

INFLUENCE OF BLAST DELAY TIME ON ROCK FRAGMENTATION: ONE-TENTH-SCALE TESTS

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ABSTRACT

The Bureau of Mines is studying blast delay timing influences on rock fragmentation in a series of tests that started in 3-ft concrete blocks and includes reduced-scale and full-scale bench blasts. This paper reports on the reduced-scale tests. In a 45-in-high dolomite bench, 18 single-row blasts were fired with 15-in burdens. Spacings were 21 and 30 in. Delay intervals ranged from 0 to 45 ms, equivalent to 0 to 36 ms/ft of burden. Each shot was instrumented for strain and pressure for both in situ dynamics and interactions between blastholes. All fragmented rock was screened.

The finest fragmentation occurred at blasthole delay intervals of 1 to 17 ms/ft of burden. In this range, stress-wave-induced strains interacted with longer lasting gas-pressure strains from earlier holes. Coarse fragmentation resulted from short delays (<1 ms/ft), where breakage approached presplit conditions with a major fracture between blastholes and large blocks in the burden region. Coarse fragmentation also resulted from long delays (>17 ms/ft), with explosive charges acting independently. The broad acceptable range provides blast design tools for a variety of purposes, including optimum muckpile displacement and vibration control.

INTRODUCTION

The explosives industry is developing and testing delay blasting caps of improved accuracy. Precise delays have been cited as factors in controlling blast vibration amplitude and frequency and improving fragmentation (1-2). However, data on complete fragmentation assessment of shots initiated with precise delays is limited. As part of its blasting research program, the Bureau of Mines is examining the influence of timing intervals by completely screening the blast-induced rock. Three- and four-hole shots have been conducted in concrete blocks in the laboratory and at reduced (45-in bench) and full (22-ft bench) scale in the field. Tests thus far have mostly been concerned with the effect of delay time on fragmentation and on the interaction between shotholes. Initial testing in the laboratory provided an effective means for establishing a methodology of controlled experimentation. The tests at reduced scale in the field provided experience in fragmentation assessment techniques and results that could be used to optimize the expensive full-scale field tests. The full-scale field tests are currently in progress. This paper discusses the reduced-scale field tests and results.