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Blasting in Ohio's Quarries and Surface Coal Mines ***(Reproduced from ODNR Citizen Guide to Mining in Ohio – 1999)**

The word "blasting" often conjures up visions of destruction - mushroom clouds, gigantic craters, high-rise buildings collapsing, bridges falling and cars exploding. However, each day in Ohio, nearly half a million pounds of explosives are safely detonated in quarries and surface coal mines. The Ohio Department of Natural Resources, Division of Mineral Resources Management is the agency responsible for regulating the environmental effects of mining and blasting. Some of the commonly asked questions and misconceptions regarding blasting are addressed below.

Q: If there is any structure or water supply damage from mining and/or blasting, who will fix the damages? Who should citizens contact?

A: If structural or water supply damage occurs, the mine operator carries public liability insurance and is ultimately responsible for remediation. In the case of a damaged water supply, the law requires the mine operator to replace the affected water supply. In the case of blasting damage, DMRM may not be able to compel a mine operator to make repairs or compensate an owner for damages. This is often a private matter between the owner and the mine operator. If a property owner believes structural or water supply damage has occurred, DMRM suggests that the citizen first contact the mine operator. If the mine operator's response is unsatisfactory, the property owner may file a citizen complaint by writing to DMRM. DMRM will conduct an investigation and issue a written response. This complaint procedure in no way prevents a person from pursuing any claims as a citizen complaint.

Q: Why is blasting necessary?

Blasting is the most cost effective way to fracture rock so that it can be excavated by earth-moving equipment. This in turn reduces the costs of building materials such as gravel and concrete, energy produced from coal, and many other products derived from limestone, coal and other minerals. **Q: Is dynamite still used?**

People living near quarries and coal mines often express concern about "the dynamiting going on over there." In fact, dynamite, a nitroglycerin-based explosive, is rarely used today in Ohio's quarries and surface coal mines. The most widely used explosive is a mixture of ammonium nitrate (AN) and fuel oil (FO) called ANFO. The ammonium nitrate is in the form of a prill (small, bead-like pellets), which absorbs the fuel oil. ANFO is far less hazardous than dynamite and breaks more rock per unit of cost.

Q: How far do fractures extend from a blasthole?

Blastholes are normally drilled vertically and arranged in a grid pattern. Typical blasthole diameters range from two to seven inches in quarries and five to nine inches in surface coal mines, with typical depths from 10 to 70 feet. Upon detonation, fracturing of rock generally occurs no greater than 20 to 30 feet from any blasthole, depending largely upon hole diameter and the densities of the rock and explosive. A common misconception is that fracturing extends far beyond the mine property - even miles from the blast site. If this were true, the blastholes could be placed much farther apart than the commonly used spacing of six to 18 feet in quarries and 12 to 25 feet in surface coal mines, and blasting would be much more economical since less drilling and explosives would be necessary. Another common misconception associated with blasting is that significant fracturing occurs far below the bottom of a blasthole. In fact, most of the gas pressure forces created by the detonation of the explosive radiate outward along the length of the cylindrical blasthole. Depending upon the hole diameter, type of explosive and nature of the rock, gas-pressure forces below the bottom of the blasthole are comparatively minimal and fracturing of rock is generally limited to several feet. In most surface coal mines, a buffer of only three to five feet between the bottom of the blastholes and the top of the coal seam adequately protects the coal (which is brittle to begin with) from being fractured and contaminated by the rock material immediately above it. Failure to protect the coal from fracturing can increase the cost of cleaning the coal and significantly reduce the mine operator's profits.

Q: What causes ground vibration and how is it measured?

When a blast detonates, some of the explosive energy not utilized in breaking rock travels through the ground in all directions as wave motion, similar to the ripple created in a pond when a stone hits the water. This wave motion, or ground vibration, travels mainly along the surface at speeds of 5,000 to 20,000 feet per second, depending upon the density and thickness of the rock and soil. Its energy level decreases rapidly with distance from the blast and normally decays to levels undetectable by humans beyond several thousand feet. Because explosives are expensive and vibration represents wasted energy, it is to the blaster's advantage to utilize as much of the energy as possible in fragmentation, thereby minimizing vibration.

Blasting seismographs are used to measure ground vibration in terms of particle velocity, which is the speed at which each particle in the ground oscillates as the wave motion passes. This would be similar to measuring the speed of a fishing bobber in a pond as it moves up and down when a ripple passes under it. Particle velocity is measured in inches per second, but beyond several hundred feet from a blast the actual movement of the ground, or displacement, is generally only a tiny fraction of an inch, about the thickness of a piece of paper, or less. So it is important to understand that a particle velocity reading expressed in inches per second refers to the speed at which the ground moved, and not the amount of movement.

Q: How is ground vibration controlled?

Blasters control ground vibration mainly by limiting the weight of explosives detonated within any 8-millisecond period of time. They do this by using millisecond delay detonators (blasting caps) to separate the firing time of each hole from adjacent holes. In a typical 50-hole blast, the result would be 50 smaller and separate explosions instead of one large blast. A common misconception is that the number of blastholes determines the resulting intensity of vibration. However, given the same charge-weight per delay (pounds of explosive detonated within any 8-ms period) and the same distance, a 100-hole blast can be designed to produce no more vibration than a 10-hole blast.

Q: What are the ground vibration and airblast limits?

The United States Bureau of Mines (USBM) conducted extensive research over a 35-year period on the effects of blast-induced ground vibration and airblast on residential structures. This research produced recommended limits, that, if adhered to, will effectively protect residential structures from damage, even if the blasting is repeated on a daily basis over a period of many years. Around 1983, the State of Ohio a modified version of the USBM ground vibration and airblast limits for surface blasting in Ohio coal mines, as required by the federal Office of Surface Mining. In their simplest form, ground vibration must not exceed 1.0 inch per second and airblast must not exceed 133 decibels at a dwelling. And in 2002, the USBM limits were adopted for Ohio quarries. In quarries and coal mine blasting, seismographic monitoring is required if the explosive charge-weight per delay will exceed the maximum allowed by specific formulas, based on the distance to the nearest dwelling.

Q: If the dishes rattle, is my home being damaged?

It is helpful for homeowners to know that when blast vibrations are far below the legal limit, highly perceptible vibration can be experienced inside the home; windows and dishes may rattle, knickknacks and pictures might move or fall if not securely fastened, and hanging lamps might sway. These effects can be generated by ground vibration or airblast acting separately or together, and can last from one to three seconds or more, depending upon the distance from the blast, geologic influences other factors. Despite these sometimes startling effects, there is no direct correlation between how a blast "feels" and its potential for causing structural damage to a home. In fact, cultural stresses (e.g., doors slamming, kids jumping, people pounding nails) and natural stresses (e.sunlight, wind, rain, temperature and humidity fluctuations and changes in soil moisture) can place greater stresses on a home than legal blast vibrations

Q: How can I obtain additional information on the mine subsidence insurance program?

A: Contact your insurance agent or company. You can also contact the Ohio Mine Subsidence Underwriting Association or the Ohio Insurance Institute at:

Mine Subsidence Insurance Underwriting Associations (OMSIUA)
2500 Corporate Exchange Drive, Suite 250
Columbus OH 43231
(614) 839-6446
(800) 282-1772 inside Ohio
(614) 839-2882 FAX
www.ohiominesubsidence.com/

The complete Citizen Guide can be downloaded from the ODNR website at www.ohiodnr.com