# CASE STUDY

# DRILL TO MILL™ PROJECT ADDS $58.1 MILLION FOR METALS MINE BY OPTIMIZING MILL THROUGHPUT

## 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 tons 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 -1/2” size fraction) going to the SAG mill circuit by 10% through improved and optimized blasting practices.

Mill modelling showed that even the slightest improvement in the -1/2” 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 yielding 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 -1/2” 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, optimize drilling and blasting, and ensure the desired results were met.

## AT A GLANCE

**$58.1 MILLION IN VALUE ADDED**

**15% INCREASE IN MILL THROUGHPUT**

**5-10% INCREASE IN -1/2" SIZE FRACTION**

### CHALLENGE

- Increase mill throughput by increasing -1/2" fines percentage

### SOLUTION

- Execute a Drill to Mill initiative to analyze and optimize blasting to increase the -1/2" size fraction and overall mill throughput

### OUTCOME

- Up to 10% increase in -1/2" size fraction
- 15% increase in mill throughput
- $58.1 million in value added

***We hit new throughput milestones at the concentrator in the second half of the year, averaging above 100% met table rates consistently for the first time ever.”***

**-Site General Manager**

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## PROCESS

### OUTCOME-BASED FRAGMENTATION USING DRILL TO MILL

The Drill to Mill process has four steps: 1) Baselining, 2) Analysis, 3) Optimization, 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 optimize the fragmentation in each rock type, targeting an improvement in the -1/2" size fraction. The site then chose the design they wanted to use to start the Optimization phase.

Blasts were executed at the new optimized 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 optimized blasts compared to the baseline. Mill modelling was then re-run with the new optimized blast PSD curve to predict mill throughput improvements. In addition, current and historical mill through put data was used to verify the throughput improvements predicted by the mill modelling and achieved throughout the initiative.

## TECHNOLOGY & PROCESSES APPLIED

### DRILL TO MILL AND DYNO NOBEL PRODUCTS

TITAN® 5000G emulsion with DIFFERENTIAL ENERGY² (ΔE²) technology was used on 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 optimize drill and blasting, gather baseline data before making changes, gather results after optimization, compare and validate the data gathered, initiate discussions with the customer to help them continuously improve, and ensure that the optimization scenarios implemented were sustainable long-term.

## PRODUCTS/ TECHNOLOGY & SERVICES USED

- DYNOCONSULT + DRILL TO MILL
- TITAN 5000G + ΔE²
- DIGISHOT PLUS 4G COMMANDER

*Baseline Material Fragmentation*

*Optimized Material Fragmentation*

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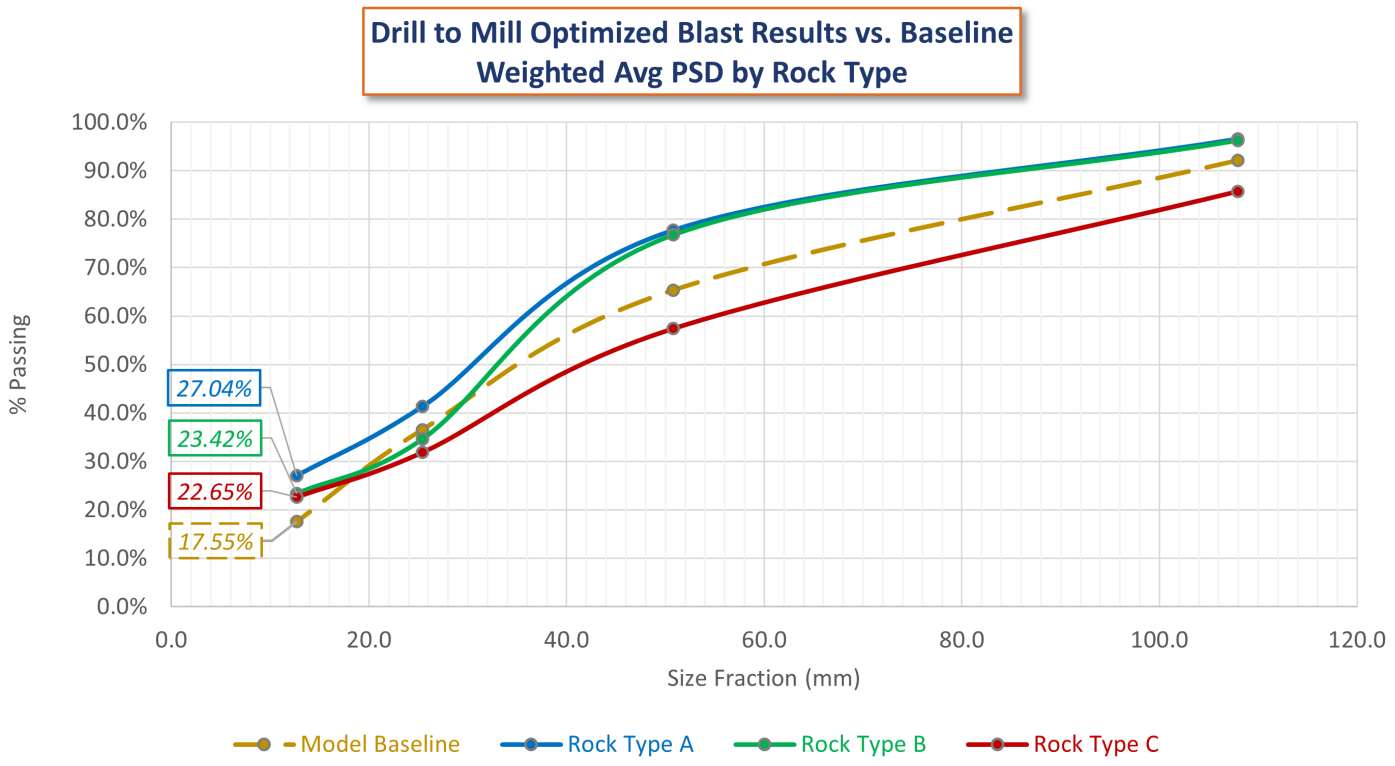
## VALUE ADDED

### 15% INCREASE IN MILL THROUGHPUT FOR $58.1 MILLION IN VALUE ADDED

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 -1/2" size fraction. Conservative estimates by the customer show a minimum of a 15% increase in mill throughput by increasing the -1/2" size fraction by ~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 monetized value-add to the operation of $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 optimization were discovered. The primary focus of the Drill to Mill initiative at this site moving forward is to continue to optimize fragmentation in the other rock types identified as hard ore and use customer Smart Drill data to optimize pattern loading. The Dyno Nobel hardness algorithm and DIFFERENTIAL ENERGY² technology will be used to take advantage of available drilling data and further optimize energy distribution throughout every blasthole in a shot.




*Optimized Blast Results vs. Baseline*



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