Transformative Technologies and Specialized Services @ CanmetMINING

Recent accomplishments and working towards the green mining of the future...



Kristie Tarr December 2019

Digitalization and Al



• International Energy Agency (IEA)

- Digitalization and Artificial Intelligence for Energy Efficiency and GHG Emissions Reduction
- Supporting adoption of digitalization in energy intensive industries internationally

GMG AI Working Group

- Significant contributions to "Foundations of AI in Mining" and "Applications of AI in Mining" guidelines

• Impact Canada's Crush It! Challenge

- Technical review of COREM project
- AI for designing more energy efficient mill flowsheets







GMG

impactcanada

Digitalization and Al





- GMG Data Access & Usage Group
 - Issues regarding mobile equipment data access
 - Challenges in lack of standardization with data from different OEMs
- Machine learning algorithms
 - Detecting microseismic events





Digitalization and AI



Real-time monitoring of mine hoist guides

- Could improve safety and productivity
- Partnership with UQAT to use AI for data analysis
- Decision-support tools for inventory and maintenance planning
 - To reduce downtime and capital and operating costs
 - To ensure that tire inventory levels are sufficient to prevent the need to remove trucks from production





Digitalization and Al



• Al for reversing the trend

- Opportunities for applicability of AI or other digital technologies for streamlining the mining permitting process
- BC mining stakeholders, MABC and OMA engagement
- Aligns with Mining Association of BC Innovation Roadmap for developing agile and efficient regulations



Digitalization and AI



AI / Big Data Platform for Mining

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- Collaboration with CanmetENERGY
- Useful for process engineers, specifically for data visualization and real-time monitoring which could be used for fault detection in processing plants
- Data processing and real-time monitoring functionality
- Built-in AI algorithm (neural network) for modeling









Real-time ground support monitoring for deep mining

- Development/demonstration of Instrumented Rock Bolts with NRC
- Technical feasibility studies of the sensor technology
- Underground demonstration trials
- Geodynamics for static and dynamic support of underground excavations



Deep mining





- Novel rock fragmentation approaches for improving ground stability at depth
 - Collaborative development of novel approaches to fragmenting underground rock using expansive cement with The Royal Institution for the Advancement of Learning/McGill University



- Energy efficient heating and cooling for deep mining
 - A two-phase model and in-depth study of an engineered "natural heat exchange area" (NHEA) for deep mining
 - Participants include Vale, MIRARCO, Cambrian College







Certified Engines 2018
Caterpillar Engine Model C11 (AD22)
Caterpillar Engine Model C13 (R1700K)
Caterpillar C7.1
Deutz F6L914 T2
Cummins QSF3.8, T4F
Cummins QSB4.5
Cummins MY2019 ISBN6.7
Deutz TCD 4.1 L4, CFVI115A
Deutz TCD 4.1 L6 214 CFVI160
Cummins QSK19-C760 T4F
Caterpillar Engine Model C18 (AD45)
Caterpillar Engine Model C15 (R2900K)
Cummins QSB6.7, T4F
Cummins QSL9-C325, T3
Cummins QSF3.8

• Diesel engine certification/ clean diesel

- CanmetMINING operates the only dynamometer facility in Canada that is equipped, staffed and accredited (ISO 17025) to perform specialized testing services and certification of diesel engines destined for use in underground mines (CSA and Mine Safety and Health Administration standards)
 - Canadian mining provinces and territories can allow these engines underground with the knowledge that emissions have been characterized and safe ventilation rates have been calculated
 - Mine operators can realize energy savings by acquiring the best, cleanest and most fuel-efficient engines



Clean energy

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Clean alternative energy

- Development of the alternative energy vehicle sections of the M424 CSA standards for use in underground mines
 - First comprehensive review of CSA M424 in 25 years

Clean diesel tech R&D

- Collaborative research projects to develop new types of emissions control catalysts and to study biodiesel renewable fuels
- Delivery of the annual Mining Diesel Emissions Council (MDEC) conference
 - Global forum for dissemination of technologically advanced research to reduce and control diesel emissions in mining











Mine Electrification

- "The 100% electric mine: converting the biggest diesels to electric"
- Collaborative project with CanmetENERGY and FVT, Glencore and North American Palladium
 - Assessing and optimizing electricity use in an allelectric mine

• GMG Electric Mine Working Group

- Establishing an information sharing platform:
 - Sharing of "lessons learned"
 - Benchmarking of relevant key performance indices for electric vehicles
 - Revision three of GMG Recommended Practices for Battery Electric Vehicles in Underground Mining



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Clean energy

Hydrogen Implementation for Mining Transition to a low-carbon, resource-efficient economy

- Key enabler of Green Mining: Mines require heavy-duty vehicles and operate in enclosed spaces
- Publication of the Guidelines for the use of H2 power in underground mining fuel cell vehicles
- Canadian Hydrogen Installation Code Review Mining
- International Network of Expertise and Steering committee



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• Hydrogen Implementation for Mining Support for drive to implementation

- National Hydrogen roadmap
- Mining companies technology developers workshop
- Equipment manufacturers interested in uptake
- Short term gap projects started
 - » Survey of the Canadian underground diesel fleet
 - Best hydrogen power vehicle architecture
 - » Design of an underground refueling station
 - WORLD FIRST Demonstration project funded



Clean energy







Questions?



ANNEX

Digitalization and AI

Deep mining Clean energy



For more information...

• The latest CIM Journal on Mineral Processing includes:

"Breaking down energy consumption in industrial grinding mills", an article co-authored by J. Bouchard and D. Georges-Filteau of Université Laval, Gilles LeBlanc and Michelle Levesque of CanmetMINING, and Peter Radziszewski of Metso Minerals Canada: <u>https://www.ceecthefuture.org/resources/breaking-energy-consumption-industry-grinding-mills</u> <u>https://magazine.cim.org/en/voices/todays-task-en/?mc_cid=bb9f763d1f&mc_eid=b4a006d549</u>

- Software development paper @ 2019 North American Mine Ventilation Seminar: <u>https://www.xcdsystem.com/cim/program/KCk2N8S/index.cfm</u>
- Towards Deployment of Vehicle Hydrogen Power by the Canadian Mining Industry @ Energy & Mines World Congress 2019: https://worldcongress.energyandmines.com/files/2-40-Implementing-Hydrogen-for-Mines-and-Building-a-Regulartory-Framework-Marc-Betournay-Natural-Resources-Canada.pdf
- Levesque, M., Amazouz, M., 2019. Big Data and AI platform for mining. GMG-CIM Montreal Forum: Artificial Intelligence in Mining, May 01, 2019.
- Levesque, M., 2019. Reducing energy and GHG emissions in mining. IEA Annex XVIII: Digitalization for energy efficiency and GHG emission reduction in industry, 10 April 2019.
- Sun Z., Wu K.T., Kruger S., Levesque D., Gagnon D., Quenneville Y., NRC; Lacroix R., and Royer R., CanmetMINING; Next generation rock bolt sensor technology for 3D mapping of ground condition. ESG 8th Microseismic Symposium, Kingston, June 11, 2019.
- Sun Z., Wu K.T., Kruger S., Levesque D., Gagnon D., Quenneville Y., NRC; Lacroix R., and Royer R., CanmetMINING; A new paradigm in ground support monitoring through ultrasonic monitoring of clusters of rock bolts. 9th International Symposium on Ground Support in Mining and Underground Construction, Sudbury, October 14, 2019

• CIM 2020

- Short course will take participants through the basics of AI and an applied example
- Participants will be able to:
 - configure an environment
 - understand the fundamentals of machine learning
 - perform basic data processing and data visualizations

