INITIATION TIMING INFLUENCE ON GROUND VIBRATION AND AIRBLAST

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ABSTRACT

A major concern with blasting at surface mines is generation of ground vibrations and airblast and their effects on nearby residences. This Bureau of Mines report looks at the use of millisecond delays in blast design and their effect on the resulting ground vibrations and airblast. A total of 52 production blasts were instrumented and monitored at a surface coal mine in southern Indiana. Arrays of seismographs were used to gather time histories of vibrations and airblast. The data were analyzed for peak values of vibration and airblast and for frequency content. Various delay intervals were used within and between rows of blastholes. Delay intervals within rows were 17 and 42 ms, and those between rows ranged from 30 to 100 ms; these intervals are equivalent to burden reliefs of 0.5 and 1.3 ms/ft within rows and 1.2 to 4.3 ms/ft between rows. Subsonic delay intervals within rows reduced airblast by 6 dB. Large delay intervals between rows reduced the amplitude of ground vibrations; vibration frequency depended primarily upon the geology of the mine site.

INTRODUCTION

Millisecond-delay blasting caps were introduced to the mining industry in the 1940's and gained wide acceptance as a tool for improving rock fragmentation. The use of these delays also reduced ground vibration levels. The Bureau of Mines reported on this technique, which allowed the explosive in each delay period to be treated separately in its contribution to the ground vibrations, in 1963 (1).

The Bureau undertook a major research effort during the 1970's to quantify these ground vibrations and their effects on structures (2). Out of this study came the fact that not only amplitude is important in preventing damage, but also the frequency content of the vibrations, because resonances were occurring at the natural frequencies of oscillation of structures. A study was then undertaken at a surface coal mine to determine if the predominant frequency of ground vibrations could be controlled by an appropriate choice of blast delay intervals. This paper summarizes that study, published as RI 9026 in 1986 (3).

During the analysis of the Bureau's coal mine data, another study of delay control of blasting was undertaken by Reil (4) through a Bureau contract. Reil's study in two stone quarries involved precise timing control. Results were mixed with respect to both amplitudes and frequencies; results also appeared to be both distance and measuring site