Blast management plan for opencast mine adjacent to underground colliery

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ABSTRACT

The paper deals with a systematic study of large-scale coal mine blasting operations in open-pit and its influence on underground colliery. Sixteen blasting trials with varying explosives weight and initiation sequences were conducted at Samleshawari open-pit mine and eighty four blast vibration data were recorded in the Hingir Rampur underground colliery in India. These involved multi-seam coal mine workings. The number of holes detonated in a blast round varied from 16 to 242 and their depth varied between 4 m and 14 m. The amount of explosives detonated in a blast ranged between 800 kg and 37260 kg, with explosives weight per delay varying between 100 kg and 6140 kg. The depth of cover between underground vibration monitoring locations and open-pit blasting face varied between 105 m and 174 m. The recorded peak particle velocities varied widely (e.g. 1.3 mm/s to 172 mm/s in the roof, and 0.7 mm/s to 64 mm/s in the pillars). Analysis of vibration data showed that the roof of the underground openings vibrated with up to 4.3 times the amplitude of those in the pillars and the floors. It was also observed that coal chips detached from roof when the peak particle velocity reached 131 mm/s or higher.

Keywords: Blast vibration, Blast frequency, Underground damage, Stability, Underground Safety

INTRODUCTION

The ever-increasing demand for coal has necessitated large open-pit operations and extensive deposits of coal are currently being mined by open-pit mining. Presently, in India about 89 % of coal production is from opencast mining and rest 11% is from underground mining. The optimal recovery of coal from underground mines is limited to 50 to 60 % which also allow a huge reserve in pillars to be left un-mined. On the other hand recovery of coal is nearly 90 % by way of open-pit mining of thick seam coal. Underground mining of thick seam coals is an international problem in mining. This makes open-pit mining as a preferred choice over underground technology (Singh, V. K., 2010). There are number of situations where open-pit and underground mines are operating side by side. In a few situations the upper seams are being mined out by open-cast mining methods whereas below seams are mined out by underground room and pillar method of mining. The trend is towards larger diameter and higher benches. These blasts generate significant seismic vibrations, which may damage the support system, ventilation/isolation stoppings, and water dams in underground workings. They may also induce opening of cracks in the strata rendering them unstable. There is also the possibility that spalling of coal may occur in some adjoining workings which may lead to spontaneous heating over a period of time. The damage potential of the resulting vibrations will depend on the total explosives energy released during the blast and the proximity of the underground workings to operating open-pit mines. The quality of rock in which an opening has been created can have a significant influence on the amount of damage done to it by open-pit blasting. The size of bord (room) and pillars, immediate roof rock and the ages of the underground workings have significant influence in sustaining the damage from seismic loading. The paper deals with a blast management plan carried out at Samleshwari open-pit mine, which is producing 5 Mt of coal per annum. The Hingir Rampur colliery is also in operation beneath this open-pit mine with capacity of 0.7 Mt of coal per annum.

NEED FOR THE STUDY

The objectives of the study was to investigate the impact of Samleshwari open-pit blasting on the stability of the multi-seam workings (seams V, IV and I) of Hingir Rampur colliery and to recommend threshold value of ground vibrations for the safety and stability of the underground workings. It was also decided to establish the best-fit predictor equation to compute the safe explosives weight per delay to be detonated in open-pit blasts to ensure the safety and stability of underground workings. The supports were also to be designed for galleries and junctions to ensure greater safety considering the repeated blast loading from the open-pit operations.

EXPERIMENTAL SITES DETAILS

Samleshwari open-pit mine and Hingir Rampur colliery belongs to Mahanadi Coalfields Limited. In this area, out crop of seven coal seams have been found viz. Hingir Rampur I, II,