ENFORM

The Safety Association for Canada's Upstream Oil and Gas Industry

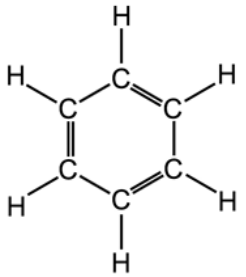
Controlling Benzene Exposure

Agenda

- What is Benzene?
- How Could Benzene Affect Me?
- Where is Benzene Found?
- Where Might I be Exposed to Benzene?
- How do I Control Exposure?

What is Benzene?

- Benzene:
  - A 6 carbon-ringed hydrocarbon
  - Flammable
  - Highly toxic
    - Low Occupational Exposure Limits (OEL)
  - Easily becomes airborne
- Why talk about it?
  - Because you can be overexposed when under 10% of the Lower Explosive Limit (LEL)



How Could Benzene Affect Me?

- Benzene causes cancer and various blood disorders
  - Leukemia (acute myeloid leukemia)
  - Typically associated with on-going exposures especially those that are high dose rate
  - Cancer ranges from 2 to 50 years of exposure with an average around 10 years(1)
- Benzene can get into your body via:
  - Ingestion or injection
  - Skin absorption
  - Inhalation

(1) http://onlinelibrary.wiley.com/doi/10.1002/ajh.20934/pdf

Where Is Benzene Found?

- Naturally occurring
  - Crude oil, condensate, etc.
- Found in process intermediates
  - Chemical scrubbers (glycol, amine, etc.)
  - Drilling fluids
- Found in wastes
  - Sludge, produced water, etc.
- Fugitive emissions
  - Still column vents, scrubber vents, blow downs
- Check your Safety Data Sheet (SDS)

Where Might I be Exposed?

- When handling or working near products that contain benzene
  - Opening closed systems during tasks such as:
    - Tank gauging and thieving
    - Tank cleaning
    - Tank inspection*
    - Pump maintenance
    - Y-strainer cleanouts
    - Basket strainer cleanouts
    - Separator cleanouts
    - Filter changes
    - Orifice plate changes
    - Sending and retrieving pigs
    - Glycol accumulator skimming
    - Liquid and gas sampling

* See slide notes

Where Might I be Exposed?

- When working near fugitive emissions from:
  - Production and flow back tanks
  - Truck vent line ports
  - Dehydrator still column vents
  - Scrubber exhaust ports
  - Blow down vents
  - Etc.

Hazard Assessment

- Conduct a hazard assessment
  - Consider exposure factors:
    - Percentage of benzene
    - Volume of liquid
    - Environment (outdoors vs indoors)
    - Exposure time
    - Surface area
    - Temperature (liquid and ambient)
    - Agitation
  - No LEL does not mean no benzene!

Sources: http://www.raesystems.com/products/ultrarae-3000 and http://www.draeger.com/sites/enus_us/Pages/Chemical-Industry/Draeger-Chip-Measurement-System.aspx

How to Control Exposure?

- Avoid bringing products to site that contain benzene (substitution)
- Engineer out liquids exposure
  - Purging (required for more than just H_2S)
  - Mechanical ventilation during confined space occupancy*
- Administrative
  - Procedures, signage, time and distance
- PPE
  - 4-head gas monitor (LEL, O_2, H_2S, CO)*
  - ½ mask organic vapour respirator and gloves (nitrile)*

Source: http://www.honeywellanalytics.com/en/products/GasAlertQuattro, * See slide notes

How Might This Impact Us?

- Have we conducted benzene exposure assessments?
- Do we know when, where and what controls are required?
- How confident are we that everyone is protected?

Additional Information

- Enform, Controlling Chemical Hazards Guideline

- Alberta Labour, Workplace Health and Safety, Benzene at the Work Site Bulletin, August 2010

For additional information please contact
Robert.waterhouse@enform.ca

Slide Notes

- Slide #3:
  - Benzene has two occupational exposure limits (OEL); a full-shift 8-hour time-weighted average of 0.5 ppm and a 15-minute time-weighted average of 2.5 ppm. This 15-minute OEL is referred to as a short-term exposure limit (STEL). Because of the task-based nature of exposures in oil and gas, managing the STEL is often where the challenges exist.
- Slide #6:
  - Tank inspection is a task that is not commonly associated with benzene exposure, because typically the vessel or tank has been cleaned of liquids and solids. Similar to H2S, benzene and other hydrocarbons can build up inside the confined space over time. Sources can include residual amounts of hydrocarbon liquid (e.g. millilitres located in the boot of a separator vessel) or vessel or tank coatings that may off-gas products previously contained in the tank or vessel (e.g. during ambient and radiant temperature changes such as when the clouds dissipate and the mid day sun shines on the vessel or tank).
  - A variety of other tasks may exist that can expose workers to benzene as well in addition to those listed here.

Slide Notes

- Slide #8:
  - Percent: WHMIS 2015 classifies at 0.1% benzene as a hazard. Percentage in most crude is between 0.1-1% and with condensate is typically 0.1-5%. Higher percentage fluids generate higher levels of airborne benzene. It is possible to encounter fluids within certain processes where benzene may be significantly more concentrated in part of the process fluids than the original feedstock. Two examples where this may occur are vapour recovery units (VRU) on glycol dehydrators and within select components of condensate stabilizers.
  - Volume: What is risk of overexposure when working with 1 mL? With 250 mL? With 1000 L? Larger volumes generate higher and sustained levels of hydrocarbons.
  - Environment: How does this change if I am outside vs inside a big building vs a meter shack? Ventilation is an important factor. In general, the more ventilation the comparatively less exposure; however, if the volume and percent composition are high enough, overexposure in well ventilated environment including outdoors is possible.
  - Exposure time: One minute? Five minutes? 15 minutes? All day? Understanding the exposure profile is important and includes how long the exposure last, how often it occurs during the day etc. In general, the more exposure that occurs, by either frequency or duration, the more risk.
  - Surface area: The effects of how hydrocarbons float on water such as a collection pan or bucket has an impact on the airborne generation rate. Vapours are generated at the surface of liquids and are not dependent on how deep the liquids are. That being said, deeper liquids have the ability to generate airborne levels for longer periods.
  - Temperature: Elevated temperature has an impact on evaporation and therefore exposure. Where might this be a factor? An example would be amine and glycol filter changes where the temperature of these fluids is often 60-80 ° C.
  - Agitation: How does hitting crude oil with a wash gun impact airborne levels? How does the presence of hydrates impact agitation of crude oil in a pig barrel collection bin? Agitation generates more elevated benzene levels and more sustained levels impacting the likelihood of exceeding OELs.

Slide Notes

- Slide #9:
  - Mechanical ventilation such as air horns are frequently used on tanks, towers and vessels prior to occupancy. There are many instances where mechanical ventilation is not used during occupancy, due to costs and obstructions of the vessel or tank entrance. A variety of engineered solutions are now available that allow for the confined space to be ventilated during occupancy with minimal restrictions on the confined space entrance, such as saddle vents.
  - Mechanical ventilation during occupancy is recommended for all confined space entry as it eliminates much of the potential for hazardous gases and vapours to accumulate in the space. It also mitigates hazards that may not have been identified on the hazard assessment, acting as an additional barrier.
  - Gas monitors are effective if they are; calibrated and bump tested on a regular basis, worn near the breathing zone of the worker (clipped on shirt pocket), turned on, and workers and management respond to gas monitor alarms.
  - When dealing with formation-derived hydrocarbon mixtures commonly encountered in oil and gas the use of a nitrile or equivalent chemically protective glove is advised.