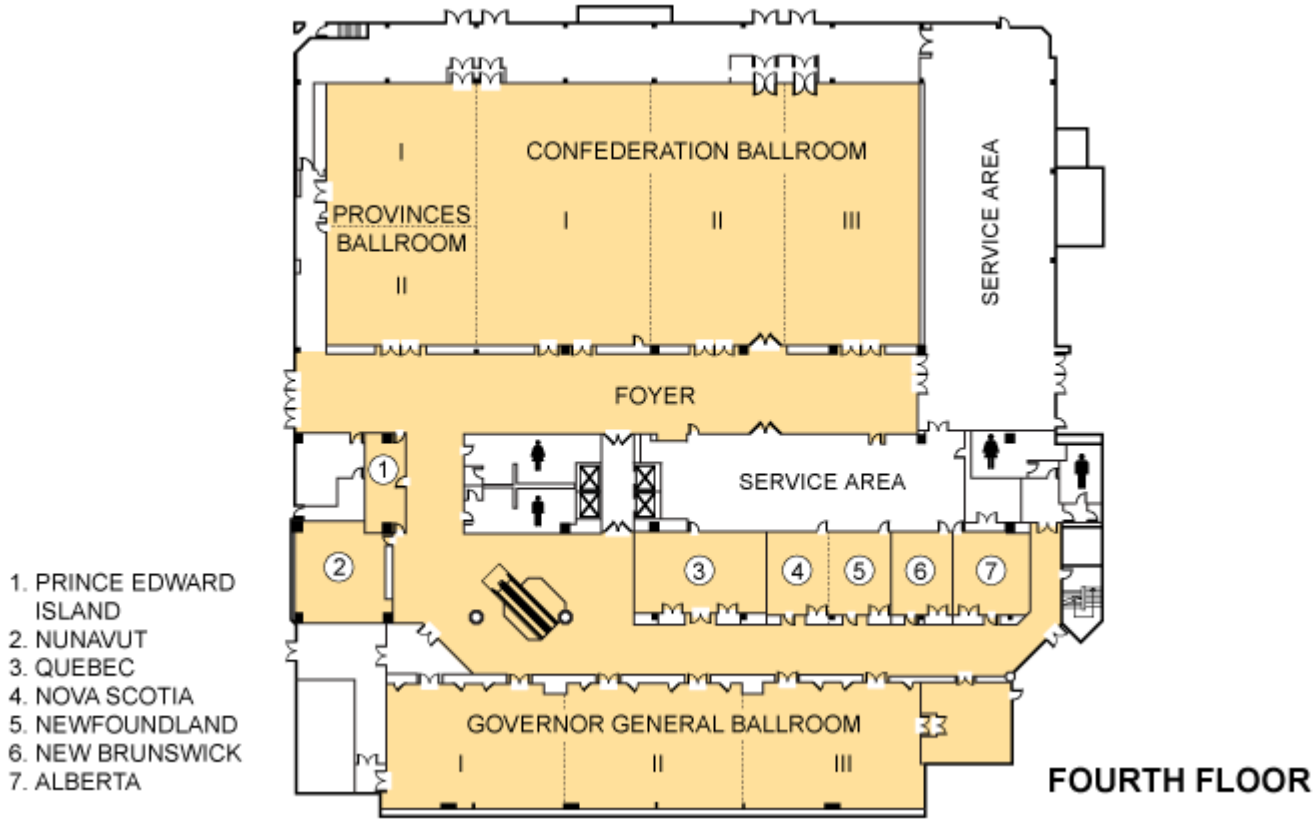
The Executive of the Canadian Mineral Processors Society invites nominations from the membership for the CMP 2017 Awards under the following five categories.

CMP Award	Recognizing ...
Mineral Processor of the Year	Outstanding results recently achieved by an active CMP member while *tackling significant mineral processing challenges.*
Lifetime Achievement	Outstanding results/influence achieved by a retired CMP member *throughout his/her career* in mineral processing.
Bill Moore Special Achievement	Outstanding results achieved by an active CMP member throughout *the early part of his/her career* in mineral processing.
A.R. MacPherson Comminution	Outstanding results recently achieved by an active CMP member *while tackling comminution challenges* in mineral processing plants.
Ray MacDonald Volunteer	*Exceptional volunteer contribution* to the Canadian Mineral Processors Society

