CASE STUDY

INNOVATIVE VIBRATION CONTROL TECHNIQUES UNLOCK $1.82M IN ADDITIONAL REVENUE

15,163 TONS OF COAL RECOVERED

TOTAL VALUE OF $1.82M

BACKGROUND

PIT EXTENTS NEARING CONTROLLED STRUCTURE

DynoConsult was contacted by a surface coal mine for assistance with vibration compliance. This mine is a shovel and dozer operation located within the Illinois Basin with two overburden seams of interest. The top seam is blasted for half of the pit width and dug on the other. The vibration-critical seam is this top seam, with anywhere from 60 to 75 feet of overburden cast off every shot. This area of vibration sensitivity is along a side of the pit extents where multiple structures exist. As of the time of writing, there were five structures being monitored by five separate seismographs. Of these structures, one required vibration control for compliance.

The mine is under constant-monitoring compliance for these structures. This state's vibration limit is held at 1 Inch Per Second (IPS) when blasting to scaled distance compliance, regardless of frequency. The mine had controlled this vibration with decking and number of holes within the shot but was at maximum number of decks allowed. Vibrations were nearing exceedances at over 100 feet farther away than expected, cutting the pit short of full extents. At the time of this project, the customer wanted to maintain sub-1 IPS compliance to allow for full recovery of material as stated by the mine plan.

PROJECT GOALS

MAINTAINING COMPLIANCE FOR FULL RECOVERY

The objective of this project was to stay under a 1 IPS limit using any necessary means to allow for the full pit extent and recovery of saleable material. Increasing decking was no longer an option and the mine was constrained by drill size. Shots were already at the smallest size possible. Thus, a new strategy was needed to promote compliance.

Example of Customer Cast Blast

TECHNOLOGY APPLIED

DYNO42 AND PRE-SPLIT DESIGN

Dyno42 is a proprietary software that utilizes signature hole input and analysis to determine the best optimized timing schemes to minimize ground vibrations in both frequency and peak particle velocity (PPV). Signature hole analysis is facilitated by detonating a singular hole within the same working area as the blast. This hole is loaded to the same specifications (burden, charge weight, stemming, etc.) as the production blastholes. Dyno42 uses the waveform from this singular hole to recreate the total blast vibration waveform that will occur from the production shot using the principle of superposition. In this project, using Dyno42 allowed DynoConsult to analyze various Regular Rhythmic Timing (RRT) delays to determine the lowest possible vibration outcomes. Regular Rhythmic Timing is the utilization of a common delay time (for example 25 ms) between all charges upon detonation, including between decks within the same hole.

DYNO®
Dyno Nobel

CASE STUDY

Pre-Split is a common technique for creating a stable highwall after a blast. Pre-splitting involves drilling out a series of holes in a line along the back of the shot and detonating these holes at a reduced charge weight. Less commonly, it can be utilized to lower vibrations if set between blast and structure. The customer had used pre-split in the past as a means for highwall stability but not as a means for reduction in vibrations at this mine. This technique was implemented along with RRT to provide the highest likelihood of compliance.

VALUE ADDED

DYNO42 AND SIGNASHOT PROMOTE CONTINUED USE OF 2-DELAY BLAST PATTERNS

Since the customer had a site-specific scaled distance law for this particular mine, the results will be presented in comparison to the PPV prediction of said law. Before the implementation of the above strategy, PPVs at the structure in question within this top seam were collected from a period of April 2022 to mid-June 2022. The global average indicated vibrations were 24% higher than what the modified scale distance law predicted. It is important to note that the other monitored structures within this area were within the site-law predictions.

Once this strategy was implemented in mid-June of 2022, results were collected for this same structure in question until the end of July. The results of the complete data collection can be seen in Table 1. The results are aggregated by month from April 2022 to the end of July. Red indicates before strategy implementation; green indicates post-strategy implementation. The global average of results after vibration control measures were put in place was approximately 98% of the site-specific modified scale distance law, a vibration reduction of 26% when controlling for distance and charge weight. There were no instances of vibrations being above the 1 IPS mark when this vibration control methodology was implemented.

Time Period	Vibration
April	128%
May	122%
1st Half June	119%
2nd Half June	98%
July	99%

Table 1. Reduction in vibration compared to modified scaled distance law prediction

Due to the implemented strategy, the mine no longer had to stop short of the mine plan due to blast vibrations. Now that complete coal extraction would go as planned, 15,163 tons of coal could now be recovered again. At the time of writing, a conservative estimate of $120.00 per ton of coal will yield approximately $1.82 million for the mine.

In addition to this recovery, compliance was the utmost goal for the customer to not only continue mining, but to put all neighbors involved at ease. If complaints were being received, the customer would implement a self-imposed change to remedy the situation. DynoConsult aided in maintaining this relationship with the surrounding area. At the time of writing, the mine was on good terms with the surrounding community.