GLOBAL MINING REVIEW

JANUARY/FEBRUARY 2024
VOLUME 7 ISSUE 1

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SEEING THE BIGGER PICTURE

Miguel Valenzuela, Dyno Nobel Americas, examines how adopting a broader perspective can optimise mill throughput and boost profits.

In today's mining industry, getting the most from a mining operation's performance to reduce costs and increase production must go beyond individual processes; a broader view of the entire value stream is needed. However, what is the best way to go about it?

Dyno Nobel's Drill to Mill™ initiatives take optimisation beyond explosives and blasting, combining expert insight with its range of products to provide real solutions throughout the mining process.

In a recent project, Dyno Nobel implemented a Drill to Mill initiative that helped a large metals mine gain US$58.1 million in added value over a single year and optimise their operation for years to come.

Background: Identifying value-driving opportunities

A surface metal mine identified an opportunity to improve mill throughput for their hard ore as a significant value driver. Several rock types posed a challenge to mill throughput, due to their hardness and grindability characteristics. The mine plan showed that the tonnes of the rock types classified as hard ore would increase significantly throughout the next several years,

so the mine engaged Dyno Nobel to execute a Drill to Mill initiative with a focus on increasing the fines percentage (particularly the -0.5 in. size fraction) going to the SAG mill circuit by 10%, through improved and optimised blasting practices.

Figure 1. Baseline material.

Figure 2. Optimised material.

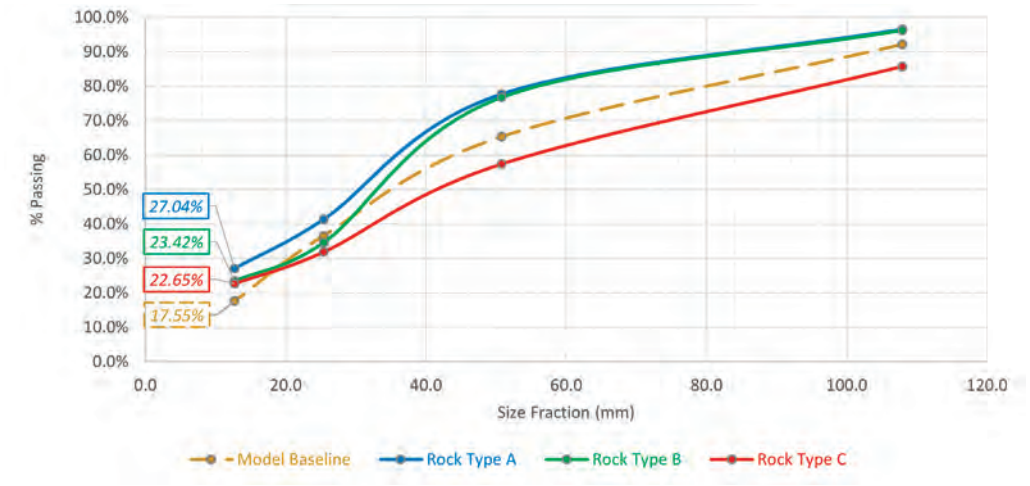

Figure 3. Drill to Mill optimised blast results vs. baseline weighted average PSD by rock type.

Mill modelling showed that even the slightest improvement in the -0.5 in. size fraction reporting to the mills would significantly improve overall mill throughput, thereby adding value to the operation in pounds of copper produced. Dyno Nobel's 'Beyond the Bench' approach views the entire mining process from drill to mill as a value stream, with small changes in drilling and blasting contributing to large value-adds by the time the blasted material reaches and is run through the processing circuit. In a partnership with the customer, Dyno Nobel deployed its people, processes, and technology and executed a Drill to Mill initiative. This yielded significant value to the operation over the past year, with continued value added for several years to come.

Project goals: Improve mill throughput by increasing fines percentage

The primary goal for this project was to improve mill throughput for their hard ore by increasing the mine's fines percentage in the -0.5 in. size fraction. In order to achieve this goal, Dyno Nobel would examine the entire mining process in a Drill to Mill initiative to identify areas for improvement, optimise drilling and blasting, and ensure the desired results were met.

Process: Outcome-based fragmentation using Drill to Mill

The Drill to Mill process has four steps: 1) Baselining, 2) Analysis, 3) Optimisation, and 4) Control and Measure. During baselining, rock characteristics were collected from geologic data along with current customer drilling and blasting designs. Blasted material was gathered from the hard ore and then stockpiled and screened to establish the baseline particle-size distribution (PSD) curve for each material type of interest. Photo fragmentation analysis was also performed during this phase.

With the baseline established, the initiative moved to the analysis phase. Several Dyno Nobel fragmentation models were calibrated using the baseline PSD data and then re-run at different design parameters to optimise the fragmentation in each rock type, targeting an improvement in the -0.5 in. size fraction. The site then chose the design they wanted to use to start the optimisation phase.

Blasts were executed at the new optimised design over several months during the control and measure phase. A second round of sampling, photo analysis, and screening concluded the control and measure phase and were used to measure the results of the optimised blasts compared to the baseline. Mill modelling was then re-run with the

new optimised blast PSD curve to predict mill throughput improvements. In addition, current and historical mill throughput data was used to verify the throughput improvements predicted by the mill modelling and achieved throughout the initiative.

Technology and processes applied: Drill to Mill and Dyno Nobel products

TITAN® 5000G emulsion with DIFFERENTIAL ENERGY^2 (ΔE^2) technology was used for all of the Drill to Mill blasts. The ability to vary emulsion density from hole to hole, as well as vertically within each individual blasthole, allowed Dyno Nobel to place the explosive energy where it was needed most. The DigiShot® Plus 4G Commander electronic initiation system allowed for safe, accurate, and precise blast initiation, with the sequence designed specifically to optimally fragment the rock type blasted.

The Drill to Mill process for this customer was structured to optimise drill and blasting, collect baseline data before making changes, gather results after optimisation, compare and validate the data gathered, initiate discussions with the customer to help them continuously improve, and ensure that the optimisation scenarios implemented were sustainable long-term.

Outcome

Using the Drill to Mill process, the site achieved and exceeded its mill throughput goals for the first time in its history. Changes to burden and spacing, explosives density, stemming length, blast initiation timing, and priming practices produced measurably better rock fragmentation, particularly in the targeted -0.5 in. size fraction. Conservative estimates by the customer show a minimum of a 15% growth in mill throughput by increasing the -0.5 in. size fraction by approximately 5% to nearly 10% over the course of the year.

Based upon the customer's calculations, the Drill to Mill process over the past year showed a monetised value-add to the operation of US$58.1 million. Additional downstream benefits in truck and shovel cycle times, bucket fill factors, extended GET and shovel rope wear, crusher power consumption, and mill power consumption are anticipated.

By gathering the data throughout the Drill to Mill process, several future opportunities for optimisation were discovered. The primary focus of the Drill to Mill initiative at this site moving forward is to continue to optimise fragmentation in the other rock types identified as hard ore, and use customer Smart Drill data to optimise pattern loading. The Dyno Nobel hardness algorithm and DIFFERENTIAL ENERGY^2 technology will be used to take advantage of available drilling data and further optimise energy distribution throughout every blasthole in a shot.

By optimising the entire value stream rather than focusing on single processes, Dyno Nobel's Drill to Mill initiatives are changing the way mines approach their goals, including production, costs, and overall performance. GMR