

## upfront

PROCESSING by Marta Samuel

# Mine-to-mill mastery

## Antamina boosts throughput for hard ores with support from Metso PTI

Courtesy of Compañía Minera Antamina



Samples were taken at all steps of the comminution process.

The ore body that Compañía Minera Antamina has been mining in Peru since 2001 contains two principal ore types: copper-molybdenum ores and much harder copper-zinc ores, which exist at about a 70:30 ratio. Historically, the copper-zinc ores were processed far slower than the copper-molybdenum ores, so it was clear that something needed to be done. A collaboration with Metso Process Technology and Innovation (PTI) was born in 2007 to optimize the entire comminution process, from drilling and blasting, to crushing and grinding.

“The objective was to see how we could increase the throughput of the copper-zinc ores,” says Ed Rybinski, process area manager for Antamina’s production optimization program. Before 2007, the copper-molybdenum ore had a throughput of 4,100 tonnes per hour, and the copper-zinc ore had a throughput of 2,800 tonnes per hour.

### Road trip

Before beginning optimization work in Peru, Rybinski and Frank Dávila, drill and blast general foreman from Antamina, accompanied Metso PTI vice-president Walter Valery and other Metso PTI employees on a visit to Newmont’s Batu Hijau operation in Indonesia, where Metso PTI had done extensive work. Batu Hijau’s optimization was conducted using the same approach that was to be applied at Antamina – what Valery calls “mine-to-mill,” which relies heavily on collecting data and detailed analysis to gain a full understanding of the ores and processes. “We thought Batu Hijau provided a good opportunity for Antamina to see the results of the project and discuss the process with the Newmont personnel,” says Valery. Like Antamina, Batu Hijau had enlisted Metso PTI to help decrease the difference in throughputs achieved when treating hard and soft ore types. And also like Antamina, the goal was achieved by tailoring the blast design for the different ore types to provide consistently fine run-of-mine (ROM) fragmentation.

Rybinski says he was convinced that working with Metso was the right thing to do before going to Indonesia. “The objective of the visits was to get some hands-on information about how the projects were managed, what they thought were the keys to success, or the possible paths to failure, to help us develop our project,” he recalls. “I was impressed that people from many areas – concentrator operations, metallurgy, drilling, blasting, geology and others – were all talking about mine-to-mill. It was not just one person running a project in isolation. It was critical to get buy-in from concentrator and mine, and from various levels of the organization, to ensure continued success for the program.”

Metso’s mine-to-mill process is a “structured methodology,” according to Valery. That means although mining operations and the changes needed to optimize them vary from site to site, the methodology of the optimization process remains consistent.

### More bang for your buck

The collaboration between Antamina and Metso PTI began to take shape on site in Peru in early 2007. The team began by auditing Antamina’s drilling and blasting practices, as well as auditing and sampling the crushing and grinding circuits. This helped them develop models that



Courtesy of Compañía Minera Antamina

Antamina's harder copper-zinc ore before and after the mine-to-mill optimization

would reveal what each step was achieving, and what could be tweaked to improve performance. “We were on site at Antamina on a number of occasions,” says Valery. “We benchmarked how they were operating the mine and the processing plant. We calibrated our models and then we ran a very large number of different scenarios of operating strategies in the mine and the plant.” This involved Metso’s in-depth review of existing blasting designs and comminution circuit operation.

As in all mine-to-mill optimizations conducted by Metso PTI, the ore was categorized into groups of varying hardness. Blasting practices were audited and blast fragmentation was measured, which made it possible to benchmark existing practices in the mine, and to define the main constraints related to wall stability and control, ore dilution and environmental aspects.

Once the team created site-specific models for the entire comminution process, it became evident that they would find the largest potential gains in improvements to the blasts. The basic idea was to increase the powder factor – using more explosives to create finer ROM fragmentation – so that downstream equipment like the crusher and SAG mill would have less trouble treating the copper-zinc ore.

In the drilling process, they decreased the drill pattern (burden and spacing) over time – from 7 m x 8 m to 6 m x 7.5 m and finally to 5.5 m x 6.5 m. By maintaining the same type and amount of explosives in each drill hole, the corresponding blast powder factor rose from 0.35 kg/tonne to 0.43 kg/tonne and finally to 0.54 kg/tonne. In addition, switching to electronic detonators proved to be more reliable and ensured blasts went off according to plan. A number of changes were also made to the crusher, SAG and ball mill cir-

cuits to ensure the benefits from the blasting changes were realized for the overall process.

Metso cooperated with Antamina’s geologists, drill and blast engineers, and metallurgists in the plant. “We wanted to make sure that what we were implementing was approved by them and that we were all moving towards the right direction together,” said Valery. Metso staff offered internal workshops and training programs for Antamina staff, and they worked together to collect necessary data, understand the current operating practices and build collaboration with the different groups.

### Serious improvement

As of 2011, Antamina was processing copper-zinc ores at an average rate of 4,400 tonnes per hour; up 60 per cent from the performance prior to 2007. The copper-molybdenum ores also saw a more modest increase to 4,800 tph. Three main factors allowed Antamina to achieve such large throughput improvements:

- Mine-to-mill optimization work with Metso PTI, which increased throughput by 30 per cent
- Projects led by Antamina in the concentrator (including the installation of a pebble crusher and modification to pulp lifters), which increased throughput by 10 per cent
- Reduction in hardness of the copper-zinc ores, which increased throughput by 15 per cent

Having done mine-to-mill optimizations at other sites, the 30 per cent increase associated with the optimization of the drill and blast and comminution circuit operation was one of the biggest gains Valery has seen. What is more, those gains were accomplished without the purchase of additional drills, and the same downstream equipment before the optimization was still being used. “There has been a huge increase in revenue for us because that’s additional copper-zinc that we’re now producing in the mine,” Rybinski explains.



Courtesy of Compañía Minera Antamina

Optimizing comminution at Antamina was a team effort.

Overall, staff at both companies were pleased with the results, and for the most part, the process went smoothly. Of course, operating costs increased somewhat at the mine, but the gain in throughput more than paid for the increased cost of more explosives and the drilling and blasting that were required. According to Valery, those expenses were paid back within weeks.

“We wouldn’t have been able to do this if the guys on site at Antamina and their operations weren’t on board,” points out Valery. “If they didn’t embrace it and if we didn’t have good support from the top, it wouldn’t have succeeded.” **CIM**

*Compañía Minera Antamina and Metso Process Technology and Innovation were awarded with the 2012 Coalition for Eco-Efficient Comminution Medal for their work together.*