MINE HAZARDS & SAFETY-1 LAB

Semester: 5TH

IIPM SCHOOL OF ENGINEERING & TECHNOLOGY

KANSBAHAL, ROURKELA, SUNDARGARH

ODISHA -770034

Department of Mining Engineering

IIPM School of Engineering & Technology Kansbahal, Rourkela, Odisha

LIST OF EXPERIMENTS

EXPERIMENT: 01

AIM: Dismantling and assembling of different types of Flame Safety Lamp.

APPRATUS:

1. Flame Safety Lamp (Volex type).
2. Magnetic unlocking arrangement.

THEORY:

A dismantled flame safety lamp is assembled by bringing the upper section and the middle section together. This assembly is then screwed onto the lower section and it gets magnetically locked. Like wire gauze, even locking arrangement in a flame safety lamp is one of the important safety device. A properly assembled safety lamp will not produce any sound due to lose components, if it is shaken by hand.

The locking arrangement consists of a spring loaded steel bolt housed in a tubular body which is fitted and soldered with the bottom flange of the middle section. The magnetic lock bolt passes through the collar into the notches on the oil vessel. When the middle and top sections are fitted on the oil vessel by screwing, the lock bolt prevents their unscrewing by the ratchet construction at the top end of the oil vessel. When we want to unlock, the top of magnetic locking device is placed below the pole of magnet unlocker in the lamp cabin. The lock bolt is pulled by the magnet and the base of the lamp can then be unscrewed. The magnetic locking arrangement is so designed that ordinary magnet cannot unlock the lamp.

PROCEDURE:

1. Each group will select one kind of Flame Safety Lamp.
2. Install each of them correctly according instructions.
3. For dismantling purpose first unlock the magnetic lock by a proper unlocking arrangement. The lock bolt is pulled by the magnet and the base of the lamp can then be unscrewed.
4. Once dismantled, bring the upper section and middle section together. This assembly is then screwed onto the lower section and it gets magnetically locked.

तमसो मा ज्योतिर्गमय

IIPM

KANSBAHAL

ESTD.: 1979

EXPERIMENT: 02

AIM: Detection of Methane using Flame Safety Lamp.

APPRATUS:

1. Flame Safety Lamp (Volex type).
2. Source of Methane gas (Aspirator Bulb)

THEORY:

Methane in mine air can be detected either by using chemical analysis in laboratory or by using flame safety lamp and special instruments called Methanometer. Using safety lamp or Methanometer, methane can be detected on the spot in underground.

TESTING PROCEDURE OF METHANE:

Test for methane is usually done in two stages. The two stages are:

1. Accumulation test
2. Percentage test

Accumulation test: It is carried out with a luminous flame of standard height. This test gives a better indication of methane. This is because luminous-flame test produces more heat inside the lamp which causes better lamp ventilation resulting in a larger quantity of methane being drawn inside the lamp. Also for carrying out accumulation test it is not necessary to create a dark surrounding. The test carried out indicates that the flame spires/jump, if the percentage of methane in the air is 3% or more. It is because of this reason that we have to raise the lamp to the roof very slowly/cautiously so that we can see the behavior of flame as well. If the flame spires/jumps, it indicates that the methane content in the air is more than 3% and

percentage test is not necessary in this case.

Percentage test: This test is also called cap test. The surrounding is made dark, before carrying out this test. This test is carried out with a reduced flame. The flame can be reduced with the help of the regulating knob. The flame should be reduced to an extent such that there appears a continuous blue line just above a speck (a very small mark or shape) of white/yellow light. The lamp is raised slowly to the roof and the percentage of methane is indicated by the height of the cap produced.

PROCEDURE:

1. Each group will select one kind of Flame Safety Lamp.
2. Install each of them correctly according instructions.
3. For Accumulation test, a luminous flame of standard height is required. Therefore each group will go for a luminous flame of standard height.
4. For Percentage test, the surrounding is made dark and a reduced flame (blue line appears) is prepared. The height of cap is the sign of percentage of methane in that particular environment.

EXPERIMENT NO. 03

AIM: Study and use of MSA-D6 Methanometer.

APPRATUS:

1. MSA D-6 Methanometer.
2. Source that emits low amount of Methane (Aspirator Bulb).

THEORY:

A Methanometer is an instrument used to measure methane gas in the air of a mine. The Mine Safety Appliances Company Ltd. manufactured the first type - W8 Methanometer around 1950 and it was approved for use by the Ventilation Regulations. A catalytic-type Methanometer uses an array of four heated wire filament elements, two active filaments are coated with a catalyst, arranged in a Wheatstone bridge with two inactive elements that have no coating. When exposed to methane-contaminated air, the coated filaments heat up due to oxidation of the methane, and the resulting imbalance in the resistance of active and inactive elements can be displayed on a calibrated meter.

