Safe Handling of Toxic, Corrosive and Flammable Gases - University of Nebraska-Lincoln

Presented by

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Overview

- **Review some of the dangers of:**
  - ***Flammable Gases***
  - ***Toxic/Corrosive Gases***
- **Key Considerations and Best Safety Practices**
  - ***Mitigate Dangers***
  - ***Proper Handling***

Flammable – Pyrophoric Gas

Pyrophoric

Flammable Gas

A substance that meets the definition of a* compressed *gas which:

- ***Is flammable in a mixture of 13% or less (by volume) with air***

OR

- ***Has a flammable range with air wider than 12%, at atmospheric temp and pressure, regardless of the lower limit***

Flammable Gases

Acetylene

Butane

Ethylene

Hydrogen

Natural Gas

Propane

Methane

Isobutane

Gases & Locations - UNL

Beadle, Filley, Kiesselbach, Othmer, Hamilton, Walter Scott, Animal Science, Hardin, Home Economics, Architecture Hall West….locations might be other than expected!

Hydrogen and Hydrogen Mixtures

Acetylene , Propylene

Others....

Hydrogen and Fuel Gases

- **Hydrogen**

  Is colorless, odorless, tasteless, and highly flammable, and burns with an invisible flame **Straw broom test

- **Hydrogen mixes**

  Hydrogen mixes: flammable at 4% - 75% by volume

- **Propylene, Propane, Butane, Ethylene**

Acetylene

- **Acetylene cylinders have special construction**
  - ***Cylinders contain a porous, sponge-like mass, saturated with acetone***
  - ***MUST STORE UPRIGHT!!***
- **Maximum safe upper pressure limit: 15 psi**
- **DO NOT use copper piping for Acetylene gas delivery systems!**

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Handling Flammable Gas

Correct Environment:

- ***Shall not be used near ignition sources-open flame, sources of heat, oxidizers, non-intrinsically safe electrical equipment***

Correct Equipment:

- ***Manifold systems and regulators designed by experienced personnel…flash arrestors, check valves, PRV's, spark-proof components, intrinsic safety features***

Pyrophoric Gases

A gas that will spontaneously ignite in air at or below 54.4C (130F)

Silane

Phosphine

Pyrophoric Gas

- **Unique gases, unique applications ……. Unique Training**
- **Contained Delivery Systems**

- ***Gas Cabinets/Coaxial Piping/Automated Controls and Emergency Shutdown Systems***

Compressed Gas Cylinders

NEVER trust a the color of a compressed gas cylinder. There is NO industry standard – varies by manufacturer.

NEVER assume cylinder contents – ALWAYS check the label!

Best Practices for Safety

- **Good ventilation**
- **Check for leaks**
- **Keep all valves, fittings, connections free of oil or grease, verify Teflon tape is approved for use with flammables.**
- **Open valves slowly, pointed away from the direction of people**
- **Never manipulate fittings – do not attempt to repair a cylinder valve yourself. Return for a replacement cylinder.**

Incident Review

- ***Schweitzer Hall Explosion at University of Missouri June 28, 2010***
- ***Lessons Learned:***
  - *Equipment*
  - *Process*
  - *Training*
  - *Remedies*
  - *Could this happen to you?*
- ***EHS Safety Listserv - August 17, 2010 (access through http://ehs.unl.edu, 'ListServ' tab)***

Toxic - Corrosive Gas

Toxic Gas

- **Toxic**
  - ***A substance that has the ability to produce injurious or lethal effects through its interaction with the body***
  - ***A toxic substance that has a median lethal concentration in air of <200 ppm***

Corrosive Gas

- **Corrosive**
  - ***A substance that rapidly attacks and produces irreversible damage to human tissue, such as eyes, skin, mucous and other living tissue***

Gases & Locations - UNL

Manter, Othmer, Hamilton, Walter Scott

Carbon Monoxide

Hydrogen Sulfide

Hydrogen Chloride

Ammonia

Chlorine

Multiple Hazards

- **Some gases represent multiple hazards**
  - ***Flammable, toxic and corrosive:***

    Hydrogen Sulfide
  - ***Flammable and toxic:***

    Carbon Monoxide

    Ethylene Oxide

Safety Considerations

- **Product-specific training for users. Product knowledge is KEY!!!**
  - ***Special valves and caps***
  - ***Material Compatibility***

- **MSDS access/review and appropriate door posting**
- **Quantity of toxic gases kept on site?**

Remember

AN EMPTY CYLINDER

IS NEVER 100% EMPTY!!!!

Handle, Store, and Transport an 'empty' cylinder as if it is a full cylinder

Best Practices for Safety

Engineering Controls

- ***Forced ventilation areas for storage and use points***
- ***Critical considerations for connections, leak test, shut-down procedures, purging/inerting the system and regular system maintenance***
- ***Regular training & maintenance***

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Best Practices for Safety

- **Toxic Gas Monitors & Alarms**

- **Emergency Preparedness**

✓ ***Adequate eye wash***
✓ ***Respiratory equipment readily available***
✓ ***Be aware of notification and evacuation procedures (Learned through web-based Emergency Preparedness training & discussions with supervisor)***

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Incident Review

- **Ames Laboratory – Hydrogen Sulfide**

  Root cause: Leaking regulator, insufficient ventilation

- **Argonne National Laboratory – Chlorine**

  Root cause; Insufficient Training, unqualified personnel handling product and delivery system

Incident

Praxair's Propylene Fire - June 2005 (security camera image)

Incident

TWO minutes later (security camera image) – ALL employees & customers evacuated safely due to emergency procedures and drills!

Emergency Preparedness

Review other incidents involving Compressed Gas Cylinders on the Chemical Safety Board web site:

http://www.csb.gov/

NOW….REVIEW YOUR LAB SPACE AS THOUGH AN ACCIDENT IS ABOUT TO HAPPEN

PROCEDURES?

TRAINING?

EQUIPMENT?

Have a Plan

What IS your department's and laboratory's plan?

The Emergency Plan is KEY to assuring the safety of persons and property!!

Resources

The Compressed Gas Association

www.cganet.com

Environmental Health & Safety
Safe Operating Procedures

http://ehs.unl.edu/sop/

General Review

If a regulator for an Oxygen cylinder is difficult to thread, you should:

A: Oil the threads –NEVER

B: Return the cylinder or the regulator to the supplier - ALWAYS

C: Use a crecent wrench to tighten it - NEVER

D: Use a regulator from a nitrogen cylinder –NEVER, or regulator designed for ANY other gas besides Oxygen

General Review

What type of cylinder should never be stored on its side?

A: Acetylene (per this training)

B: Helium

C: Breathing Air

D: Oxygen

General Review

Cylinders containing flammable gases shall not be stored near:

A: Areas where electrical sparks might be generated

B: Bunsen burners

C: Pilot Lights

D: All of the above – ANY source of ignition

General Review

It is acceptable to use plastic piping for parts of a flammable gas or high pressure gas delivery system:

A: True

B: False – plastic is a petroleum-based product and not designed to withstand the pressures involved

General Review

It is safe to conduct minor repairs to valves and regulators of cylinder gases:

A: True

B: False - NEVER. Instead, return to manufacturer .

General Review

It is acceptable to check if a cylinder is empty or full, by slowly opening the cylinder valve to listen for pressure and gas release:

A: True

B: False - NEVER. This bad habit can result in injury or death.

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