



Flyrock phenomena and area security in blasting-related accidents

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Abstract

In both the mining and construction industries, blasting is the predominant method for fragmentation of consolidated mineral deposits. The blasting process, however, remains a potential source of numerous hazards to people and surrounding objects. This paper presents the results of the research study on flyrock phenomena and blast area security related accidents in surface mining. The study revealed that a total of 45 fatal and 367 non-fatal accidents in coal, metal and non-metal surface mines had occurred between 1978 and 1998 where the primary causes were the lack of blast area security, flyrock, premature blast, and misfires. The lack of blast area security and flyrock accounted for 281 (68.2%) accidents. Investigations of flyrock accidents have revealed one or more of the following contributing factors: discontinuity in the geology and rock structure, improper blasthole layout and loading, insufficient burden, very high explosive concentration, and inadequate stemming. The study also shows that accidents due to lack of blast area security are caused by failure to use appropriate blasting shelter, failure to evacuate humans from the blast area, and inadequate guarding of the access roads leading to the blast area. The research results should have a positive impact on hazard awareness, prevention, and safe blasting practices in mining and construction industries. © 2005 Elsevier Ltd. All rights reserved.

Keywords: Blasting; Fragmentation; Mining; Flyrock and area security; Accidents; Prevention

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1. Introduction

The main purpose of blasting operations in surface mining is the rock fragmentation, and is considered to be essential to the success of mining operations. This process provides appropriate material granulation that will be suitable for excavation and transportation. According to the [US Geological Survey \(2000\)](#), the US coal, metal and non-metal surface mining industry uses almost 1.8 billion kilograms of explosives annually. Between 1989 and 1999, surface coal mines have used 16.2 billion kilograms and 3.3 billion kilograms have been used in non-metal mines and quarries ([Kramer, 2000](#)).

The blasting process, however, remains a potential source of numerous hazards. Even though the mining industry has improved its blasting safety, there are still reports indicating blasting-related accidents involving both people and various structures. Investigations carried out by the Mine Safety and Health Administration ([MSHA, 1994](#); [MSHA, 1999a,b](#)) provide clear evidence regarding the severity of these accidents. [Figs. 1 and 2](#) show the fatal and non-fatal blasting accidents from 1978 to 1998 for coal, metal and non-metal surface mining ([Verakis and Lobb, 2001](#)). A total of 45 fatalities occurred

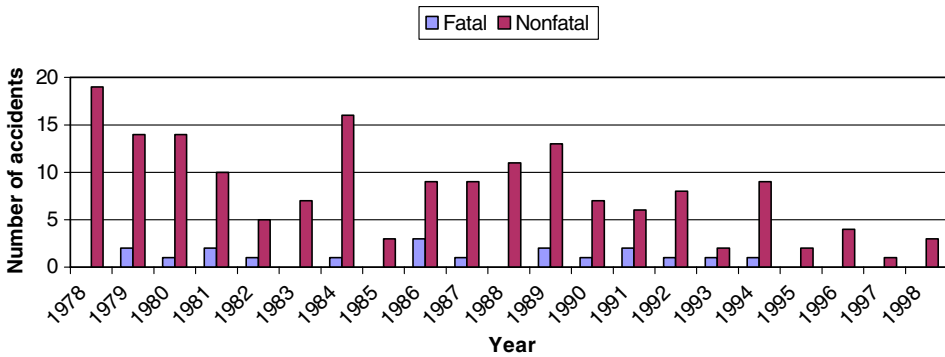


Fig. 1. Number of fatal and non-fatal blasting accidents in coal surface mining.

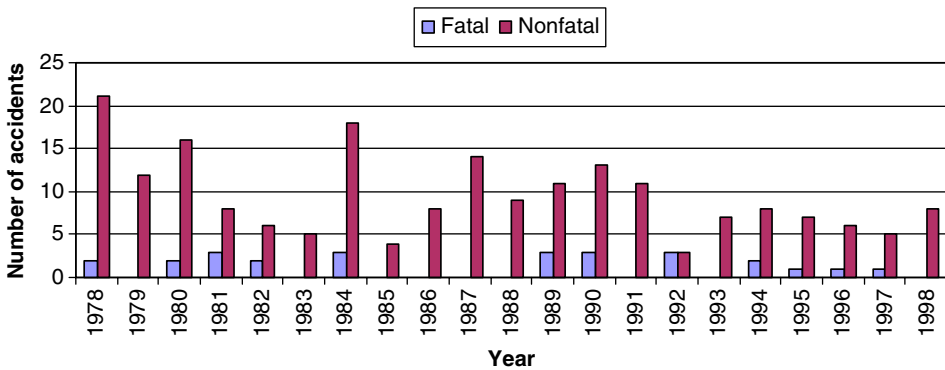


Fig. 2. Number of fatal and non-fatal blasting accidents in metal and non-metal surface mining.

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