Environmental Technology in Mining

CHAPTER I. MINE GASES

4. Gases detection and dust

Carlos Rico de la Hera

Rubén Díez Montero

Ana Lorena Esteban García

DPTO. DE CIENCIAS Y TÉCNICAS DEL AGUA

Y DEL MEDIOAMBIENTE

Gases measurement

Direct-reading methods:

Gas monitoring (gas detector): A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion.
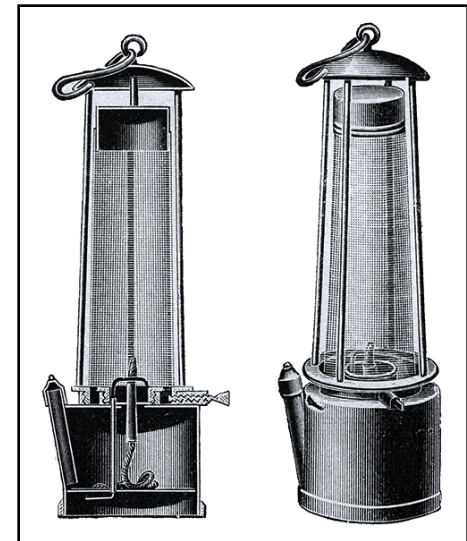
Portable device

Fixed device

Humphry Davy lamp

Specifications: gas, concentration range, calibration…
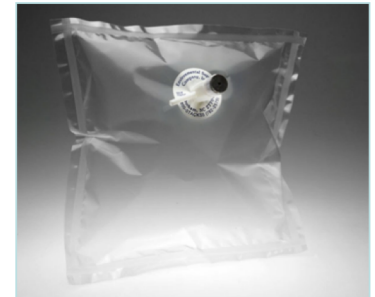
Gases measurement

Gas sampling methods:

Active systems:

Contaminants pass through a filter or an adsorption material in which is retained. It is necessary to known de volume of air that passed through the filter to calculate de concentration of the contaminant.

Air pump Gas bag

Air samples are collected in gas bags. Analysis in laboratory. The main advantage is that it allows detecting gases when there is not a clear idea of what gases are present.

Sampling procedure – ITC instructions

Flow, time, place.

Continuous monitoring systems

Air pump

<div style="background-color:#8cc63f">

Sampling order

1º Oxygen.
2º Flammable gases.
3º Toxic gases.

</div>

Portable gas analizer equipment

CALIBRATION

O$_2$ Electrochemical Sensor
NO$_2$ Electrochemical Sensor
H$_2$S Electrochemical Sensor
CO Electrochemical Sensor
CO$_2$ Infrared absorption sensor
CH$_4$ Catalytic diffusion sensor

Dust

Origin of dust:

- Perforations and blasting.
- Crushing and grinding.
- Loading and transport of materials.
- Transfer of materials
- Too high ventilation flow

Nocivity of dust:

- Chemical characteristics of dust.
- Size of dust particles: PM10: Particles sized < 10 μm can reach the lungs alveoli.

Health effects of dust:

- Silicosis: SiO_2 dust.
- Cancer: As, Cr, Ni, asbestos.
- Irritation.
- Allergy.
- Respiratory infection.

SiO_2
TLV-TWA = 0.025 mg/m^3

Dust

Other effects of dust:

- Skin injuries.
- Conjunctivitis.
- Risk of explosion. Organic matter and metals in dust form in the air dispersed as a cloud can burn with explosive violence.

https://www.youtube.com/watch?v=jENpGlJ0dzA

https://www.youtube.com/watch?v=_bp9hGxPRlc

Physical properties of dust:

Size > 10 µm. Dust remains in the air for short time.
Size < 10 µm. Dust remains in the air for long time.
Size < 0.1 µm. It does not settle, it behaves like the air.

Pathological and combustible consequences of dust are referred to size < 10 µm.
Mining dust use to be within a size range of 0.5-3 µm.
Chemical activity increases with decreasing particle size.

Dust

Dust reduction practices:

- Dilution by ventilation.
- Reduction in dust generation (prevention): combination of ventilation, water application, recolection machines, filtration equipments.
- Water sprayers before blasting and dust generating operations.
- Control and removal of dust close to the generation point.
- Isolation of dust generation processes.
- Air renewal.
- Prevent accumulation of dust.

- The last one:
- Individual Protection Equipment (IPE): dust masks