Improved Digability, Reduced Vibration in Truck Shovel Operation

Project Summary

REDUCED VIBRATION ALLOWS MINE TO DISREGARD SCALED DISTANCE LIMITATIONS

The close proximity of both power lines and railroad tracks caused this mine to adopt blast designs that did not result in optimum digging rates for shovels. Use of scaled distance calculations required multiple decking that did nothing to aid in digability while having marginal impact on vibration at key structures. The use of SHA (Signature Hole Analysis) and electronic detonators allowed the mine to dial in optimum timing sequences regardless of the number of holes per delay, resulting in reduced vibration and better digging rates allowing for faster removal of overburden.

Background

PIT ADVANCE REQUIRED CHANGES IN BLAST DESIGN

The advance of this coal pit has moved steadily toward the rail loop that serves the mine. In addition, power transmission lines run parallel to the railroad tracks. Both the railroad tracks and the power transmission lines have imposed vibration limits based on either seismic monitoring or the use of a modified scaled distance formula approved by the state regulatory agency.

As the pit advanced, decking became necessary in order to maintain charge weights that met the modified scaled distance factor. While seismic monitoring was performed for most shots, blast designs were still based on scaled distance.

Multiple decking resulted in increased loading times as well as increased costs for accessories. Decking also required a reduced burden and spacing in order to maintain the desired powder factor. This added significantly to the cost of drilling per unit volume of overburden.

Project Goals

DEVELOPING A TECHNIQUE THAT WOULD ALLOW FOR MINIMIZING THE USE OF DECKED HOLES WHILE MAINTAINING VIBRATION WITHIN DESIRED LIMITS

The decision was made to shoot a series of single hole test shots and utilize SHA in an effort to determine optimal firing times for future blasts. The goal was to develop blast designs and timing scenarios that minimized or eliminated the need for decked holes, allowed for exceeding the modified scaled distance charge weight limit and resulted in recorded peak particle velocity values well within the 5.0 ips restriction in place for both the railroad tracks and the power transmission poles.

Technology Applied

VIBRATION CONTROL SOFTWARE EMPLOYED TO DETERMINE OPTIMUM FIRING TIMES TO BE USED WITH DIGISHOT® ELECTRONIC DETONATORS

A series of single hole blasts was recorded by an array of seismic units. Data from these seismographs, deployed at key locations along the power transmission line right-of-way, was processed and used with the Dyno 42 vibration control software program. Optimum firing times were calculated on a shot by shot basis to determine the best delay sequence to create destructive interference between transient vibration waves radiating from each hole.

Selected firing times were integrated into the blast through the use of both DigiShot programmable electronic detonators and NONEL® nonelectric detonators. The use of derived timing sequences allowed for exceeding the calculated modified scaled distance charge weight limit without risk of exceeding the vibration criteria for the key structures.

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Groundbreaking Performance

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Value Added

IMPROVED VIBRATION AND ENHANCED DIGABILITY ALLOW PIT PROGRESSION TO STAY ON TRACK

Blasts using the new timing recommended by Dyno 42 showed reduced vibration that allowed the mine to disregard exceeding the scaled distance limitations. The use of DigiShot electronic detonators serves to further enhance the ability to create destructive interference within the blast, further reducing vibration.

While the primary objective of this program was to control and minimize vibration adjacent to critical, restricted structures, empirical evidence has shown better cycle times for the shovels leading to faster overburden removal and increasing coal extraction. Eliminating decking resulted in an increase in pattern footage by over twenty percent (20%) effectively reducing drilling costs by unit volume of material.

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