International Center of Excellence in Mining

Emerson established CEI Chile in late 2013 after being selected as a grant recipient by CORFO´s program, “Attraction of International R&D Center of Excellence for the Competitiveness 2.0”. The center began operations in early 2014 with a focus on applied research and development for innovative solutions to today’s mining industry challenges.

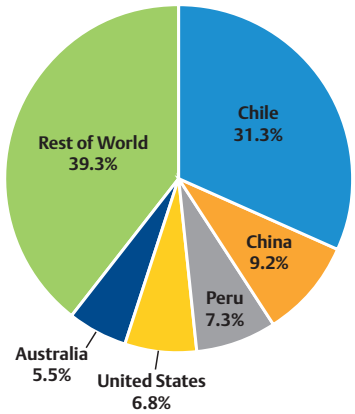
This whitepaper supplies an overview of the center’s objectives and primary areas of research.

Delivering innovative solutions from pit to plant.

BACKGROUND

As the global leader in copper production, Chile’s economic performance relies heavily on the mining industry. To that end, Santiago-based CORFO (Corporación de Fomento de la Producción), the Chilean government’s economic development organization is dedicated to promoting innovation and growth within it. Its programs support and finance a wide variety of initiatives, with goals of improving the skills of the local technology ecosystem (universities, R&D centers, and the local workforce), establishing Chile as a center of innovation, and stimulating the Chilean economy.

Global Copper Production in 2013



Data Source: USGS.gov

In 2013, the organization solicited proposals for “International Research and Development Centers of Excellence (ICE)” with a goal of developing R&D centers across a variety of industries and establishing Chile as an innovation hub. Four proposals from multinational companies were ultimately accepted; Emerson (Mining), Pfizer (Life Sciences), GDF Suez (Renewable Energy) and Telefonica (IT and Telecommunications).

After selection, Emerson quickly established its International Center of Excellence in Santiago to support research and development of products and applications to benefit both Chilean and global mining companies. The effort to date is a success and Emerson is actively working on six lines of research targeted on both mine pit and mineral processing operations.

RESEARCH AREAS

The research at CEI Chile is proceeding down two distinct paths:

1. Intelligent Operations
2. Automation for Process Efficiency

Emerson chose to concentrate in these areas to address some of the more significant challenges facing the industry today. Among these are improving mineral processing productivity; applying techniques from other industries to improve mine efficiency and safety; and developing new techniques to improve both mechanical and process reliability.

To ensure complete and straightforward IP management, CEI Chile conducts its R&D program under Emerson´s New Product Development Gate Process (NPD). This technology development system incorporates from the early stages of the project development all of the IP initiatives to patent the new concepts within Chile.

INTELLIGENT OPERATIONS

The Intelligent Operations research teams are exploring technological frameworks that enable remote collaborative assistance to improve both the reliability of critical mining equipment and the productivity and safety in high-risk mining and metallurgical operations. Active research is progressing in the following areas:

Improving the Availability of Mobile Mining Assets

Open pit mining utilizes a variety of equipment to collect and transport ore from pit to plant. These mobile mining assets include shovels, trucks, and in-pit crushers, among others and are large, expensive and highly complex. Any equipment failures can have a serious impact on the mine's productivity and profitability.

Traditional maintenance programs have attempted to quickly remedy failed equipment with large inventories of replacement parts and a reactive staff. Others utilize routine data collection on the equipment which exposes mine staff to safety hazards. In recent years, attempts have been made to harness online vibration monitoring systems; but given the dynamic nature of the equipment's operation, little progress has been made.

CEI Chile is investigating online condition monitoring systems based on more advanced signal processing techniques to overcome the shortcomings of traditional vibration analysis. Progress has been made on this front with several systems installed on electric rope shovels. These systems have accurately identified failure patterns and generated early warnings to mine staff—allowing for a proactive maintenance strategy and plan. Complementary to this research, the team is making progress in remote data collection, enabling mine staff to collaborate with expert analysts in Integrated Operations Centers (iOps) around the world.

Improving the Availability of Long-Haul Conveyors

Many mines these days are built in remote locations, making it difficult and costly for miners to use conventional haul trucks for ore transport. Instead, miners are installing long-haul conveyors that sometimes span kilometers of treacherous terrain. While more cost-effective, this transport strategy can prove more costly in the event of a conveyor failure as all transport is halted and mine productivity suffers.

Maintaining long-haul conveyors poses some difficulty for mine staff. Periodic data collection and routine inspections of critical components is performed, but this places staff in harms-way and is a time-consuming task.

Leveraging our research in the realm of mobile mining equipment, CEI Chile is investigating online and wireless condition monitoring systems that use advanced signal processing techniques. To date, several conveyor installations have yielded similar results to our mobile equipment program.

Improving the Safety and Efficiency of Heap Leaching Operations

Heap Leaching is the preferred hydrometallurgical process to extract metals from large amounts of low grade ores. Leach pads are very large irrigation operations that percolate leaching solutions onto the ore bed. Typically, these are manual operations in a dangerous environment, issues like plugging, leaks and misdistribution of the leaching solutions. Most heaps have low or nonexistent instrumentation and control, mostly because of the corrosive environment and the lack of proximity to power.

CEI Chile is working in conjunction with miners to develop an intelligent heap leaching control strategy that maximizes metal extraction and achieves safer and more productive

operations. The technology aims to automatically control irrigation and detect problems with the irrigation process. The automation solution includes wireless instrumentation, a control system for monitoring and controlling process variables, and an application station for dynamic process modelling and the application of advanced control strategies.

AUTOMATION FOR PROCESS EFFICIENCY

The second line of research examines automation solutions around mineral processing to improve productivity while also reducing the use of energy and water.

Hydrocyclones

Hydrocyclone packs are the preferred method for separating slurries by size and density. Due to process upsets, cyclones may plug or develop what is known as a “roping” underflow condition. Whenever a cyclone is roping, the separation process degrades and large amounts of coarse material flow through the cyclone overflow to the flotation circuit. When plugging occurs, the process stops altogether and all material ends up in flotation. In either case, recovery is compromised.

CEI is piloting solutions that use vibration to characterize the cyclone and identify the onset of process upsets such as plugging, roping, apex wear, vortex finder wear, as well as the detection of ore fractions from the overflow. Cyclone advanced control will improve the use of water and energy, provide more consistent liberation, and will result in more efficient and effective downstream processing.

SAG Mills

SAG mills are the heart of the primary grinding circuit in a mineral processing plant. Its energy efficiency and throughput significantly impact the overall economics of a grinding-flotation mineral processing plant. Implementing dynamic control and optimization of its operation is desired in the industry.

Our R&D challange is to develop technology that combines non-invasive sensors, intelligent information systems, and control algorithms that dynamically control the operation of SAG mills. This approach is based on modelling the energy profile within a mill and continuous adjusting the internal load for the most efficient grinding conditions.

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