Atmospheric Hazards

AGRICULTURAL CONFINED SPACES

PRESENTED BY: JOE MLYNEK CSP, OHST
Outline

Hazardous Atmospheres

Air Monitoring

Ventilation

Questions
What is a Hazardous Atmosphere?

According to OSHA – an atmosphere that could expose employees to the risk of death, incapacitation, impairment of the ability to self rescue, injury or acute illness from one or more of the following:

• Atmospheric oxygen concentration below 19.5 % and above 23.5%

• Flammable gas, vapor, or mist more than 10% of its lower flammable limit (LFL)

• Air borne combustible dust meeting or exceeding its LFL. This concentration may be approximated as a condition in which dust obscures vision at a distance of five feet or less

• An atmospheric concentration of any substance for which a dose permissible exposure limit is published by OSHA.

• Any atmospheric condition that is Immediately Dangerous to Life and Health (IDLH). IDLH is any condition posing an immediate or delayed threat to life, causing irreversible adverse health affects or interfering with an individual’s ability to escape unaided from a permit required confined space.
Oxygen Deficiency

• Defined in OSHA’s Respiratory Protection Standard 1910.134 as an atmosphere with an oxygen content below 19.5 by volume.

• Defined in OSHA’s Permit Required Confined Space Entry Standard 1910.146 and Grain Handlining Standard 1910.272 that an atmosphere with less than 19.5% oxygen is hazardous

• Many safety professionals agree that entry into any hazardous space or other areas where oxygen deficiency may exist, requires the oxygen levels to be as close to normal as possible (20.9%).
Oxygen Deficiency

• The air we breath:
  • 20.9% oxygen
  • 78% nitrogen
  • Smaller quantities of gases such as argon and carbon dioxide

• The immediate effects of low oxygen environments can be traced to the body’s oxygen transport system.
Oxygen Deficiency

• Blood absorbs oxygen from air in the lung to fuel cells in the body.

• The brain is the body organ most sensitive to oxygen deficiency

• Persons begin to feel the effects associated with lack of oxygen with decreases of 1-2 %
Oxygen Deficiency

15-19% - Healthy individuals have difficulty working strenuously or lose coordination

12-15% - Increased breathing and heart rate

10-12% - Respiration increases, lips turn blue and judgement is impaired

8-10% - Fainting and unconsciousness occur

6-8% - Death can occur within eight minutes

Note: Levels vary from individual to individual based on factors such as a person’s health, level of physical activity, and the environment.
What Causes Oxygen Deficiency?

- Generally caused by another gas displacing oxygen in poorly ventilated spaces
- Decomposition of organic material (grain) can produce elevated levels of carbon dioxide
- Carbon dioxide can displace oxygen within spaces such as silos, bins, tanks, etc.
- Carbon dioxide is denser than air and often accumulates in lowing lying areas within or adjacent to hazardous spaces
Lower Flammable Limit (LFL)

- Terms Lower Flammable Limit (LFL) and Lower Explosive Limit (LEL) are interchangeable.
- Atmospheres with a concentration of flammable vapors above 10% are considered hazardous.
- Concentrations below 10% are not necessarily safe just too lean to burn.
Causes of Measurable Levels of Flammable Vapors

• Pipes that are not blanked, or should have been blanked allow product into the space
• Shifting or movement of product in the space
• The release of flammable vapor from product residue
• Oxy-fuel cutting equipment that is leaking gas
Carbon Monoxide (CO)

• CO is a colorless, odorless and tasteless gas
• Results from incomplete burning of natural or any other material containing carbon such as:
  ◦ Gasoline
  ◦ Kerosene
  ◦ Coal
  ◦ Wood
  ◦ Grain
Carbon Monoxide

- Carbon monoxide displaces oxygen in the blood depriving the heart, brain, and other vital organs the oxygen they need.
- Large amounts of carbon monoxide can kill workers in minutes without warning
- OSHA PEL is 50 parts per million
- NIOSH IDLH – 1,200 ppm
What is a Permissible Exposure Limit (PEL)?

• Established by OSHA

• Highest level of exposure an employee may be exposed to without incurring the risk of adverse health affects.