As stated earlier, this apparatus utilizes the principle of Wheatstone bridge. It is well known that the resistance of a wire will increase on heating by combustion of methane. Thus a balanced wheat stone bridge circuit becomes unbalanced and therefore it starts passing current through the galvanometer. The amount of current flow is calibrated against percentage of methane present in air.

PROCEDURE:

1. Each group will select one kind of MSA Methanometer.
2. Install each of them correctly according instructions.
3. Test each Methanometer for its proper functioning.

1. Check the voltage of the battery by pressing the voltage check button. The

pointer should lie in the red zone indicating a voltage of 2.2 to 2.8 Volts.

2. Draw mine air sample by squeezing the aspirator bulb. Around 2 to 3 squeezes are enough.
3. Press the methane check button for 10–15 seconds. The pointer swings with a jerk and comes back to a steady position momentarily indicating the methane percentage.

A Typical MSA Methanometer:

EXPERIMENT: 04

AIM: Demonstration of whirling hygrometer and determination of relative humidity using whirling hygrometer.

APPRATUS:

1. Whirling Hygrometer

THEORY:

The whirling hygrometer or sling psychrometer consists of two thermometers mounted on a frame that can be whirled in the air by hand. The bulb of one thermometer is covered with a tight-fitting muslin sack and wetted with water. This thermometer is known as the wet-bulb thermometer. The other is the dry-bulb thermometer. The psychrometer is whirled to force air past the bulbs. The dry bulb indicates the temperature of the air. The wet bulb helps determine the relative humidity.

When the sling psychrometer whirls through the air, water from the muslin evaporates. The evaporating water cools the wet bulb. The amount of cooling that occurs depends on the relative humidity. The lower the humidity, the faster the water in the muslin will evaporate, and the more the bulb will cool. High humidity will cause less evaporation, slowing the cooling process.

In air that has less than 100 per cent relative humidity, the wet bulb will record a lower temperature than the dry bulb. This difference in temperature is known as wet-bulb depression. A special chart is used to convert the wet-bulb depression to relative humidity or the relative humidity can be determined by correlating the readings with those on a simple slide rule, which is supplied with each instrument.

Relative humidity (H) is the ratio of the vapor pressure (e) of the moist air to its saturation vapor pressure (e_s) at its temperature, which is expressed in %.

$H = (e/e_s) \times 100$ %

PROCEDURE:

1. While calculating relative humidity using whirling hygrometer first of all saturated vapor pressure (e_w), as a function of (t_w) and then calculate the ratio of vapor pressure
   (e) to (e_w).
2. If the vapor pressure is determined to be a minus value, consider the relative humidity to be zero.
3. Using the saturation vapor pressure table e_w corresponding to t_w is taken. Similarly e is taken corresponding to t.
4. Thus the relative humidity is calculate as follows:

$$H = (e/e_w) \times 100$$

A typical whirling hygrometer:

EXPERIMENT NO. 05

AIM: Study and use of multigas detector

APPRATUS:

1. Multigas detector
2. Source that emits low amount of gases (Aspirator Bulb).

THEORY: A gas detector is a device that detects the presence of gases in an area, often as part of a safety.Originally, detectors were produced to detect a single gas. Modern units may detect several toxic or combustible gases, or even a combination. multi-gas detectors are usually equipped with sensors to monitor levels of gases and detect the presence of combustible and toxic gases in the environment.

Operation of the Instruments:

Instruments containing electrochemical cells should not be left out in temperatures below freezing since the electrolyte can freeze and cause permanent damage to the cell and to the electronic controls. Normal operating temperature range of the multigas monitors is from 0 to +40°C. Sensors should be allowed enough time to respond, the average being less than 20 seconds. However, if a sampling probe is attached more time should be allowed since the air sample has to travel the length of the probe before reaching the sensors. The multigas monitor should be allowed to run in a clean atmosphere for a few minutes when sampling is completed to ensure that the cells and the pumping system are flushed. It is very important that the instrument be calibrated at least every three months and after each use to ensure proper operation of the sensors. The multigas monitors are easy to use and do not require extensive training of the operators. Result interpretation is usually straightforward except for situations when many chemicals may be present or when the universal MOS sensor is used; one has to know which chemical was used to calibrate in order to be able to interpret the results. Use of electronic equipment such as UHF and VHF radios, especially if they are in the transmission mode, can cause interferences. Instrinsic safety is also of utmost importance because of the possibility of entering a potentially explosive atmosphere.