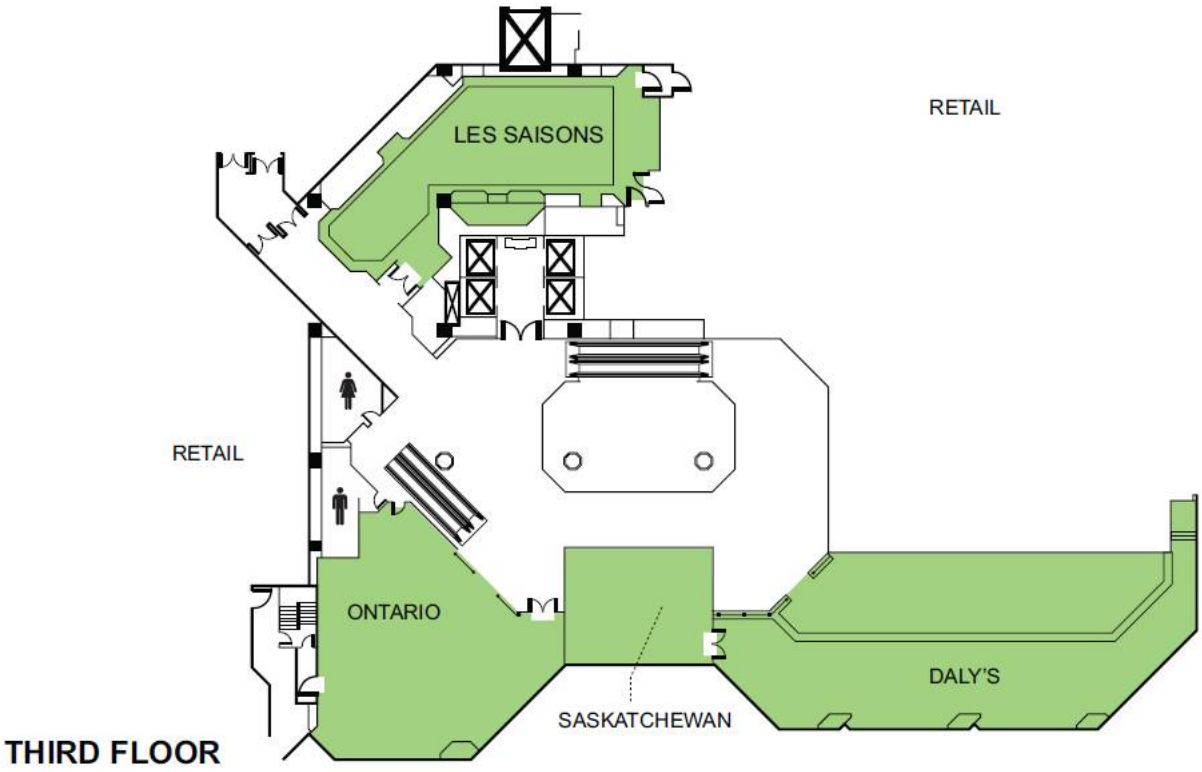
Awards are in the form of an engraved medallion and a framed certificate and will be presented during the Awards Banquet to be held at the 2017 Annual CMP Meeting in Ottawa. Nominations for the 2017 CMP awards open on **January 22, 2016**. Nomination applications should be sent to Paul Blatter paul.blatter@ggmines.com, CMP Past Chairman (2017) **by November 15, 2016**.

Guidelines for nominations, award categories, selection criteria, and information on past awards are available at www.cmpsoc.ca. Please take the time to recognize your mineral processing colleagues and peers.

WESTIN FLOOR PLAN



FOURTH FLOOR



THIRD FLOOR

ADDITIONAL NOTES

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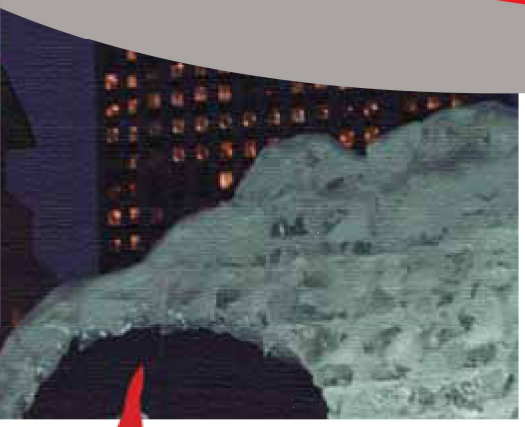
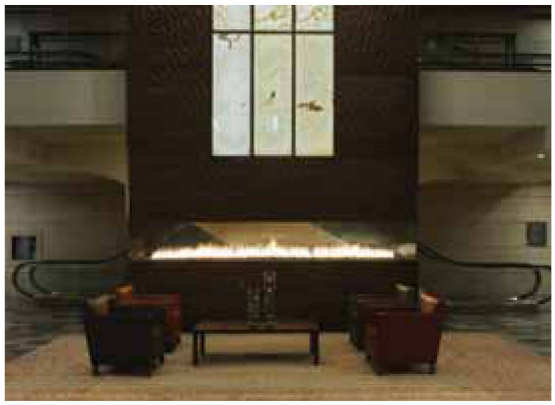
CMP gratefully acknowledges the contributions and financial support





Photos: Courtesy of The Westin, Ottawa Tourism, and the City of Ottawa

Canadian Institute of Mining, Metallurgy and Petroleum

L'Institut canadien des mines, de la métallurgie et du pétrole