• Based on an 8-hour work day

• Prohibits workers from being exposed to more than PEL averaged over an eight-hour period
Carbon Monoxide Symptoms

Initial symptoms include:
- Headache
- Fatigue
- Dizziness
- Drowsiness
- Nausea

Symptoms of higher prolonged exposures:
- Vomiting
- Confusion
- Collapse
- Unconsciousness
- Muscle weakness
Hydrogen Sulfide (H2S)

- Colorless and flammable
- “Rotten egg” smell
- Common names include: sewer gas, swamp gas, or manure gas
- Occurs naturally in crude petroleum and natural gas
- Produced by bacterial breakdown of organic materials in human and animal wastes
Hydrogen Sulfide

- Heavier than air
- Collects in low-lying and enclosed, poorly ventilated areas including confined spaces
- Workers can detect hydrogen sulfide at low concentrations in air
- With continuous low level exposure or at high concentrations, workers will lose ability to detect the gas with the sense of smell
Hydrogen Sulfide Symptoms

Hydrogen sulfide is both an irritant and asphyxiant which affects oxygen utilization and the central nervous system.

Low concentrations irritate the eyes, nose, throat, and respiratory system.

Repeated or prolonged exposure may cause:
- Eye inflammation
- Headache
- Fatigue
- Irritability
- Digestive disturbances
- Weight loss
Hydrogen Sulfide Exposure

• High concentrations can cause shock, convulsions, inability to breath, unconsciousness and death.
• OSHA PEL is 10 ppm
• NIOSH IDLH – 100 PPM
Phosphine (PH3)

• Used to fumigate grain storage structures since the late 1950s
• Available formulations include aluminum or magnesium phosphide which produce phosphine gas when exposed to heat or moisture
• Odor comparable to dead fish or garlic
• Heavier than air
• Can settle in low-lying areas and also be contained within grain and release when disturbed
Phosphine Symptoms

Symptoms of low-level exposure may include:

- General fatigue
- Ringing in the ears
- Nausea
- Pressure in the chest

Symptoms may occur immediately or several hours after exposure
Phosphine

Symptom of exposure to greater quantities may include:

- Fatigue
- Nausea
- Vomiting
- Diarrhea
- Chest pain

OSHA PEL is 0.3 ppm

NIOSH IDLH 200 ppm

Symptoms generally disappear when a person is removed from the exposure area to fresh air
• Ammonia (NH3) is a colorless gas having a distinct pungent odor which serves as a warning signal.

• Often used in farm fertilizers, commercial refrigeration, water purification and chemical plants

• Ammonia can be dissolved in water such as in the case of aqua ammonia
Ammonia Exposure

• Causes severe burns to the eyes, nose, throat and skin.

• Federal OSHA sets the PEL for ammonia at 50 ppm

• Some state managed plans have established lower PELs

• NIOSH IDLH – 300 PPM
Airborne Combustible Dust

- Solid material composed of distinct particles or pieces, regardless of size, shape, or chemical composition
- Fire or explosion hazard when suspended in air
- Considered hazardous in permit spaces at concentrations that meet or exceeds its lower flammable limit
- This can be approximated as a condition which dust obscures vision at a distance of five feet or less.
Detection

HAZARDOUS ATMOSPHERES
Atmospheric Testing and Ventilation

OSHA Permit Required Confined Space Entry Standard 1910.146 requires testing the atmosphere within a permit required confined space with a calibrated direct reading instrument.

OSHA Grain Handling Standard 1910.272 requires “The atmosphere within a bin, silo, or tank shall be tested for the presence of combustible gases, vapors, and toxic agents when the employer has reason to believe they may be present. Additionally, the atmosphere within a bin, silo, or tank shall be tested for oxygen content unless there is continuous natural air movement or continuous forced-air ventilation before and during the period employees are inside.”
Direct Reading Air Monitoring Instruments

- Aspirated monitors are equipped with an internal or external pump to allow airflow over the sensors.
- Diffusion monitors allow atmospheric gases to diffuse through normal air currents into the openings on the sensor’s face.
- Always refer to user manual for the amount of time needed to allow air to flow over the monitor’s sensor.
Air Monitor Calibration

• Should be calibrated according to manufacturer guidelines

• Calibration refers to an instrument’s measuring accuracy relative to a known concentration of test gas.

• Remember that calibration gas does have an expiration date
Bump Testing

• Should be performed prior to each use.

• A bump test is a qualitative function check in which a challenge gas is passed over the sensors at a concentration and exposure time sufficient to activate all alarm settings.

• The purpose is to confirm that gas can enter the sensor(s) and that the instrument’s alarms are functional.

