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A STUDY ON VARIOUS SURFACE BLAST INITIATION SYSTEMS

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Abstract - *Initiators are indispensable in blasting system as without these, explosives cannot initiate. There is an important evolution in initiation systems that is electronic detonators, it took two decades to invent the electronic initiation system but it provides greater safety and security even if it is expensive. The concept of electronic initiation system is presenting itself as a challenge to traditional initiation systems. Precision of electronic detonators are more compare to the pyrotechnic detonators. Electronic initiation system prevents ensuing dilemma in inter hole blasting or row-to-row blasting of blasting pattern. The accuracy of delay timings in between the hole to hole or row to row delays are revolutionized by the electronic initiation systems. There are more benefits by using Electronic Delay Detonators such as improvement in fragmentation of rocks, reduction of ground vibration, reduction of air over pressure and back break. The wireless initiation systems are new technologies in mining industries, constructional and underground tunnels. The wireless initiating system includes the software and hardware of the underground and surface initiation control unit and for initiation control process. The wireless communication encrypted with in the control unit to initiation system. The remote wireless initiation system developed network security technology. In the present study it was observed that electronic detonators having more benefits compare to the conventional detonators.*

Key Words: ***Electronic detonator; Pyrotechnic detonator; Precision blasting; Timing accuracy; Wireless initiating system.***

INTRODUCTION

Mining industry is the backbone for the development of any nation. Mineral resources can be extracted by two methods namely underground mining and surface mining. In both the case extraction of mineral is done by loosening the material. Surface mining is the most popular method of ore excavation worldwide. Drilling and blasting are the major operations involved in the ore extraction process. Drilling is the process of making a hole into a hard surface and Blasting is the process of loosening and reducing the size solid body with the help explosives. Blasting is the most energy efficient stage in the comminution system and in mining the basic aim is to achieve maximum extraction of minerals keeping in view the environmental, economic and lease constraints. Conventional blasting operations includes drilling holes, placing a charge and detonator in each hole detonating the charge, and clearing away the broken material. In the blasting operations initiation system plays an important role to do effective blasting. Initiation systems require initial energy source, distribution network to deliver the energy to each blast hole and in-hole component to initiate a detonator-sensitive explosive. Detonators are initiators without which blasting cannot commence as hot spots required firing an explosive charge are created by these devices. Detonators are one of the critical components in the complex blasting systems that provide a delay mechanism between holes and rows in a single blast. As a general rule, before you choose an initiation system, you should familiarize yourself with numerous site-specific factors like controlled and uncontrolled parameters of blasting. In this paper an attempt has been made to study different initiation systems used in surface mines, this study will help in designing the appropriate blasting scheme for the particular blast.

DIFFERENT TYPE OF INITIATION SYSTEMS

Detonator: A detonator is a small copper or aluminum tube containing essentially a small auxiliary charge of special explosive.
Ordinary electric detonator: Ordinary electric detonators are of instantaneous, i.e., without any delay element. These are fired by passage of electric current through the detonator.
Electric detonator: A device containing primary explosive that is used for initiating detonation in another explosives material and uses direct electrical energy from the device's leads.
Delay detonator: it is an electric detonator with a delay element.
Nonel: Nonel is a shock tube detonator designed to initiate explosives.
Electronic detonator: a tool containing primary explosive that's used for initiating detonation in another explosives material and utilizes a computer circuit and/or micro processing technology.

An initiation system provides the initial energy required to detonate an explosive used for rock blasting. Initiation systems require:

- An initial energy sources.
- A distribution network to deliver the energy to each blast hole.
- An in-hole component to initiate a detonator-sensitive explosive.

Initiator is a term used in the explosive industry to describe any device that may be used to start a detonation or a deflagration. In order to choose the right initiation system for a blasting operation, certain considerations, ensuring safe and effective blasts, must be taken into account.

DETONATORS

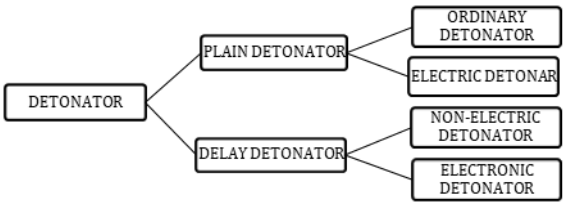

Fig 1: Classification of Detonator

Ordinary Detonator

It consists of an aluminum tube, 6mm Dia, 32 to 50 mm long, 0.3mm thin section of aluminum tube. This tube consists 0.25 gms base charge tetryl (trinitro – phenyl – methyl – nitramine). The base charge covered by prime charge on top, the prime charge contains mixture of lead Azide and lead styphnate with small amount of aluminum powder (ASA) in quantity 0.35 gms. These are fired with the help of safety fuse.

Electric Detonator

Electrical detonator consist of Copper or Aluminum tube of 6 mm Dia and 32 to 53 mm length and the tube is made up of thin plate with a thickness of 0.3 mm. Inside the tube there are two parts namely base charge and prime charge the Pentaerythritol tetranitrate (PETN) is the main charge it will act as a detonating medium. The base charge is at the bottom and it is covered with the priming charge or top charge. The prime charge contains Lead Azide, Lead Styphnate and small amount of aluminum powder known as ASA. The opening side of the detonator is closed with a neoprene plug, this plug contains two leading tin coated iron wires or copper wires of 1.8 m or more length outside the detonator another end of the wires connected to the fuse head.

