Appalachia Coal Producer Finds Operational Efficiencies in Cast Blasting

Project Summary

OPERATIONAL EFFICIENCIES WITH OVERBURDEN REMOVAL

Using existing technology and experience, the DynoConsult team set out to design, load, and safely initiate a series of large overburden blasts at a coal operation having close proximity off site structures.

Background

PAST VIBRATION COMPLAINTS DROVE THIS CUSTOMER TO LOOK FOR LARGE BLAST ALTERNATIVES

This large coal customer had acquired a permit from an operator who had a history of vibration complaints from nearby neighbors. The mine is located within 100 feet of a highway, 350 feet of an offsite business office, 800 feet from the nearest resident, and has multiple neighbors within 2,000 feet of the blasts. The customer desired to conduct a few large blasts designed to cast overburden into the open pit, thus minimizing the number of blast events. Large cast blast events would reduce the amount of truck hauled material and dozer pushes required to expose the coal seam. The depth of the overburden above the coal seam averaged 73 feet. The drilling equipment available used a 7 7/8" bit.

Project Goals

THE GOAL WAS TO PERFORM LARGE BLASTS WITHOUT DISTURBING THE OFFSITE STRUCTURES

The challenge was the proximity of the offsite structures. The blast would need to be designed to prevent any flyrock, minimize off-site ground vibration and off-site air-overpressure, yet ensuring the percent cast to final percent of the overburden provided a financial value to the customer.

Technology Applied

SIGNATURE HOLE DESIGN, 3D LASER PROFILER, AND OPTIMUM TIMINGS HELP ACHIEVE THE GOALS

A 'signature hole' was initiated and field data analyzed to provide data for the delay design. A series of smaller blasts were conducted adjacent to the planned blasts to verify the vibration predictions of the signature hole design data. To minimize the risk of flyrock and air-overpressure, the bench was profiled utilizing a 3D laser profiler. This information was provided to the blaster to assist in the blast layout allowing adjusted front row spacing based on front row burdens. The design of the first blast was to be 10 rows deep and approximately 40 holes wide. The drill pattern was 16 x 16 to result in the powder factor required to cast the maximum amount of overburden and minimize vibration levels. To minimize air-overpressure, the front row holes were custom loaded and all holes were stemmed with crushed stone to prevent stemming ejection in such a deep, multiple row blast.

Once the blast was drilled and the exact hole information was available, the signature hole design was utilized to develop the list of optimum timings. The list was reviewed and timings were chosen to minimize vibration, yet provide the best timings to result in good fragmentation and relief between rows.

Four seismographs were to be employed in various directions at the nearest residences to monitor the

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resultant vibration levels. In addition, the State was to set up 2 more seismographs to ensure compliance.

Value Added

EXCELLENT RESULTS FOR CAST AND VIBRATION

The 1st blast was 840 feet from the nearest residence (behind the blast) and 1465 feet from the offsite business office. The blast pattern was drilled on a 16 x 16 to be loaded with ANFO. However, heavy rains the night before and during loading required the use of a light blend in most holes which resulted in more pounds per hole and per delay. The blast consisted of 388 holes, loaded with 587,000 lbs. of explosives and DigiShot® initiation system providing a powder factor of 2.1 lbs/bcy. The large number of Digishot detonators and number of rows required three blast boxes to be linked together. The results were excellent with a good percentage of cast, readings at the nearest residence of 0.495 inches per second and at the office of 0.285 inches per second. Air-overpressure levels were within limits at all seismograph locations.

A 2nd blast was layed out adjacent to the 1st blast and designed following the same steps. This blast was a little smaller with 269 holes, 7 7/8" diameter, 73 feet deep and 10 rows of holes. The holes remained dry and were loaded primarily with ANFO, requiring 313,000 lbs. of explosives. Signature hole analysis modeling suggested we use a slightly different delay sequence. This time the DigiShot® Plus system was used so the entire blast could be initiated through one blast box unit. The results were every bit as good as the first blast. The readings at the closest structure, now the business office at 985 feet, were 0.305 inches per second. The readings at the residence, now at 1400 feet were 0.30 inches per second. Again, all air-overpressure readings were in compliance. Cast percentage and fragmentation were excellent with very little back break and material through back.

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