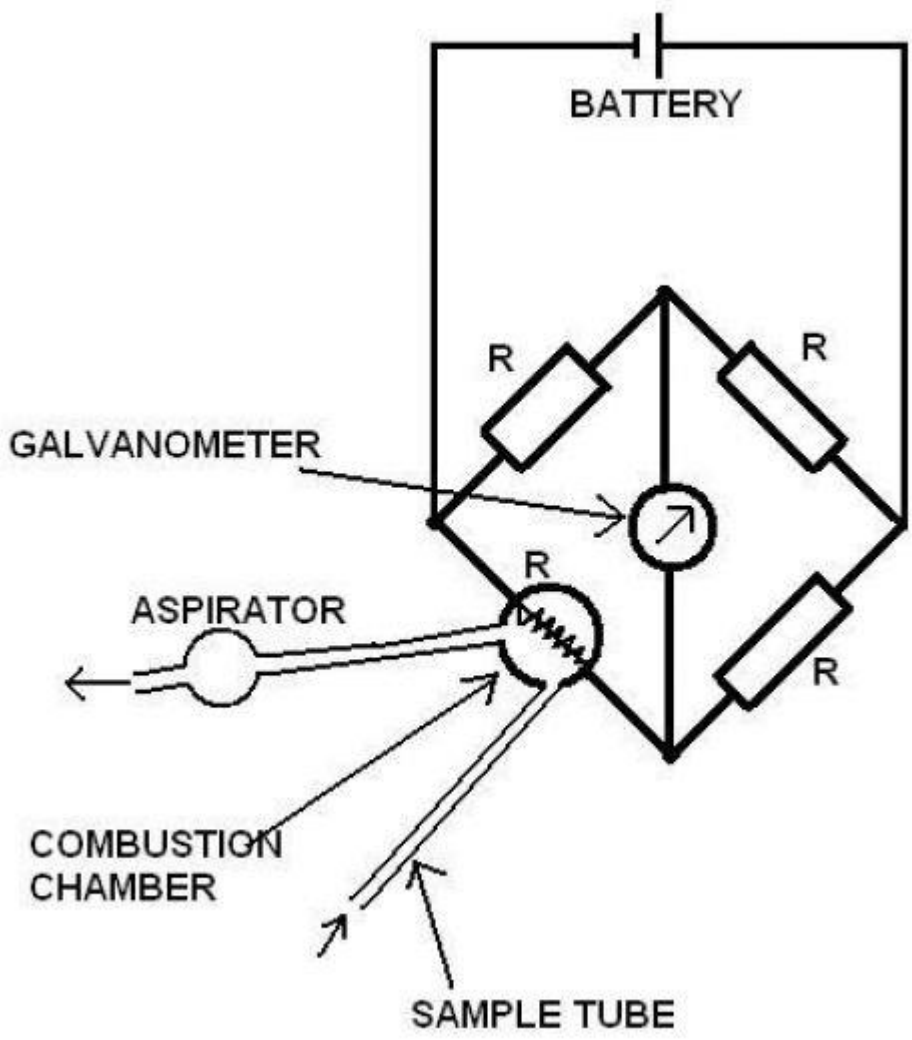
Specificity of the electrochemical cells is obtained by selecting the appropriate sensing electrode, controlling the voltage of that sensing electrode or through the use of filters that selectively remove unwanted chemicals. Cells are available for a variety of toxic substances such as sulfur dioxide, hydrogen sulphide, carbon monoxide, chlorine, nitrogen dioxide, ammonia and several others.

A sensor usually consists of three electrodes separated by a thin layer of electrolyte (sensing, counter and reference electrode). The toxic gas diffuses into the cell and is oxidized at the sensing electrode while the oxygen is reduced to water at the counter electrode. The current produced is compared to that of the reference electrode and the difference converted to the concentration of the toxic chemical. Readouts are usually given in ppm and the operating range is from 0 up to 2000 ppm.

The metal oxide semiconductor (MOS) sensor can be used to detect both toxic and combustible gases. It operates using a heated metal oxide semiconductor. The gas molecules adsorb onto the heated surface where an oxidation-reduction reaction occurs causing a change in the electrical conductivity of the metal oxide. This change is proportional to the concentration of the gas of interest. Very low concentrations of toxic gases can be detected. However, the sensor is not specific and will respond to a large number of

chemicals. This non-specificity is taken as an advantage when the sensor is used as a screening tool to determine if toxic gases are present in the atmosphere. To obtain a quantitative readout with a MOS sensor, the instrument has to be calibrated properly and one has to know which compound is present in the atmosphere.