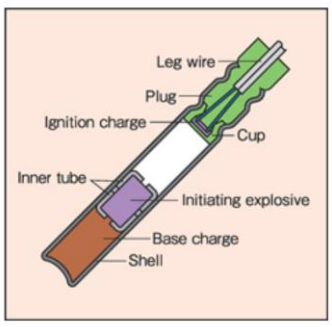

Fig 2: Electric Detonator

Nonel

Non electrical detonator is a flexible tube made with plastic of 3 mm diameter. The PETN (Pentaerythritol tetranitrate) present in the form of gas, it presents inside the tube which helps to transfer the shockwave and one end of the tube is fitted with non-electrical delay detonator. This is crimped to it and the other end is sealed, the end having detonator is connected to explosive cartridge and it is lowered into the hole and the sealed end is projected on top of the hole. The VOD of nonel is 2000 m/s.

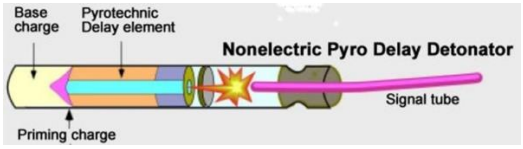

Fig 3: Non-Electric Detonator

Electronic Detonator

The electronic detonator made of integrated micro chip with pre-programed or post programmed software. The electronic detonator is most developed and advanced initiation system. Wireless initiation system is a new/novel technology for unmanned blasting.

It gives an accurate delay time and precision in blasting operation. Increased security and safety are possible by using these detonators and capability of blasting management.

Fig 4: Electronic Detonator

Wireless Electronic Detonator

The system includes wireless in-hole primers which are initiated by a firing command that communicates through rock, water and air. Unlike traditional "wired" systems where a firing command travels from the blast box through harness wire and into the detonator, this system communicates with the in-hole primer via Ultra Low Frequency signals called Magnetic Induction.

Elements of electronic detonator blasting system:

Programmable electronic detonator – MICRODET – 1, Micro logger – for assisting delay timing to Microdet -1, Bus wire – for connecting all the holes in the shot, Micro tester – for checking the circuit once the holes are connected, Micro blaster – device for firing the holes charged with Microdet – 1.

The benefits of electronic delay detonator:

1. Electronic delay detonators provide certain unique safety benefits. Because all Electronic delay detonators receive their firing command at the identical time, at which era the interior clock of every electronic delay detonator starts ticking (down the hole), it implies that the chance of the initiation lines being bring to an end, some other consequences like misfires can be eliminated.

2. Vibration levels, fly-rock and noise are better controlled with precise and programmable firing times.

3. Fragmentation, in terms of average size and size distribution, is more controllable and may be either increased or decreased. the quantity of oversize, undersize and unwanted fines can even be reduced.

4. Better control of vibrations and back-break damage allows for increased slope stability. Not only does this reduce the danger of slope failures, it actually allows for steeper slopes, deeper pits, a discount within the amount of waste rock to be mined and extends the economic lifetime of a mine.

5. The actual fact that electronic delay detonators are programmable allows for flexibility. It allows the timing to be adjusted at any stage to suit the actual circumstances.

DIFFERENCES BETWEEN ELECTRONIC DELAY DETONATORS AND CONVENTIONAL DETONATORS:

- Electronic delay detonators typically have an accuracy of between 0.5 and 1.0 milliseconds (ms), which is about 50 times more accurate than pyrotechnic delays.

- Two attributes, namely firing time precision and programmability over an oversized time range at very short delay intervals giving the blast engineer literally thousands of delay periods to decide on from which distinguish systems from other initiation systems.

- During the planning of the timing of the electronic delay detonators, there are two important aspects, namely the speed at which the blast wave travels through the rock, and therefore the rock latent period. within the design of deck charges a 3rd parameter becomes relevant, namely the rate of detonation (VOD) of the explosives.

- The undulation speed and rock time interval are derivatives of the opposite rock characteristics, like rock density, rock strength and rock elasticity. These parameters are, therefore, indirectly taken under consideration. Only Electronic delay detonators allow effective provision for these parameters within the timing design.

CONCLUSIONS

Blasting is the one of the major operations in the mining industry and the efficiency of the blasting is depends on various parameters in which, the initiation system is important parameter which effects the performance of blasting. In this paper an extensive study was performed on various types of blast initiation systems and the following points are concluded:

1. Electronic delay detonators having more unique safety benefits when compare to other type of initiation systems.

2. Vibration levels, fly-rock and noise are better controlled with electronic delay detonators.

3. As electronic delay detonators are programmable so that it is flexible and it allows the delay timing can be adjusted at blast site.

4. The wireless system allows to perform the blasting operation without wires so that the overall cost of the blasting can be minimized.

Moreover, some disadvantages are also associated with electronic delay detonator like technical issues in programming, cost, and also more time is consumed at the blast site to program the delay system. Hence some improvements are recommended to avoid the negative impacts on the initiation system.

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