Using Low Density Explosives In Iron Ore Applications

Project Summary

REDUCING THE OVERALL COST OF BLASTING AT IRON ORE MINES

Dyno Nobel developed BlastLite® and TITAN® as cost effective solutions for blasting weak to medium strength rock in Iron Ore mines.

The key to BlastLite lies in its ability to form a homogeneous blend without the need to use an emulsion matrix as a binding agent. The result is a low density explosive (LDE) of high weight strength compared to existing LDE products, offering a powder factor reduction compared to ANFO of around 25 per cent in the process.

TITAN BlastLite is based on a standard inhibited explosive formulation and has been developed as a solution for blasting reactive ground. Customers are enjoying savings of up to 35% in explosives consumption.

Both these products have the potential to significantly reduce powder factors and, therefore, the overall cost of blasting.

Background

COST EFFECTIVE SOLUTIONS FOR BOTH NON-REACTIVE AND REACTIVE GROUND

A customer in the Pilbara wanted to reduce the overall cost of blasting weak and/or highly fractured materials without impacting on blast performance or production rates. Dyno Nobel recognized that LDEs had the potential to satisfy their requirement. Most LDEs that are available for non-reactive ground are based on bulked-out versions of emulsion based explosives. The emulsion matrix is employed to make the mixture sticky, which is necessary to minimize segregation of the explosive.

However, adding emulsion can off-set the benefit of lowering the density. The challenge was to produce a low-density product for use in non-reactive ground that also had a positive impact on costs.

Reactive ground conditions, on the other hand, require special, approved explosives that inhibit the reaction between the pyritic ground and ammonium nitrate.

These explosives are based on high ratios of emulsion to ammonium nitrate prill, which promote a physical barrier between the prill and the reactive ground.

The challenge was to produce a low density product using bulking agents and inhibited emulsion explosive that had both a low density and a resistance to reactive ground. Dyno Nobel built on its previous experience with emulsion blends for reactive ground conditions to develop a new, low density reactive ground product.

Technology Used

RIGOROUS PROCEDURES FOR PRODUCT TESTING

Dyno Nobel's product protocol requires all products to be blasted in pipes at the R&T test site prior to being fired in the ground. Velocity of Detonation (VoD) provided important information on the performance of each explosive. A ShotTrack™ was used to measure VoD.

High-speed video recording was employed to enhance post blast analysis and the Modular Mining Dispatch system was used to provide information on instantaneous dig rates.

For the reactive ground solution, Isothermal and DTA tests were used to measure the low temperature reactivity of mixtures of reactive ground and low density ammonium nitrate based explosives. The isothermal test, developed by Dyno Nobel, is the closest representation to the actual conditions found in the field, where sulphide-containing ores are in contact with ammonium nitrate based explosives.

DYNO
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Groundbreaking Performance

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Large-scale field tests (bucket tests) were used to assess ground reactivity with ANFO and low density ammonium nitrate based explosives. A pH and oxidation/reduction potential assessment of the reactive grounds was also undertaken.

Project Goals

ACHIEVING OVERALL COST REDUCTIONS AND ENHANCED SAFETY LEVELS

The main project goals were to:

1. Satisfy a customer's need
2. Reduce the overall cost of blasting
3. Develop a product for non-reactive ground that is superior to existing LDEs in terms of performance and economics
4. Develop a product that can achieve the safety of working with reactive ground conditions through the development of explosive formulations best suited to the most reactive ground
5. Develop a product that meets Dyno Nobel's strict safety criteria for blasting the most reactive materials.

Value Added

ACHIEVING FINANCIAL AND NON-FINANCIAL BENEFITS

Safety and Productivity Gains

Dyno Nobel's low density explosives enhance safe blasting practices in reactive ground conditions. Using the Dyno Nobel delivery system, products can be manufactured and delivered as efficiently as ANFO direct to the blasthole.

BlastLite reduced ammonium nitrate consumption by 45% compared to an equivalent volume of ANFO.

TITAN BlastLite delivered a 45% reduction in ammonium nitrate consumption compared to an equivalent volume of TITAN 5050.

Savings in Blasting

Both of these products are in full-time use at customer's mine sites in Western Australia and are delivering significant savings over traditional products.

Blast Performance

Low density explosives offer:

- Improved explosive distributions in the
- Blasthole (increased charge length from reduced density), while maintaining low powder factors.
- Increased charge length, without increasing powder factor, results in greater uniformity of fragmentation and reduces the need for decking.
- There is a greater ability to compensate for drill pattern – ground mismatch – when the ground is easier to blast.
- As low density explosives produce less shock energy, there is less damage to final walls when utilized in trim blasts.
- Blasting efficiency is enhanced through a reduction in total quantity of explosive energy required to move less competent rock masses.