MULTI GAS DETECTOR (honeywell)



CIRCUIT OF MULTIGAS DETECTOR

Detector settings:

The following gases are to be monitored with alarms set at the indicated Low and High alarm points: Gas Low Alarm High Alarm

Gas	**Low alarm**	**High alarm**
O2	19.5%	23%
LEL (H2)	10%	20%
CO	50ppm	200ppm
H2S	9ppm	14ppm

EXPERIMENT NO. 06

AIM: Study and use of CO2 detector

APPRATUS:

1. CO2 detector
2. Source that emits low amount of gases (Aspirator Bulb).

THEORY: A carbon dioxide sensor or CO_2 sensor is an instrument for the measurement of carbon dioxide gas. The most common principles for CO_2 sensors are infrared gas sensors (NDIR) and chemical gas sensors. Measuring carbon dioxide is important in monitoring indoor air quality.
The carbon dioxide gas sensor measures gaseous carbon dioxide levels by detecting the quantity of IR radiation absorbed by carbon dioxide molecules. The sensor employs a hot metal filament that acts as an IR source to generate IR radiation.
An infrared (IR) lamp directs waves of light through a tube filled with a sample of air toward an optical filter in front of an IR light detector. The IR light detector measures the amount of IR light that passes through the optical filter.

The band of IR radiation produced by the lamp is very close to the 4.26-micron absorption band of CO2. Because the IR spectrum of CO2 is unique, matching the light source wavelength serves as a signature or "fingerprint" to identify the CO2 molecule.

As the IR light passes through the length of the tube, the CO2 gas molecules absorb the specific band of IR light while letting other wavelengths of light pass through. At the detector end, the remaining light hits an optical filter that absorbs every wavelength of light except the wavelength absorbed by CO2 molecules in the air sample tube.

Finally, an IR detector reads the remaining amount of light that was not absorbed by the CO2 molecules or the optical filter.

PROCEDURE:

1. Portable detectors allow the monitoring of carbon monoxide content in the range 0 - 200 ppm by means of sensor heads.
2. Measurement of the concentration of selected gases.
3. Gas testing in this procedure refers to portable gas detection, not fixed gas detection.
   . Before using any gas testing equipment it should be checked according to manufacturer manual like battery check, Filter Check, Probe check and Calibration check.
4. Care must be taken around valve spindles, flanges, drains and in floor voids.
5. Probes should be used to reach inaccessible places.
6. Trainer/user must be careful to prevent any moisture of sludge enter through the probe hose.

EXPERIMENT NO. 06

AIM: Study and use of FACE MASK for rescue apparatus

APPRATUS:

1. Mask

THEORY: A mask "covering to hide or guard the face", is an object normally worn on the face, typically for protection, disguise, performance, or entertainment. Protective masks are pieces of kit or equipment worn on the head and face to afford protection to the wearer, and today usually have these functions:

- Providing a supply of air or filtering the outside air (respirators and dust masks).
- Protecting the face against flying objects or dangerous environments, while allowing vision.
- **face masks** have been employed as a public and personal health control measure against the spread of virus. Their use is intended as personal protection to prevent infection and as source control to limit transmission of the virus in community and healthcare settings.
- An N95 mask is a particulate-filtering facepiece respirator that meets the N95 air filtration rating of the US National Institute for Occupational Safety and Health, meaning that it filters at least 95 percent of airborne particles, while not resistant to oil like the P95. It is the most common particulate-filtering facepiece respirator.[30] It is an example of a mechanical filter respirator, which provides protection against particulates, but not gases or vapors

Correct handling and wearing of mask:

- Clean your hands before you put your mask on, as well as before and after you take it off, and after you touch it at any time.
  •Make sure it covers both your nose, mouth and chin.
  • When you take off a mask, store it in a clean plastic bag, and every day either wash it if it's a fabric mask, or dispose of a medical mask in a trash bin.
  • Don't use masks with valves.
- Face masks are loose-fitting masks that cover the nose and mouth, and have ear loops or ties or bands at the back of the head.

remove of a face mask:

1. Clean your hands with soap and water or hand sanitizer before touching the mask.Avoid touching the front of the mask. The front of the mask is contaminated. Only touch the ear loops/ties/band.Follow the instructions below for the type of mask you are using.
2. *Face Mask with Ear loops:* Hold both of the ear loops and gently lift and remove the mask.
3. *Face Mask with Ties:* Untie the bottom bow first then untie the top bow and pull the mask away from you as the ties are loosened.

4. *Face Mask with Bands:* Lift the bottom strap over your head first then pull the top strap over your head.
5. Throw the mask in the trash. Clean your hands with soap and water .