Collaborative Initiatives to Advance Mining Innovation

Magdi Habib
Director General, CanmetMINING
Green Mining Innovation Workshop
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Green Mining Innovation

In collaboration with partners from across Canada’s mining innovation system, CanmetMINING develops and de-risks green mining technologies and practices.

Green Mining

- economically competitive
  - +
- environmentally sensitive
CanmetMINING and Green Mining Innovation
Economically Competitive and Environmentally Sensitive

Green Mining Innovation (GMI)
• Reduce the environmental impacts of mining
• Improve the competitiveness of Canada’s mining sector

Addresses Industry Priorities and Challenges
• Improving energy efficiency and reducing GHGs
• Minimizing wastes
• Increasing productivity
• Expanding mineral resource potential

Aligns with the Government of Canada’s Agenda
• Clean technology / clean growth
• Climate change
• Watershed protection
• Economic competitiveness of the natural resources sector

Contributes to the Public Good
Supports:
• Environmental assessments
• Metal mining effluent regulations
• Water quality
• Tailings management

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Highlights from 2017/2018 and Next Steps

- Energy Efficiency
- Enhanced Productivity
- Waste Management
- Water Management

Goal
Canada’s mining industry is globally more competitive and environmentally responsible
Energy

Achievements

- Developed an online energy benchmarking program for mines, in collaboration with partners

Next Steps

- Analytics and Artificial Intelligence for mine energy management
  - Issues of lack of granular data on energy use, lack of resources for bringing together and analyzing data from disparate sources, lack of tools for real-time monitoring, etc.

- Sensors and communication networks (Internet of Things)
Energy Efficiency in Comminution

Achievements

• 3D rock size sensor prototype (patent pending)
• Advances in coarse particle flotation significant energy decrease
• Consortium on high pulse voltage test work established

Next steps

Mine to mill and pre-concentration
National collaboration to be established
Rare Earth Elements: Ore to Oxide

Focus on Canadian minerals/ores to produce viable flowsheets for each of the three ores

Achievements

- Developed a **probe** to measure mineral process chemistry in real time under harsh reaction environments
- **Validation of the patent-pending Direct Oxalate Precipitation** method on industrial pregnant leach solutions
- Demonstrated potential for application of **ore sorting** technology for the pre-concentration of rare earth ores
- Developed a promising **ion exchange** process for Th, LREE, and HREE separation from leach solutions
- Development and initial testing of the **first solid-phase extraction method** designed for REE
- Successful **synthesis** of $\text{Al}_3\text{Nd}$ and $\text{CeNi}_5$ from $\text{Nd}_2\text{O}_4$ and $\text{CeO}_2$ via the Metalysis Process

http://reechromite.ca

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Rare Earth Elements

Secondary sources

Year 4 Work Plan:

- Flowsheet development for Canadian ores
- Compare existing, and develop novel acidic baking technologies
- Purification of REE precipitates
- Compendium of REE solubilities
- Further evaluation of REE ecotoxicity (advised by ECCC)
- Expanded effort in REE recovery from secondary sources
- Techno-economic assessments
Canadian Chromite R&D Program

Achievements

Two patent pending direct reduction processes for chromite

Potential reactors for direct reduction and performed computational fluid dynamics modelling identified

Successfully completed scaled-up experiments on direct reduction of chromite

Successfully completed a pilot-scale campaign on generating smelter dust and slag needed for assessing the potential for Cr(VI) generation during smelting and quality of slag as a by-product

Year 4 work plan:

- Characterization and beneficiation of furnace products
- Optimizing pellet make-up and properties
- Furnace tests
- Development of Cr(VI) sensor
- Slag quality/reutilization

Invited as opening speaker at the International Chromium Development Association (‘ICDA’) Annual Meeting in Paris

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Mine Hoisting and Ground Control Technologies

Achievements

- Successful completion of high performance synthetic rope underground field trials at Goldex Mine
- Non-destructive testing monitoring evaluated
- Started underground trials for National Research Council rock bolt sensor to assess performance
Water Management

Achievements

- Developed an effective process to treat mine and process water streams such as acid mine drainage

- SDTC funding was awarded for a 12-18 month field demonstration at a select mine site

Next Steps

- Secure a mine site for the field demonstration project;
- Construct the mobile process train; and
- Support commercialization and uptake of the new process.

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Fate and effect of metals

Achievements

- Developed lab method to determine the rates of removal of metals from the water column for environmental classification of metals

- This work contributed to the metals industry submission to the European Chemicals Agency, European Commission and OECD in April, 2018.

Next Steps

- Seek feedback from scientific and regulatory community

- Building acceptance of methodology (test protocol) – at global level

- Continued scientific work to address e.g.: 1) Criteria for substrate selection; 2) pH buffering and 3) Inter-laboratory comparison

- Application to climate change project
Organic Covers

Achievements

- Lab and field results show productive revegetation and improvement of pH and microbial diversity, which could result in $10s of millions in potential savings at closure.

- Field data and feasibility study suggest organic covers revegetated with hybrid willows may result in economic benefits through energy production from biomass.

Concerns

- Metal leaching and uptake by vegetation.
- Long-term cover performance and sustainability.

Next Steps

- Determine microbial recovery and stability of tailings covered with municipal biosolids.
- Define best practices for organic covers usage to inform industry and regulators.

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Mining Value from Waste
Advancing a circular and low-carbon economy

- Mine Waste
  - High liabilities
  - Environmental and social risk
  - High metal content

- Bio-fuel production
  - Community energy
  - Energy for operation
  - By-products from bioenergy

- Reprocessing
  - Low energy demand process

- REE, gold, nickel, cobalt, etc.

- Residues

- By-product potential

Benefits
- Reduced liability and environmental impact
- Canada brand ‘green’ commodities
- Community benefits (jobs, energy)
- Low energy/GHG process
- Reduced mining footprint

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Mining Value from Waste

Achievements:

• Successful process development for both pyrrhotite and gold-bearing tailings
  – Ni (NiS) recovery and 98% of by-product iron magnetized
  – Gold recovery (80-95% sample dependant)

Next steps:

• Non-cyanide leaching for gold tailings and ore (consortium)
• Continue to expand program with other partners
• Five potential Clean Growth projects
Energy and Mines Ministers’ Conference 2018

• August 12-14, 2018

• Two Green Mining Innovation Deliverables
  • National Collaboration Strategy Pilot Project (Mining Value from Waste)
  • Assistant to Mining Innovation (Version 2.0)
National Collaboration Strategy

1) Support a culture of communication and collaboration
2) Share resources and leverage existing strengths, tools and organizations
3) Build a culture of innovation

Short Term
- Enhance the existing Assistant to Mining Innovation portal
- Leverage existing working groups from government, industry, and supporting stakeholders

Medium Term
- Release publications about trends, challenges, innovations, and collaborations
- Assess public and private funding resources to seek alignment with initiatives that support collaborative opportunities

Long Term
- Consolidate existing technology road maps that highlight collaborative opportunities
- Communicate leading practices re: working within the regulatory environment
- Address challenges with the sector’s public perception

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Assistant to Mining Innovation

- A tool for collaborative innovation in the mining industry
- First version created for Energy and Mines Ministers’ Conference 2017
- Upgrades underway for EMMC 2018 including key innovation projects and collaborating organizations
- Your organization can feature its projects, expertise and news on the site
For additional information, please contact:

Magdi Habib
Director General, CanmetMINING
Lands and Minerals Sector, Natural Resources Canada
Magdi.Habib@Canada.ca