ISSN: 2643-6876

DOI: 10.33552/CTCSE.2019.04.000589

Current Trends in Civil & Structural Engineering

Iris Publishers

Mini Review

Controlled Blasting in Mines & Quarries- A Paradigm

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Received Date: December 09, 2019

Published Date: December 18, 2019

Introduction

In blasting, explosive is a reactive substance that contains a great amount of potential energy that can produce an explosion if released suddenly, usually accompanied by the production of light, heat, sound, and pressure. If used properly, explosive can be a useful tool, benefited for mankind. However, it can also cause disastrous effects and huge destructions to human lives and surrounding environments. One of the most useful ways of explosive usage is for rock breakage. Since after the invention of black powder, explosives are extensively used for breaking of rocks. In mining and civil engineering construction projects, till this date, blasting with commercial explosives is the cheapest and easiest method of rock breakage throughout the world. However, there are various safety issues related to rock breakage using explosives. The most common safety concerns and undesirable side-effects in case of rock breakage by blasting are ground vibrations, fly rock, noise, air and dust pollutions. Vibration, noise and fly-rock problems create great socio-economic problems for the mine management as well as for the people residing in the vicinity of the mine. Such hazardous circumstances can efficiently be handled through pre-occupational planning and their subsequent implementation in order to enhance efficiency, economy and environmental safety. Modern opencast mines are in general larger and deeper than the earlier operations, giving rise to a higher percentage of overburden requiring greater blasting in the area. Solutions to these problems call for in-depth understanding of the basic parameters involved in the process of blasting, to ascertain the basic features of generation, propagation and prediction of ground movements. In underground coal mines, the possibility of methane and coal dust explosions are another safety problem to be considered. Based on the degree of gassiness, several guidelines and standards have been framed by the Directorate General of Mines Safety (DGMS), India for solid blasting using permitted explosives. Another important application of blasting in underground coal mines is hard roof management in the depillaring panels. Induced caving of the overhanging roof-rock, blasting has been practiced in many mines which encountered hard and difficult roof to cave. By conducting induced caving by blasting, the occurrence of air blast in underground depillaring panels can be avoided. Caving of roof can also be controlled for safer extraction of coal.

Controlled Blasting

The term 'controlled blasting' has two senses of meaning and applications. In one sense, controlled blasting means controlling of ground vibration, fly rock and air overpressure (noise) within safe limit. On the other hand, controlled blasting means minimization of over-break and under-break beyond the boundary of the excavation area. The first one is generally applied when blasting operation is to be conducted near residential structures/buildings or another sensitive environment. The latter is applied both in surface as well as underground to obtain smooth and stable final excavation wall. Proper selection of blast design parameters and systematic blasting operation is crucial for controlled blasting operations. Blasting operation in ecologically fragile hilly areas requires special attention to their effects on the surrounding environment. A sudden change in the geometry of the rock mass along with blast-induced ground vibration may lead to slope stability problems. Fly rock and throw of blasted materials downwards the valley sides may endanger nearby habitant located at the foothill and close by areas. Air blast (noise) and ground vibration generated from blasting operation could scare the fauna of the area causing birds and wildlife to migrate to other areas. All these problems can be tackled amicably, if the blast design is made meticulously, explosive is chosen properly, and safety-concerns are dealt with proper care and guidance of experts working either at the same mine or from outside agency.

Emerging Areas of Blasting

The emerging areas of rock blasting require special attention for overcoming various blast-related problems and help minimizing litigation and overall cost of blasting, hauling, time-cycle.

Air-deck blasting

A controlled contour blasting method where an explosive column is combined with an air chamber. Wooden spacers and gasbags are generally used for air-decking. It has become an increasingly popular technique in production and presplit blasting.

Blast casting

It is a blasting method used for maximum overburden rock displacement and throw in surface coal mining so that with less hauling the underlying coal is exposed.

Coyote Blasting (shooting)

A method of single round large-scale blasting in which substantial amount of explosive charges are fired in small audits or tunnels driven, at the floor level, in the face of a quarry or slope of an opencast mine or even in small hills. It is used where it is impractical to drill holes vertically.

Non-electric and electronic blasting

For precise and large-scale production blasting these detonating devices are used in mines and quarry blasting.

Plasma blasting

It is a non-chemical explosive means of rock fragmentation in which an electric probe, situated in a borehole and surrounded by a highly conductive and gelled electrolytic solution, is fed with a very high capacitance discharge.

Segregation blasting

To extract thin coal bands inside the overburden rock, segregation blasting technique is used, which encounters the difference in densities of coal and overburden and their impact sensitivity at different energy levels so that when the composite medium is blasted, coal and overburden are separated and thrown away at different distances.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.