WHITE PAPER

Gas Monitoring in Mines

Ensuring safety from hazardous gases and materials has never been more important than within the harshness of mining environments. With potential hazards from carbon monoxide (CO), methane (CH_4) and oxygen deficiency/enrichment, mining applications are rife with danger. With this in mind those working within them need to be suitably equipped to enter these spaces and work safely.

CROWCON
Detecting Gas Saving Lives

The mining industry is rife with dangers and gas hazards, specifically that posed by methane and carbon monoxide. Carbon Monoxide is a risk within mines during the oxidation process of coal, as well as within the oxidation of wood in pit pros and gaseous methane in the mine atmosphere. If ingested, workers can suffer from the symptoms of CO poisoning, such as dizziness, weakness, upset stomach, vomiting, headaches, chest pain, and confusion. At high concentrations, CO can cause individuals to lose consciousness or worse, cause death.

As carbon monoxide is colourless, tasteless, and has no smell it is even more hazardous for those working in its presence. Although miners can survive the initial effects of a mine fire or explosion, they are still at danger from the risk of carbon monoxide asphyxia.

Methane poses a very real risk in mining applications as it is released directly during the process of coal extraction. The coal removed in the physical process releases the gas which has been trapped within the coal seam and this is then distributed into the air supply of the mine, meaning it can be ingested by the workers within the mine and cause a health and safety hazard.

Mine gas, a natural product, has a number of main elements; these are oxygen, nitrogen, carbon dioxide and methane. Blasting operations used within mines can cause large volumes of carbon monoxide to occur, alongside hydrogen sulphide. Mine gas presents as both a liberated gas, in fissures, and an absorbed gas on the inner surface of coal. When mine gas is released within mining operations a hazard is posed due to its flammability. When it mixes with the air it could cause a fire and explosive risk.

Utilising gas sensing and monitoring equipment provides mining operations a way to ventilate spaces that could become dangerous with concentration levels of methane, with fresh air from the surface. This dilution lessens the risk of explosion.

By monitoring the methane content of the stale air that leaves the mine, the amount of fresh air let in can be appropriately controlled and keep those working within the space safe to carry out their operations.

Health and safety processes in mines, specifically relating to gas detection, have developed dramatically over the past century, morphing from the crude usage of methane wick wall testing, singing canaries and flame safety, to the use of modern day gas detection technologies and processes as we know them.

Methane wick wall testing involved a mine worker wearing a wet blanket and carrying a burning wick. Edging along the walls of the mine the worker would assess the presence of methane from the ignition of the wick. Relying on the sodden blanket to keep them safe, the tester was usually protected from serious harm, however sometimes large pockets of methane caused the entire area to be engulfed in flames. The process for gas detection moved on from using humans as portable detectors, once the industry recognised the inherent danger in this method.

From humans, to animals, the next method for testing utilised the distinctive and noisy chirp of canaries. Recognising their similar breathing capacities as humans, alongside their audibility, workers carried the birds in cages through the mines, keeping them with them throughout the day. When they started to convulse or stopped singing, the team knew that methane was present and they needed to evacuate the area.

Although innovative, this approach was not always reliable and did not indicate fully which gas was present. From there, flame safety lamps symbolised the first gas detection device which didn't involve a human or an animal. Invented by Sir Humphrey Davy in 1815, the lamp utilised an oil flame which could be altered to certain heights to refresh the air in the space.

The flame was held within a wire gauze sleeve which contained the flame and absorbed heat. This method ensured the flame did not ignite the methane and because the miners always started the flame in an area where fresh air was abundant, the team knew that oxygen was deficient in a space when the flame lowered or began to die out. If the flame went higher, they knew both methane and oxygen were present. This ingenious method of detection is still used in many industries today.

