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Toxic Gases in Mining

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ABSTRACT

Rapid detection of causes of mining accidents leading to emergencies is to search the efforts. Controlling fires and gas leaks provides an immediate approach to rescue work for fatalities or injuries and detecting who needs resuscitation outside the mine. Evacuation and recovery operations should be guided by continuous monitoring of the mine environment due to fire and explosion hazards. The main toxic gases in mines are carbon monoxide (CO) and carbon dioxide (CO2); flammable gases are methane (CH4), CO and hydrogen (H2); suffocating gases are CO2, nitrogen (N20) and CH4; and the toxic gases are CO, nitrogen oxides (NOx) and hydrogen sulfide (H 2 S).

***Keywords*--** Toxic Gases, Nitrogen Oxides, Mining, Carbon Monoxide

I. INTRODUCTION

This research project aimed to determine the concentrations of toxic gases in restricted areas, such as those typically found in mines, which is considered a problem of special importance by the mining industry. This challenge is significantly greater in an unstructured underground mining environment, such as a stopes. A mine hole is formed as a result of repeated blasting of hard rock from strategic sides with explosives. After a mine blasting or other mining activities, such as drilling, construction and barriers, underground terrains become restricted, unknown, unstructured and particularly dangerous due to the presence of poisonous explosive gases. Mine gases are highly concentrated and toxic, threatening both the miners' health and the environment, as well as limiting visibility.

1.1 Contents

Mining is an activity that has been developed for many years. Every mining worker has advantages and disadvantages. One of the things that person must take care of is the toxic gases that mines can generate. We must take into account some of these factors such as, for example: consumption of explosives, the use of Diesel Equipment, the number of personnel working inside the mine; all these factors generate gases that in a certain amount can be harmful to health.

II. WHAT ARE TOXIC GASES?

Air is made up of a certain number of gases, including nitrogen, oxygen, hydrogen, etc.To(Office of Environment, 2020): "*Acutely toxic gas (per Globally Harmonized System, GHS) - A gaseous substance or mixture with serious health effects (i.e., lethality) that occur after a single or short-terminhalation exposure*".Obviously, we must work in an updated way with technology, since this will not allow us to have these dangerous situations.

2.1 Nitrogen Oxides

It is a greenhouse gas that, in moderate amounts, cannot cause harm. Additionally,(ToxFAQs, 2002)mention that *"Everybody is exposed to small amounts of nitrogen oxides in ambient air. Higher exposure may occur by burning wood or kerosene or near gas stoves or if you smoke. Exposure to high levels of nitrogen oxides can damage the respiratory airways. Contact with the skin or eyes can causeburns. Nitrogen dioxide and nitric oxide have been found in at least 9 and 6 ofthe 1,585 National Priorities List sites identified by the Environmental Protection Agency (EPA), respectively".*

2.2 Carbon Monoxide

Firstly,(Health): "*CO is found in fumes produced any time you burn fuel in cars or trucks, small engines, stoves, lanterns, grills, fireplaces, gas ranges, or furnaces. CO can build up indoors and poison people and animals who breathe it*". In addition, according to (Okobia, May 2015) cited by (Kaplan 2009) "*... It also has direct effects on pulmonary and non-pulmonary diseases, such as bronchitis, asthma, myocardial infraction, stroke and cancer* ".

2.3 Sulfides

One clear example is *sulfur dioxide (SO2)—a colorless, toxic gas with a sharp odor—is a very water-soluble, acidic gas. SO2 irritates the eyes, nose, and lungs. High concentrations of SO2 can result in temporary breathing impairment. It is both human-generated and naturally occurring.*(Administration, 2011); additionally, *this gaseous emission can damage or deactivate expensive exhaust catalysts in contemporary diesel engines. The transition toward ultralow sulfur diesel fuels (ULSDF) and low-sulfur content lubricants (CJ-4 oil) has promoted*

control over these emissions(Bugarski, J., G., D., & E., October 2011).

