

## Codelco Improves Production with Honeywell's Profit Controller



“Honeywell’s expertise and technology have yielded tangible improvements in our overall production processes. We went into the upgrade scenario expecting that the implementation of Honeywell’s advanced automation system would permit our operators to redirect their focus to other activities that would improve our overall productivity. What we never expected, however, was how our operators’ immediately accepted this change. This has led to a significant improvement in production.”

Arturo Barría, Automation Leader, Andina Mine, Codelco

### Benefits

With Honeywell’s Profit<sup>®</sup> Controller in place at two mine locations, Codelco has been able to make substantial improvements in its automation technology. These upgrades have been performed in a consistent fashion across both sites with an overall plan in place to implement identical changes as part of a company-wide initiative that would improve production results at all Codelco mines. The most visible and immediate improvements made possible by Profit Controller include:

- The patented robust feature of the controller means the controller responds well under differing conditions and stays on control maximizing response and optimizing the process. In addition, the ability to easily add multiple process variables results in a controller that is able to monitor and control to the majority of process changes. This minimizes the need for operator intervention and insures the controller is highly utilized, thus providing more opportunities to regulate and optimize operation.
- Significant production increases and elevated process uptimes based on the ability to rely on dependable automated processes.
- A single performance ratio is now possible for each controlled variable to adjust the desired control response independently from the other controlled variables. The result is a more intuitive and productive approach than setting multiple tuning factors on expert rules or regulatory controls.
- Aside from the basic “one-knob” controller tuning for normal operation, a patented technique allows for the controlled response of feed-forward inputs to be tuned independently as feedback inputs. This permits aggressive feed-forward disturbance rejection without introducing any instability in controller feedback.

- With objective optimization, both linear and quadratic objective functions are deployed to permit a variety of optimization strategies to be implemented. Application variables can be maximized, minimized or specified as desired targets that will be honored under optimization conditions.
- A powerful product value optimization scenario allows entering process economics directly into the controller. As a result, a true economic optimization of the process is achieved.

### Background

Codelco (Corporación Nacional del Cobre de Chile) a state-owned company headquartered in Santiago, Chile, Codelco is the world’s largest producer of copper with an estimated 200 years of reserves. Codelco produces 21 percent of world’s annual volume of copper with its principal production being 99.99 percent pure copper cathodes. Codelco also ranks among the world’s leaders in the production of rhenium and molybdenum, two side products from mining copper.

### Challenge

Codelco’s copper mine in Andina, Chile, is located high in the Andes Mountains, about 150 kilometers northeast of Santiago. To maintain the highest levels of productivity possible, Codelco officials were seeking to implement advanced process control (APC) technology at the facility to increase production volumes and raise uptime in its copper grinding process.

El Teniente, located 80 kilometers south of Santiago, is the largest underground mine in the world. For more than two decades, Honeywell technology and engineers have played integral roles in the high levels of operational efficiency achieved there.

In the search for a technology partner to improve the automation control systems on its concentration plants, management at Codelco looked all over the world to evaluate different automation suppliers. Finally, Codelco selected Honeywell to create a joint venture named Kairos Mining.

### Solution

In December 2006, Codelco first implemented Honeywell APC technology at its Andina mine. Honeywell was chosen due to its strong history of providing Codelco with more than two decades of proven onsite technology deployed by a knowledgeable team of experts.

In an effort to create a uniform set of systems and procedures across all of its mining operations, in June 2007 Codelco replicated the details of this operation at the El Teniente mine.

After engaging with Honeywell through Kairos Mining, the APC projects were delivered on time and on budget at both mines. "At the Andina mine, we had not worked with Honeywell until this APC project," said Arturo Barría, automation leader for Codelco's Andina mine. "Since our initial engagement, we continue to work together with Kairos Mining as our main automation provider."

Plant operators have shown enthusiastic support for the implementation of Honeywell's Profit Controller, which was adapted using process knowledge from Andina plant operators and engineers. As evidence, they use it more than 90 percent of the time. There is no longer a need to run their processes in manual mode in order to maintain full control.

Based on Honeywell's patented Robust Multivariable Predictive Control Technology (RMPCT), Profit Controller is a multivariable control and optimization application for complex and highly interactive industrial processes. The comprehensive package delivers all the essential tools needed to design, implement and

maintain multiple applications so that they deliver maximum economic benefits.

Codelco is so satisfied with the improvements made possible by Profit Controller that top management has endorsed using Profit Controller on its semi-autogenous (SAG) grind mill, where the plan is to integrate with the downstream process and automate that unit to become optimized across the entire facility.

"Codelco's relationship with Honeywell is great and longstanding," said Barría. "At the El Teniente mine, we are working with Honeywell as a team—not as customer and vendor."

An example of how this relationship has grown and solidified reflects in how Honeywell continually brings new ideas to Codelco, such as the suggestion to use Honeywell's APC remote monitoring service. Honeywell provides remote monitoring of the APC at the different Codelco sites and then reports on APC Key Performance Indicators (KPIs) at the sites to ensure good APC performance. Codelco relies on Honeywell's broad expertise to track and analyze how well the APC is running at the different mines. As a result, Codelco then can compare APC efficiency across its entire operation, making sure the various mines are producing at their maximum outputs.

With Honeywell's industry-specific expertise and field-tested portfolio of products, Codelco is successfully operating one of the first applications of multivariable predictive control in the world for copper SAG mills, and certainly the first one in Chile. Other mining companies in the future will be able to use the knowledge developed at Codelco because similar services will soon be sold through Kairos Mining.

"We have utilized other advanced technologies, but have only experienced poor results," said Barría. "The innovations pioneered by Honeywell represent a large part of our new automation program and the early returns look like a big winner."

### More Information

For more information on Honeywell's advanced process control solutions, visit [www.honeywell.com/ps](http://www.honeywell.com/ps) or contact your Honeywell account manager.

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