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In order to ensure the safety of those working within these dangerous environments, compliance to legal safety regulations is required. The Mines Regulations 2014 are the reference point for health and safety in mines in Great Britain. The mining sector and the safety processes within it are governed in Australia by the Australian Federal Government, however federal involvement in mining regulation is not extensive.

The General Mining Law of 1872 is the primary law in the US which governs locatable minerals on federal lands. In terms of ensuring safety from hazardous gases within mining environments the law requires that a mine operator should provide an MSHA-approved, handheld, multi-gas detector to measure methane, oxygen, and carbon monoxide to each group of underground miners and to each person who works alone, such as pumpers, examiners, and those who are stationed away from the coal face, perhaps somewhere near the shaft. The US law also requires that there is at least one qualified person in each group of underground miners, and those who work alone are trained to use the multi-gas detector. The law requires that all equipment is also properly maintained and calibrated.

Within the EU further legislation is proposed around the prevention of methane leakage in the mining sector, in order to lessen the contribution of methane to global warming. As well as the risk to the environment, as explored earlier, methane leaks are also dangerous to humans and so enhanced legislation, alongside reliable monitoring and detection internally can only further enhance the safety within mining environments.

Although compliance with legal requirements is paramount within the mining sector, there is also an onus on the owners and managers within businesses in the sector to ensure safety processes are in place. This onus is basically commercial accountability, and relates to the way in which businesses ensure the ongoing safety of their workers.

As mining operations are wide-spanning appropriate research is required to ensure the correct type of detection equipment is utilised, whether fixed or portable, within each varying environment. Utilising the correct equipment will make sure gas levels are accurately monitored, and that workers are alerted to dangerous concentrations within the atmosphere at the earliest opportunity.

Personal portable gas monitors, as the name suggests are carried throughout the site as a personal device.

Having explored the dangers inherent in this industry the need for effective, reliable monitoring solutions (that don't rely on a canary's song) is clear. There are a range of fixed and portable devices that mining operations can implement to detect the concentration of gases within the atmosphere.

Fixed gas monitors provide constant readings from a specific location and therefore can be implemented throughout a mine site or building for a cross section of monitoring reports. Site-wide warning systems offer data from a number of areas and can be analysed within a central control room and across the safety network. If abnormalities are detected, automatic alerts and safety measures can be activated to provide safety fall backs, alongside options to remotely shut down an area and isolate hazards.

Personal portable gas monitors, as the name suggests are carried throughout the site as a personal device. This offers versatility and flexibility in use and again if heightened gas levels are detected can activate alert systems, enabling workers within mining environments to take immediate appropriate action.

SMART 3G-Grl is specifically designed for use within mines and tunnels

Sensitron SMART 3-G

Equipping workers with the best in gas detection equipment, and providing extensive training on the way to work with it safely inside hazardous spaces, is an important way to significantly reduce the number of incidents, of toxic gases harming human health, explosions or in the worst case fatalities.

For mining workers who are moving around portable gas detectors will be required to ensure they remain aware of the risks within changing environments. Crowcon's portable range comprises T4, Gas-Pro, Clip SGD, Gasman and Detective+ all of which offer reliable, transportable detection capacities for a variety of gases.

The Sensitron SMART 3-G is specifically designed for use within mines and tunnels, and is employed to detect the presence of flammable and toxic gases in areas classified as Group I. The detector is available with a front display, alongside a four digit back-lit visibility for the gas concentration reading.

It is SIL2 approved and ATEX certified to ensure EHSR and Performance. The detector has non-intrusive calibration, a 5 mode status LED and high visibility multi-colour LED light ring.

To ensure ease of ongoing use the detector has easy sensor replacement and is able to employ Pellistor, Infrared and electrochemical cells depending on the gas being detected. The system includes PL4+, MULTISCAN++S1 and S2. All control panels are ATEX certified according to EN 60079-29-1 available with 8, 32, 64 128 e 256 channels.

For more information about gas monitoring in mines and the detection equipment Crowcon offers, get in touch with a member of our friendly team.