• The bump test does not provide a measure of the instrument’s accuracy.
Hazardous Areas

- Confined spaces containing combustible dusts, flammable vapors, pose significant risk to entrants.
- Ensure that monitors and other equipment are properly rated for these areas.
- Intrinsically safe monitors are required when entering hazardous areas.
- Term “intrinsically safe” means that the available electrical and thermal energy in the monitor is low enough to prevent ignition of hazardous atmospheres.

Hazard Alert: Combustible Dust Explosions
Combustible dusts are fine particles that present an explosion hazard when suspended in air in certain conditions. A dust explosion can be catastrophic and cause employee deaths, injuries, and destruction of entire buildings. In many combustible dust incidents, employers and employees were unaware that a hazard even existed. It is important to determine if your company has this hazard, and if you do, you must take action now to prevent tragic consequences.
Air Monitor Alarm Functions

Alerts entrants and attendants of alarm conditions with:
- Audible alarms
- Flashing LED Lights
- Vibration

Alarm when:
- Oxygen concentration below 19.5% or above 23.5%
- LEL/LFL exceed 10%
- Atmospheric concentration of a substance exceeds its permissible exposure limit
Air Monitor Alarm Functions

Peak/Low Function
- Allows user to view the highest or lowest reading for each sensor during a period of time

Latche Alarm Function
- Ensures that the alarm does not shut-off in alarm mode.
Pre-Entry Atmospheric Testing

Tested in the following order:
- Oxygen
- Combustible Gases (LEL/LFL)
- Toxic Gases/Vapors

Minimum Response Time
- Allowing enough air from the space to be drawn into the equipment or over the sensors
- Tubing or probe extension use may require additional response time
- Always consult user-manual
Stratified Atmospheres

- Permit spaces may have significant depth or remote areas that lead away from the entry point
- Some gases are heavier than air causing atmospheres to stratify (layer)
- Testing should be performed in the area where the worker will be positioned and the area where they will move
- Defined as four feet in the direction of travel and four feet to each side of the entrant
- Use of sampling probes or remote monitoring techniques
Continuous Monitoring

- Extremely important while entrants are inside the space
- Can be achieved by remote monitoring or entrant with monitor, combination of both is best practice
Ventilation

FORCED AIR VENTILATION
Mechanical Forced Air Ventilation

- Common method used to ventilate permit required confined spaces
- Involves use of grounded air movers powered by compressed air or electric fans or blowers
- Draws air from one area, compresses it and directs it into the space
- Ensure that ventilation equipment is rated as explosion proof by National Recognized Testing Labs
- Forced air ventilation pushes fresh clean air into the space and purges contaminated air, commonly referred to as “positive pressure ventilation”
Forced Air Ventilation

• It is not permissible to enter a permit space until forced air ventilation has eliminated the hazardous atmosphere.

• Forced air ventilation must ventilate the immediate areas where entrants are present within the space

• Ensure that air used to ventilate is from a clean source
Forced Air Ventilation Purge Times

- Calculating purge time is essential
- In order to calculate purge time requires the space’s cubic footage
- Divide cubic footage by the cubic foot per minute (cfm) of the blower.
- This number provides the ACH or air exchanges per hour
- Federal OSHA does not regulate ACH
- American Industrial Hygiene Association recommends 20 air exchanges per hour
Forced Air Ventilation

• Never assume forced air ventilation is effective

• Always use an atmospheric monitor to test the air within a permit space prior to and continually during entry.
Training

Include atmospheric monitor training as routine training topic. Include important aspects such as:

- Alarm modes
- Latching/Peak Low Functions
- Response Time
- Remote monitoring
- Calibration
- Bump Testing

Ventilation Training

- When required
- Calculation for space volume
- Purge Times
- Unit’s cfm rating
Additional Resources

• Supervisor Talking Points
• Quiz
• Copy of this Webinar will be posted on Grainnet.com
This presentation was developed to give general safety information. Progressive Safety Services LLC (Progressive Safety) does not make any representation or warranty as to the accuracy or completeness of the information in this presentation. Refrain from doing any act or omission that are reasonably foreseeable that a particular other person (or class of persons) is likely to suffer damage or loss as a result of the act or omission. Progressive Safety is excluded from liability for negligence for both personal injury and damage to property. The information within this presentation is general. It does not constitute and should not be relied on as legal advice. Progressive Safety Services LLC tries to ensure that the content of this presentation is accurate, adequate or complete, it does not represent or warrant or its accuracy, adequacy of completeness.
Thank You for Participating

joe.mlynek@progressivesafety.us

Joe@safetymadesimple.com