DIFFERENTIAL ENERGY® drives efficiencies in Australian conditions

Project Background

DIFFERENTIAL ENERGY® IN AUSTRALIA

Dyno Nobel introduced the DIFFERENTIAL ENERGY (ΔE) bulk delivery system into the Australian market in 2018. The first trials of the system took place in July 2018 at a Western Australian gold mine and was later demonstrated at an iron ore mine in the Pilbara.

Both demonstrations proved successful and the customer subsequently approved extended trials in order to validate the system on several mine sites. These trials commenced during the last quarter of 2019.

Project Goals

ADDING VALUE THROUGH TECHNOLOGY

The goal of the trials was to prove how the system can add value throughout the entire mining process.

A successful result would show positive impacts to a customer's value chain such as:

- Increased payloads and delivery rates
- Reduction of overall powder factors
- Ability to tailor specific energy placement within a single blasthole
- Detonation characteristics over that of traditional bulk products and delivery systems.
- Improved fragmentation

Technology Applied

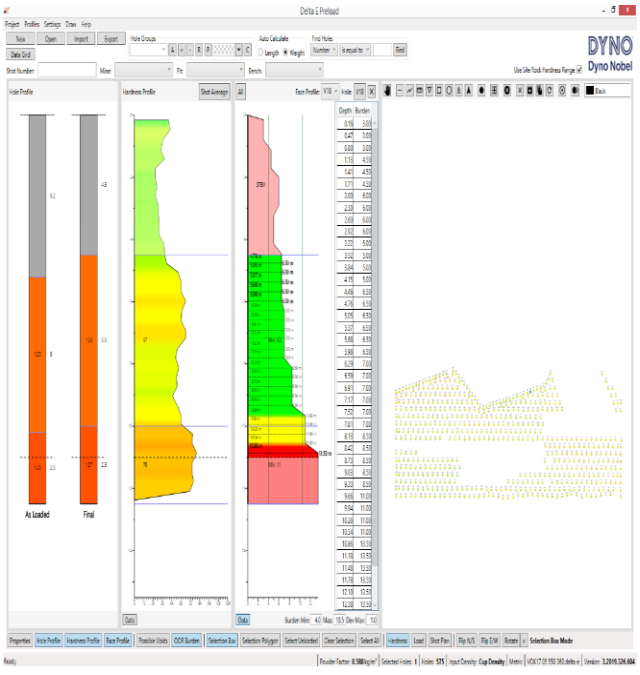
BENEFITS OF DIFFERENTIAL ENERGY

Dyno Nobel's DIFFERENTIAL ENERGY technology provides the Australian mining industry with a unique bulk emulsion loading system.

This innovation aims to increase process efficiencies and productivity, while allowing for blast optimisation to aid in reduction of total mining unit costs.

DIFFERENTIAL ENERGY TECHNOLOGY

ΔE technology is a 100% emulsion product and delivery system, with the ability to alter the emulsion density, in real time within individual blastholes through End of Hose Gassing (EOHG) technology as shown below.



The system can load up to four distinct segments in each blasthole in a single pass. Measurement While Drilling (MWD) data is captured and set to a specific energy requirement using ΔE^2 software, to optimise design with the required energy placement in each blasthole. The aim is ultimately to improve the overall blasting outcomes.

DYNO Dyno Nobel

Groundbreaking Performance

DIFFERENTIAL ENERGY® drives efficiencies in Australian conditions

Value Added

PROCESS EFFICIENCY GAINS

Pumping rates reached up to 1,000kg/minute from the delivery system.

When combined with the increased payload of the MPU, this resulted in productivity gains of up to 30% when compared to standard MPUs and products.

PRECISION LOADING TO DESIGN

Together the ΔE^2 software and on-board controller afforded greater precision while delivering product down-hole.

Data such as; hole number, collar coordinates, product quantity loaded, and product densities are captured and can be downloaded at the end of every load or the end of every shift. This allows for precise reconciliation of all products that have been loaded into the blast pattern.

MULTIPLE SEGMENT LOADING

Multi-segment loading of up to three segments were achieved in a single pass through the applications encountered.

Any combination of density segments can be accommodated, such as low density at the toe and higher densities nearer the collar region or vice-versa. When matched with MWD data, the ΔE^2 software allowed a targeted energy placement according to each hole hardness profile for this project.

INCREASED PRODUCT DELIVERY SPEEDS

Pump rates of 1000kg/min were achieved while delivering explosives into wet, dry and reactive ground conditions.

LOW DENSITY EMULSION DELIVERY

ANFO equivalent densities (0.70g/cc open cup) at pump rates of 900kg/min through conventional gassing methods were achieved. Validations down to 0.85g/cc (open cup density) were also achieved through EOHG, with work underway to further lower achievable densities using this methodology.

Increases to dig rates between 3-10% were achieved when compared to the equivalent blasts with standard products.

Improved dig rates were in some cases achieved, with a reduction on powder factors.

Complex ground conditions with hard and soft banding that had previously seen large variances in dig rates, achieved more consistent and increased production rates.

HIGH VELOCITY OF DETONATION (VOD) READINGS

High order detonation of the product was achieved with VoD recordings measuring velocities in excess of 6,000m/s.

These higher velocities resulted in an increased detonation pressure created in the blasthole, up to 3.6 times greater than that of ANFO. Increased detonation pressure improved fragmentation results, and at a rate even lower than standard powder factors.

ZERO NOX EVENTS

Over 5,000tonnes of product was loaded, including in areas that typically produce fume such as those with high water levels or low hole confinement.

In all cases, there have been no reports of post blast fumes (NOx). The higher viscosity of the ΔE product assists in maintaining explosive column integrity and efficient detonation.

Trial Highlights and Future Work

MATCHING ENERGY REQUIREMENT TO GROUND CONDITIONS

Initial utilisation of MWD data with the ΔE^2 software to match individual hole densities to the ground hardness profiles, and place the right energy in the right place, saw reductions in unit costs while improving blast performance.

Further validation and utilisation of this technology is planned in upcoming trials and site conversions.

This will be done through multiple in-hole density segments which will continue to increase the benefits achievable with the Differential Energy system.