AGGREGATE BLASTING

The Surface-Mined Land Conservation and Reclamation Act was amended in 1995 and authorized the regulation of blasting operations at non-coal surface mining sites. Regulations were promulgated establishing air blast, ground vibration and fly rock standards, training, examination and licensing requirements for persons supervising blasting operations, requirements for maintenance of blasting records and enforcement provisions which give the Mine Safety and Training Division the authority to suspend or revoke blasting licenses, issue notices of violation and/or cessation orders and assess civil penalties in instances of non-compliance.

So why do companies employ blasting at their operations? Below you will find answers to this and other questions related to blasting at Illinois mines.

WHY DO MINING COMPANIES BLAST?

Blasting is the most cost effective way to fracture rock. Therefore, blasting reduces the costs of consumer goods such as electricity, sand, gravel, concrete, aluminum, copper and many other products manufactured from mined resources. The old statement "If it can't be grown, it has to be mined" is still true today.

WHAT EXPLOSIVES ARE USED FOR BLASTING?

Dynamite, a nitroglycerin-based explosive, is rarely used today for blasting at surface mines in Illinois. Blasting agents account for almost 99% of the explosive materials used. ANFO, ammonium nitrate and fuel oil, is the most common explosive. ANFO, pound for pound is as powerful as dynamite and is less expensive per pound and less sensitive to initiation and therefore safer to use.

WHAT IS BLASTING?

Holes are drilled into the rock to be broken. A portion of each hole is filled with explosives. The top portion of the hole is filled with inert material called stemming. The explosive in each hole is initiated with detonators or blasting caps. The detonators are designed to create millisecond (thousandths of a second) delay periods between individual holes or charges. A blast with 25 individual holes will essentially consist of smaller individual blasts, separated by millisecond delays and the entire blast may only last ¼ - ½ of a second. When an explosive is detonated, it undergoes a very rapid decomposition which produces a large volume or expansion of gases, instantly. This expansion of gases is what causes the rock to fracture. The stemming material keeps the gases in the rock to maximize the amount of the energy utilized in the fragmentation process. The delay periods between charges ensures that each hole will only have to fragment the rock immediately in front of it, which enhances fragmentation.

HOW FAR DOES THE FRAGMENTATION EXTEND FROM THE BLASTHOLE?

Small blastholes are usually drilled from 6 to 15 feet apart and large blastholes may range up to 30 feet apart. The fact that holes have to be drilled relatively close together is a good indicator of how far the fragmentation occurs. Even micro-fractures may only extend 40 blasthole diameters away from the blasthole. There is even less fracturing below the blasthole. This is demonstrated at surface coal mines, where only a few feet of rock separates the explosive (bottom of the blasthole) from the top of the coal seam, and protects the coal, which is a relatively weak or brittle rock, from fracturing.

WHAT IS GROUND VIBRATION?

When a blast is detonated, some of the energy travels through the ground as vibration. The ground vibration travels mainly on the surface at varying speeds depending upon the density and thickness of the geology. Although perceptible, the energy level decreases rapidly with distance. To the blaster, vibration represents wasted explosive energy. Blasting accounts for a large percentage of production costs, therefore it is to the operators advantage to maximize fragmentation by minimizing vibrations.

Blasting seismographs measure ground vibrations in terms of particle velocity which is the speed at which the ground moves. Particle velocity is measured in inches per second. The peak particle velocity (PPV) which is not to be exceeded to prevent damage to homes is 1.0 inch per second. Although 1.0 inch per second sounds like a large movement of the ground, it is important to remember that this is velocity of movement and the actual displacement occurring with ground vibrations from blasting is measured in thousandths (0.001) of an inch.

Ground vibrations are mainly controlled by limiting the pounds of explosives detonated per delay interval, as discussed above. For example, a 100-hole blast can be designed to have the same vibration as a 10-hole blast with the same pounds of explosives per hole and at the same distance.

WHAT IS AIRBLAST?

Airblast is a change in air pressure caused by blasting. When a blast is detonated, some of the energy is vented into the atmosphere through the fractures in the rock or through inadequate stemming material. However, the upward or outward movement of the rock from the blast is the main source of airblast. Due to the frequency content, airblast cannot be effectively heard by the human ear. Airblast travels at the speed of sound and can be influenced by wind and temperature inversions.

Airblast is also measured with a blasting seismograph equipped with a special microphone. The most common units to measure airblast is decibels (dB) which is a logarithmic sound-pressure scale related to human hearing. A difference of 6 dB represents a doubling or halving of the airblast energy.

Airblast is controlled by properly confining explosive charges in the borehole. This is accomplished by using adequate stemming material and by not loading explosives into weak zones in the rock. Airblast also represents wasted explosive energy. If the explosive gases escape from the blasthole, there will not be adequate energy to fragment the rock.

HOW ARE HOMES PROTECTED FROM GROUND VIBRATION AND AIRBLAST?

Many scientific studies have investigated the potential of blast vibrations to damage residential-type structures. The conclusions from these studies have been incorporated into DNR's regulations. The blasting activities at all surface mining operations are regulated to prevent threshold or cosmetic damage (hairline cracks) to the weakest of building material. This is best accomplished with performance standards which limit peak particle velocities (ground vibration) and decibels (airblast). This is not to say that blasting limits which are designed to prevent damage will not be annoying to neighbors. Blast vibrations are perceptible to humans at much lower levels; as low as 0.02 inch per second PPV. The level of annoyance resulting from ground vibrations varies from person to person, thus making annoyance limits a poor choice for regulatory programs.

Blast vibrations can be perceptible in a home at great distances from a blast. Structures respond to very low levels of ground vibration and/or airblast. It is interesting to note that the everyday environmental influences on a home, such as doors slamming, kids running in the house, running up and down stairs, pounding nails, outside temperature, wind, humidity and soil moisture changes produce strains greater than legal blasting limits. These everyday activities often go unnoticed due to the fact that they are expected whereas blast vibrations can be unexpected.