Air Monitoring Exercise

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Presentation Topics

- Monitoring Strategies
- Air Sampling and Air Monitoring
- Direct-Reading Instruments for:
  - Flammable Atmospheres
  - Oxygen Atmospheres
  - Toxic Atmospheres
- Calibration and Relative Response
- Using Detector Tubes

Flammable Atmospheres

- Readings expressed as % of LEL
- Instrument does not identify specific chemical
- Instrument does not respond to combustible dust
- General action level is 10% of LEL

Oxygen Atmospheres

- Electrochemical sensor is selective for oxygen
- Expresses readings in % oxygen in air
- Normal air is 20.9% oxygen
- Acceptable readings are 19.5 – 23.5%
- Any variation *could* indicate problem

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Toxic Atmospheres

- Chemical-specific and general survey instrument
- Readings expressed in parts per million (ppm)
- Survey instrument (PID) may be converted with relative response factor if only one chemical and it is identified
- Specific chemicals have exposure limits such as:
    - Permissible Exposure Limit
    - Threshold Limit Value

Detector Tubes

- Specific chemical or family of chemicals
- Most express reading as length of stain with scale on side of tube
- Readings in PPM
- ± 25% accuracy allowed
- Interference or cross sensitive chemicals

Air Monitoring Instrument Exercise
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Workshop Summary

The objective of this exercise is to have the participants practice using air monitoring instruments with an emphasis on learning the capabilities and limitations of basic equipment. The 1-hour exercise immediately follows a presentation outlining the basic procedures of measuring chemicals, the function of basic sensor types, calibration, relative response, and using detector tubes.

The instrument exercise uses specific atmospheres produced from specialty gas cylinders and from commonly available materials to produce certain expected results that are then discussed in a group review. The discussion reinforces and demonstrates points made during the initial presentation.

Materials and Methods

MATERIALS:

- Air monitoring instruments with calibration accessories and instructions
- Multigas with flammables, oxygen, and carbon monoxide sensors
- Photoionization detector (PID)
- Detector tubes and pumps - Hexane and Carbon Monoxide and Alcohols and Ammonia
- Tubing to connect instruments to bag
- Gas bags (# needed for groups, plus 2), hypodermic syringe, SCBA cylinder, chemicals (isopropyl alcohol, ammonia, etc.)
- Prepared gas cylinders (cal gas, hexane, methane)
- Exercise worksheets

Preparation

- For alcohol and ammonia bags - Inject a drop or two of the isopropyl alcohol and/or ammonia solution with the syringe through the septum into a gasbag and fill with air from an SCBA cylinder
- Inflate bags from the prepared cylinders
  - Calibration gas (Typically 50% of LEL Methane, 18% Oxygen, 10 ppm Hydrogen Sulfide and 50 ppm Carbon Monoxide)
  - Hexane ~100 ppm and/or 10% LEL (1200 ppm)
- Set out detector tubes and pumps

Exercise

- Distribute one bag per group. Do not tell them what chemical is in each bag. The group will need to try to identify their chemical and estimate the concentration.

- Each group will need to use each of the instruments and one of each kind of detector tubes. Review the results when all groups are finished. Confirm that any relative response calculations are done correctly.

Main Points

Instrument Calibration Gas

- Instruments calibrated to another gas (e.g., propane, pentane) will typically read lower than the labeled 50% LEL, but will still be more than 10% LEL, the evacuation level for most agencies. If the flammable reading were 0, the oxygen level could be addressed by the use of SCBA.
- Photoionization detector will give no reading if the flammable gas used is **methane** because its Ionization Potential is 12.6 eV.
- Carbon Monoxide detector tubes and the CO sensor usually show good agreement

Hexane

- If ~100 ppm is used, typical multigas instruments (without PID sensor) will not alert to the presence of a significant amount chemical
- 10% LEL formulation will give a lower reading by the flammable sensor (4 – 6% LEL, depending on the calibration gas of the instrument)
- Hexane detector tubes tend to read pretty accurately.
- Carbon Monoxide detector tubes will give a response because of cross-sensitivity or interference (see the instruction sheet for the tubes). The fact that the sensor in the multigas meter did not respond should be a clue. Emphasize the importance of using multiple tools.
- PID response is lower than the actual concentration. If you have a relative response factor for your instrument to hexane, use that to convert the reading to an estimate of the actual concentration and compare this to the detector tube reading.

Alcohol and Ammonia

- Typically a very slight reading of the flammable sensor (~1-2% LEL) is the only response of the multigas instrument
- Detector tubes for alcohols and ammonia will give estimates for the respective concentrations.
- The current Draeger detector tubes available for measuring alcohols (n-Butanol 10/a) makes a slight, almost undetectable, color change from pale yellow to mint green.
- PID readings are typically much lower than the combined concentrations of alcohol and ammonia as estimated by the detector tubes. However, unlike the hexane bag, a relative response factor cannot be applied to the reading, because more than one chemical is present.

Summary Points:

- Even though the same bag (and hence, the same concentration) is being measured, different instruments will provide different readings, even after relative response differences are calculated.
- Ignoring (or being unaware of) the concept of relative response can result in serious underestimating of the concentration of a chemical in the air. You must know the chemical's identity to be able to estimate a concentration
- Common direct reading instruments are not able to identify unknowns or selectively measure the components of a mixture of chemicals. Other hazard assessment tools such as containers, labels, placards, etc. are needed.
- Without air monitoring, responders cannot determine whether or not a chemical is in the air and, if so, how much. It is necessary to understand the capabilities and the limitations of the team's instruments to protect responders.