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MSHA's Occupational Illness and Injury Prevention Program Health Topic

"Effects of Blasting on Air Quality"

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First!**

At surface and underground mines, miners routinely detonate explosives to break the overburden, coal, ore or host rock into smaller pieces that can be readily transported for processing, beneficiation or disposal. The detonation of explosives generates potentially harmful gases such as carbon dioxide, carbon monoxide, oxides of nitrogen, ammonia, and sulfur dioxide. The gases generated depend upon the composition of the explosive and the material undergoing blasting. Blasting also reduces the oxygen concentration in the air. Breathing contaminated air after a blast may kill a miner in a few minutes. Consequently, miners need to recognize that the atmosphere immediately after explosives are detonated may present a health hazard.

Blast areas must be cleared of smoke, dust and gases before anyone is permitted to enter. Good ventilation sweeps the harmful gases from the area quickly. After blasting is completed, and the area cleared, but before miners enter a blasting area, the area needs to be examined by an experienced and qualified individual. This person will determine if the concentrations of oxygen and the blast gases are at a safe level and do not present a hazard to the miner. Because most gases do not have a distinct odor, taste, or color, the mine management should consider the use of instruments to check the oxygen level and the toxic gas concentrations in blast areas. The gases affect miners in different ways.

Carbon dioxide

After blasting there is an increase in carbon dioxide (CO₂; CAS 124-38-9). Carbon dioxide displaces the oxygen in the atmosphere. At lower concentrations, miners respond by breathing faster and deeper (more lung ventilation). At elevated levels, carbon dioxide causes inattentiveness, sleepiness, and an accelerated heart rate. This impairment may lead to the potential for increased accidents. Also there is the danger that miners with preexisting heart conditions may be severely affected by an elevated heart rate. When the carbon dioxide concentration reaches 3 percent, the lung ventilation rate doubles. A 10% concentration can only be tolerated for a few minutes by a miner at rest. High concentrations of carbon dioxide will asphyxiate a miner.

MSHA has set the exposure limit for carbon dioxide at 0.5% for 8 hours at underground and surface metal/nonmetal and coal mines [with a short term exposure for underground coal mines set at 3.0% for 15 minutes and for metal/nonmetal mines, at 1.5 % for 15 minutes].

Ammonia

Ammonia (NH₃; CAS 7664-41-7) is a colorless, strongly alkaline gas with a strong irritating odor. As the concentration increases, the strong penetrating odor becomes increasingly irritating. Ammonia is absorbed by inhalation, ingestion, and probably through the skin at concentrations high enough to cause skin injury.

Ammonia irritates the eye and causes tears to form. Additionally, ammonia irritates the mucous membranes in the nose and throat. Mild to moderate exposure can produce headache, salivation, burning of the throat, loss of the sense of smell, perspiration, nausea, vomiting, and chest pain. A rare allergic reaction from inhaling ammonia is hives or nettle rash.

Severe exposure can cause death from suffocation or fluid in the lungs (pulmonary edema). With prompt medical treatment most victims recover completely. However, in some cases residual effects, such as visual impairment, decreased respiratory function, and hoarseness, remain.

The MSHA exposure limit for ammonia is 25 parts per million (ppm) for 8 hours.

Sulfur dioxide

Sulfur dioxide (SO₂; CAS 7446-09-5) is a clear gas with a characteristic strong suffocating odor. When inhaled, sulfur dioxide irritates the mucous membranes of the upper respiratory tract. The rapid formation of sulfuric acid on contact with moist mucous membranes explains its prominent biological effect. Chronic effects include dryness of the throat, cough, and inflammation of the mucous membranes in the nose (rhinitis).

Acute overexposure may result in death by asphyxiation. Survivors may later develop bronchopneumonia with bronchiolitis obliterans. After an interval of several days, bronchopneumonia may prove fatal in some people.

Long term exposure to sulfur dioxide may result in inflammation of the nasal passages and upper windpipe (nasopharyngitis), fatigue, altered sense of smell, chronic bronchitis, and shortness of breath, cough, and increased mucous secretion.

The MSHA exposure limit for sulfur dioxide is 5 ppm for 8 hours.

Carbon monoxide

The health effects of carbon monoxide are discussed in [another web article](#).

Oxides of nitrogen

The health effects of oxides of nitrogen will be discussed in another web article.

Oxygen

The oxygen concentration in the workplace air has an affect on the health of the miner (see table). Insufficient oxygen leads to unconsciousness and death. Frequently, before unconsciousness early warning signs are present. MSHA requires the oxygen concentration in areas where miners work or travel to be at least 19.5%.

Oxygen Concentration in %	Associated Health Effects
21.0	None - normal atmospheric value
19.5	None - lowest mine atmospheric value permitted in U.S.
12-16	Disturbed respiration, emotional upsets, abnormal fatigue upon exertion -
10-11	Increased respiration and heart rate, disturbed coordination, some euphoria, possible headache
6-10	Nausea and vomiting, inability to move freely, possible unconsciousness, possible collapse while remaining conscious but cannot move
Less than 6	Gasping respiration; respiration stops followed by cardiac arrest, death within minutes

If you have a tip you would like to pass on, you can e-mail it to zzmsha-MinersTips@dol.gov. If your tip is selected, you will receive credit in this space.