UNDERGROUND CASE STUDY

Electronic Detonator Technology Induces Breakthrough in Cave Propagation

PROJECT SUMMARY

PRECISELY CONTROLLED FIRING DELIVERS ADDITIONAL ORE

Harmony Gold Australia's South Kal Mines owns the Mount Marion Mine, which is located 55km southwest of Kalgoorlie in Western Australia.

Production is approximately 45,000 tonnes of ore per month at an average grade of 4.4 grams per tonne. Operations are divided into east and west zones.

Stoping in the mine's western zone began in November 2005. The time frame for steady caving to commence was uncertain and, until caving commenced, less than half the ore fired was being recovered.

Dyno Nobel's innovative solution enabled by the much greater flexibility, accuracy and communication capability of electronic detonators, was to fire out a section of the Western Zone's hanging-wall to increase the unsupported span.

Site management evaluations showed that payback was possible even if caving did not begin immediately, as controlled firing would allow additional ore to be mined.

PROJECT GOALS

IMPROVED RECOVERY THROUGH DYNO NOBEL'S EXPERTISE

The key objective was to improve recovery from the mine's western zone by propagating the cave.

This had to be carried out within the constraints of a producing gold mine, which was located immediately above the current stoping operations.

An advantage of Dyno Nobel's blast design was that minimal development was needed, helping to ensure low costs.

As drilling vertical holes was potentially risky and would delay stope production, the decision was taken to use shallow angled drill holes, up to 90 meters long, to hold the explosives.

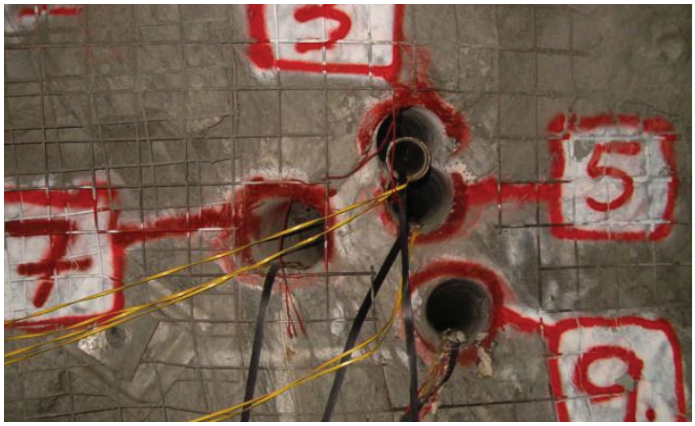
This was the maximum length allowing effective removal of drill cuttings.

Dyno Nobel's design minimised the number of detonator connections in the hole and at the collar, while providing redundancy.

However, connectors had to withstand being dragged along the length of the holes and being covered in emulsion for up to four days.

Two detonator trains were used in a direct 'toe to collar' in-the hole firing sequence, with safety primers spaced 10 meters apart.

The preferred solution was to fire all holes in a single blast, as staged detonation could risk damaging holes and prevent the charging of later blastholes.



Collars of charged 90m holes.

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TECHNOLOGY APPLIED

ELECTRONIC DETONATORS AND TITAN® 7000 – ROBUST AND CAPABLE

Performance of Dyno Nobel's gas sensitised TITAN 7000 emulsion was confirmed using a 165mm diameter, 12-metre test hole drilled at 35 degrees above horizontal.

This was loaded with gassed emulsion, but not primed, and after two weeks the emulsion was still intact with no slumping. A special 100-metre hose was manufactured for the bulk emulsion delivery vehicle.

Results demonstrated the electronic detonator system's robustness and TITAN 7000 emulsion's strong adherence capabilities. The successful blast used over seven tonnes of TITAN 7000 emulsion and 46 detonators.

Over four days of charging there was no emulsion slumping. The electronic detonator system allowed the charged holes to be retested every morning, confirming the integrity of the detonator trains.

The electronic detonator system performed extremely well.

Despite dragging connectors and leads up to 90 meters in the hole and having up to 12 connectors immersed in emulsion for up to four days, there were no communication errors or leakage.

VALUE ADDED

REDUCED PRODUCTION COSTS AND INCREASED ORE RECOVERY

The results were excellent. Electronic detonation successfully induced caving.

An immediate increase of seismic activity after the blast indicated that caving of the Mount Marion Mine's Western Zone had commenced.

Dyno Nobel's innovative solution helped to reduce production costs and extend the economic life of the mine.

Effective design controlled vibration and debris, enabling drill and blast activities to be carried out with minimal change to mining operations.

Benefits included reduced potential of air-blast and lower risk of possible delays to production in other parts of the mine.

Using electronic detonation substantially increased ore recovery, with production rates returning to levels not seen for over two years.

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