Electronic vs Pyrotechnic Detonators

Presented by Philipa Lamb

RedBull Powder Company Ltd
Overview

- **Background**
- **Methodology**
- **Case Studies**
- **Conclusions**
Background

Historic Review of Scatter

- Safety Fuse 1 meter
- Electric Detonators
- Pyrotechnic Detonators
- First Generation Electronic Delay Detonators

Log Scatter (ms)

10000
1000
100
10
1
0.1

Methodology - First Example

Probability and Consequence

Inter Shot Interval (ms)

Relative Rock Response

Relative Electronic Timing Probability

66% Confidence Interval for Pyrotechnic

Relative Pyrotechnic Timing Probability

Relative Effect
Methodology - Second Example

Probability and Consequence

Relative Rock Response

Relative Electronic Timing Probability

66% Confidence Interval for Pyrotechnic

Relative Pyrotechnic Timing Probability

Inter Shot Interval (ms)

Relative Effect

Probability and Consequence

Methodology -- Second Example
Methodology Conclusion

- **Electronic detonators improve timing accuracy:**
  - Increases fragmentation
  - Improves production rates
  - Increases overall efficiency

- **Stock inventory decreases, as any delay time can be chosen**
Case Studies using Electronic Detonators

Manukau Quarry, Auckland - Basalt Quarry
- Controlling Vibration

Reliable Way Quarry, Auckland - Basalt Quarry
- Controlling Vibration

Martha Gold Mine, Waihi, New Zealand - Open Cast Gold Mine
- Controlling Vibration and Increasing Production

Trapper Coal Mine, Colorado, USA - Open Cast Coal Mine
- Controlling High Wall Stability
Manukau Quarry, Auckland
Basalt Quarry

- **Aim**
  - To control vibration while blasting next to main highway and archeological site

- **Result**
  - Vibration levels controlled through use of explosive decking and timing optimisation
  - Production levels maintained

- **Conclusion**
  - Significant improvement in vibration control through the use of electronic detonators
Reliable Way Quarry, Auckland
Basalt Quarry

- **Aim**
  - Maintain production levels while complying to vibration limits of 5mm/s (PPV)

- **Methodology**
  - Delay optimisation for vibration control
  - Sequential delaying of explosive decks within each blast
Reliable Way Quarry, Auckland
Basalt Quarry

Delay Sequence of Explosive Decks within a Blast

0ms 350ms 140ms 245ms 210ms 595ms
70ms 175ms 35ms 105ms 280ms 420ms 385ms
Reliable Way Quarry, Auckland
Basalt Quarry

- **Results**
  - Production blasting achieved to within 35m of quarry boundary
  - Frequency channelling improved the public perception of blasting

- **Conclusion**
  - Extended the reserves of the quarry through the use of electronic detonators
Martha Gold Mine, Waihi, New Zealand
Open Cast Gold Mine

- **Aim**
  - Increase predictability of vibration
  - Improve fragmentation
  - Improve mining production
Results

- Charge masses per hole doubled
- Blast size increased from an average 70 holes to a maximum of 1300 holes
- There was a five fold increase in production on the North Wall
Martha Gold Mine, Waihi, New Zealand
Open Cast Gold Mine

- **Results**
  - Oversize percentage decreased by 50%
  - Mine production improved 8%
  - Excavator efficiency increased by 17%

- **Conclusion**
  - Mine converted to electronic system
Trapper Coal Mine, Colorado, USA
Open Cast Coal

• **Aim**
  - To improve the stability of high walls
  - To improve cast, fragmentation and dragline production

• **Methodology**
  - To use the flexibility of electronic timing to reduce the vibration that affects the high walls stability
Trapper Coal Mine, Colorado USA
Open Cast Coal

• **Results**
  - High walls stable where previously pyrotechnic presplit had failed
  - Improved fragmentation

• **Conclusion**
  - Mine converted to electronic system
Case Study Conclusion

- Electronic systems have been successful at the four sites discussed

- Electronic Delay Detonators have:
  - Improved production rates
  - Improved overall efficiency
  - Minimised vibration
  - Improved fragmentation
  - Improved face conditions
  - Increased safety
Conclusive Benefits of Electronic over Pyrotechnic Detonators

- Significantly improved cost efficiencies and output
- Electronic detonators have extended the life of quarries and mines
- Greater flexibility for blast design
- Despite higher unit cost of electronic detonators production output and cost efficiencies more than offset this cost.
- True comparison of cost is not of using an electronic system, but rather not using one!