2.4 Carbon Dioxide

We all know that the main source of carbon dioxide comes from the burning of fossil fuels;(TSI, 2004)describes that "*Fossil fuels are hydrocarbons, meaning they are composed primarily of carbon and hydrogen. Whenfossil fuels are burned, carbon dioxide (CO2) and water (H2O) are the principle chemical products,formed from the reactants carbon and hydrogen in the fuel and oxygen (O2) in the air*" as well as "*CO_2 toxicity in humans Carbon dioxide at low concentration has little, if any, toxicological effects. At higher concentrations (>5%),it causes the development of hypercapnia and respiratory acidosis. Severe acidosis increases the effects of parasympathetic nervous activity, possibly by interfering the hydrolysis of acetylcholine by acetylcholinesterase, resulting in a depression of the respiration and the circulation. Concentrations of more than 10% carbon dioxide may cause convulsions, coma, and death. CO_2 levels of more than 30% act rapidly leading to loss of consciousness in seconds. This would explain why victims of accidental intoxications often do not act to resolve the situation*" (Permentier, Vercammen, Soetaert, & Schellemans, 2017).

III. METHODS TO CONTROL TOXIC GASES

Science and experience generate novel inventions capable of detecting toxic gases that are detrimental to the health and work of the worker.

- The use of robots to calculate the number of toxic gases in mining is a good tool"*Static and mobile robot sensing nodes provide an electronic "nose" on board, which includes an SD card slot and GPRS capabilities for sending an sms, and come in different communication flavours of Zigbee using the Xbee protocol*" (O., 2013).
- In underground mines, spaces are used especially for powder magazines and the storage of certain substances that, under certain conditions, can generate toxic gases; therefore,(Analytical Technology, 2016) "*The F12is Gas Transmitter is used to monitor for gas leaks near storage cylinders, process piping, or gas feed equipment in nearly any type of industrial plant environment. It is housed in NEMA 4X, polycarbonate enclosure and features an H10 Smart Sensor, a non-intrusive four button user interface with a backlit transflective graphics display, three level alarms with three (optional) alarm relays, a high-resolution 4-20mA current loop output, real-time clock, data-logger, and optional HART™ or Modbus™ communication interface. In addition, the transmitter offers several optional E18 gas generators for automatic, timed testing of H10 sensors*".
- Working in confined spaces leads to exposure to asphyxiation or intoxication, "*Portable gas detectors are available as single or multi-gas units. Single gas units contain one sensor for the detection of a specific gas, whilst multi-gas units usually contain up to six different gas sensors (typically Oxygen, flammable, Carbon Monoxide and Hydrogen Sulphide)*"(Inc., 2013).

IV. EMERGENCY RESPONSE PLAN FOR TOXIC GAS EMERGENCIES

Gas detection equipment can fail and put the lives of one or more workers in the mine at risk; however, we must know how to respond to these situations, "*HYDROCHLORIC ACID Use and Location: Hydrochloric acid is stored and is used to wash cement build up off of underground mobile equipment. Response Procedure: • Personnel shall wear full protective clothing / gear and SCBA (For low concentrations of HCl, use acid gas respirators). • If the acid has breached a concrete containment, control spill with soil. • Dilute with water and neutralize with lime. • Control HCl vapors with water spray. • Remove contaminated materials to the heap leach area. • Return spilled solutions to the process circuit. […] PROPANE / NATURAL GAS: Response Procedure: • Evacuate the area. • Extinguish / remove all sources of ignition from spill area. • Shut down source of gas supply. • Ventilate the spill area. • Disperse fumes with water spray. DIESEL / GASOLINE: Use and Location: Diesel Used to for all underground equipment located at underground shop. Gasoline used for all surface equipment located by vent shaft. Response Procedure: • Extinguish / remove all sources of ignition from spill area. • Shut down source of fuel supply. • Use absorbent pads or other absorbent material to absorb the spill. • Non dripping absorbent materials may be taken to the landfill. • Oil stained soils must be taken to the bio-remediation facility*" (Safety, 2015).

V. CONCLUSION

The present investigation determined that it is necessary to carry out continuous monitoring of gases at regular intervals in the mine to prevent fires, occupational diseases such as silicosis and, in the worst case, suffer fatal accidents such as possible gassing of workers in underground mines.

The relationship of multiple indices should be analyzed together for best results.Advanced test methods

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such as gas chromatography must be used for more accurate gas detection, even at low concentrations.

RECOMMENDATIONS

Consideration should be given to expanding self-rescue training to include use in times of low oxygen environments and excessive levels of carbon dioxide. Mines must conduct a risk assessment to determine post-incident atmospheric monitoring requirements (explosion, fire, gas event, etc.).

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