Noxious Gases on the Farm

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Learning objectives

- What are they?
- Why are they dangerous?
- Where are they?
- How can we protect ourselves against them?
- What if we get into trouble with them?

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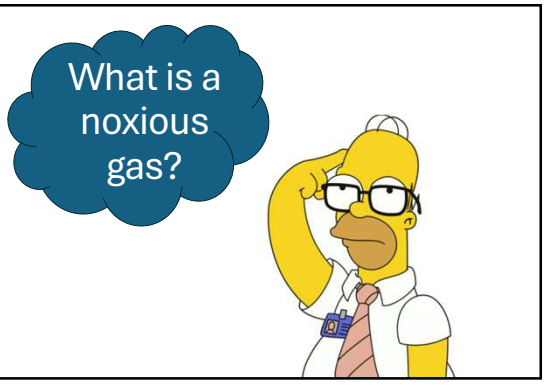

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noxious adjective

nox·ious 'näk-shəs

Synonyms of *noxious* >

1 **a :** physically harmful or destructive to living beings
noxious waste
noxious fumes
b : constituting a harmful influence on mind or behavior
especially **:** morally corrupting
noxious doctrines

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What's the big deal?

- Three main traits of noxious gases that make them dangerous are:
  - Asphyxiants
  - Toxic
  - Explosive / flammable

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Where are these gases?

- They can be anywhere – keep your head on a swivel!
- They're most dangerous in higher concentrations
- Watch for areas that allow for confinement and rising concentrations.
- Low ventilation areas - doesn't have to be confined spaces!
- Organic materials
- Gas powered machinery
- Anerobic environments

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Grain bins



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Manure pits

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Manure pit fatalities

- Between 1975 and 2021, 486 incidents were reported with 288 (59%) being fatalities.
- The average age of these victims was 37.
- Most common events leading up to the death of the farmer is maintenance work in/around the manure pit.

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What gases are common on the farm?

- Hydrogen sulfide (H_2S)
- Ammonia (NH_3)
- Carbon dioxide (CO_2)
- Nitrogen dioxide (NO_2)
- Methane (CH4)
- Carbon monoxide (CO)

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Methane gas

- Odorless
- Less dense than air
- Asphyxiant – displaces oxygen
- Flammable/explosive
- Byproduct of decomposing organic products like manure

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Hydrogen sulfide

- Smells of rotten eggs –can rapidly overwhelm our sense of smell
- Asphyxiant
- Toxin – acts similar to cyanide
- Sudden loss of consciousness
- Denser than air – lays in lower areas
- Byproduct of manure
- Low concentrations affects eyes and respiratory tracts
- Medium concentrations present with headache, nausea, dizziness
- Dangerous at as little as 100 ppm

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Hydrogen sulfide gas exposure limits

Severity Category	Health and Safety Impact Description	Effects of up to 5 min H_2S Exposure	Range of H_2S in breathing zone
Very low / None	No health and safety consequence –	Up to Occupational Exposure Limit	0 – 10 ppm
Low (S1)	First aid case	Up to Peak Exposure Limit	> 10 ppm to 50 ppm
Moderate (S2)	OSHA recordable incident	Loss of smell, irritation of respiratory tract and eyes;	> 50 ppm to 300 ppm
High (S3)	Injury resulting in hospitalization or permanent disability	Difficulty breathing, serious eye damage and severe lung irritation	> 300 ppm to 700 ppm
Very High (S4)	Fatality	Rapid unconsciousness, collapse, potentially fatal within minutes due to respiratory paralysis;	> 700 ppm

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Ammonia

- Very sharp / offensive smell
- Used in refrigeration
- Commonly used in agriculture as fertilizer
  - Binds with airborne nitrogen and allows for nutrient rich nitrogen consumption in plants.
- Also, product of organic decomposition
- Very harmful to skin – especially mucous membranes
- Reacts violently with moisture and can lead to ulcerations in eyes and respiratory tract

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Carbon dioxide

- Manure decomposition accountable for 5% of production.
- Something that humans exhale as a byproduct from normal metabolism.
- Can be accompanied with other noxious gases in areas of low ventilation.
- Can be deadly, likely not the cause of death with manure gas inhalation.

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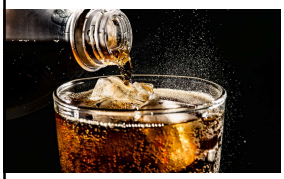
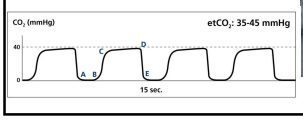
Carbon dioxide





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Nitrogen dioxide

- "Silo gas"
- Has a red, brown, or yellow colored hazy appearance in higher concentrations.
- Naturally occurring from breakdown of organic products.
- Asphyxiant
- Sometimes very little warning to occupants before they become overcome by anoxia

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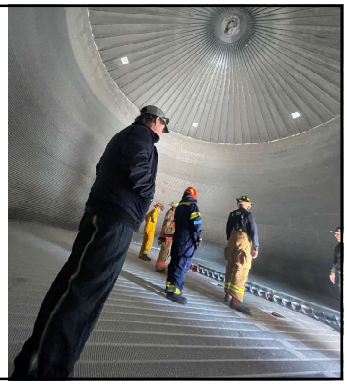
Carbon monoxide

- Highly prevalent on the farm.
  - Grain bins, around combustion engines, etc.
  - Watch for mold on grain or musty smells as warning signs.
- Odorless
- Can kill fast without much warning.
- Common warning signs at lower levels
  - Headaches
  - Dizziness
  - Nausea/vomiting



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Carbon Dioxide

Methane

Hydrogen Sulfide

Ammonia

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"Hope for the best, expect the worst."

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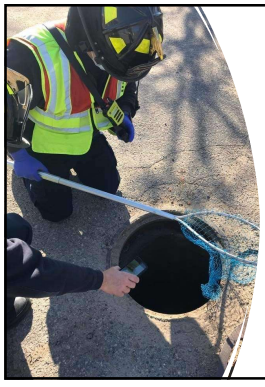

What is a confined space?

- Areas that are not intended for inhabitation.
- Limited areas of ingress/egress – often times only one mode of access.
- Limited or inexistent ventilation.
- Restricted areas usually intended for storage
  - Tanks
  - Silos
  - Grain bins

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Know your surroundings!

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Safety tips

- Have a buddy system
  - Two in, two out!
- Monitor air before you enter.
- Bring your own stuff!
  - Ventilation
  - Respirators
  - Communication
- Have someone there that knows the equipment.
- Don't assume it's safe. It's never safe!

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Responding to these emergencies.

- Multiple patients are likely
- Perform adequate scene size up
- Constant monitoring
- Rescuers should have safety mechanisms in place
  - SCBA
  - Ventilation
  - Ropes

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Hydrogen sulfide treatment considerations

- Immediate fresh air – toxicity is due to inhalation of the gas
- Remove clothing – poorly absorbed, but can continue to spread gas
- Administer high flow oxygen therapy
- Consider trauma alert if suspicion of fall
- Treat ensuing hypotension
- Cyanokit has shown anecdotal evidence of clinical improvment
- Rapid transport

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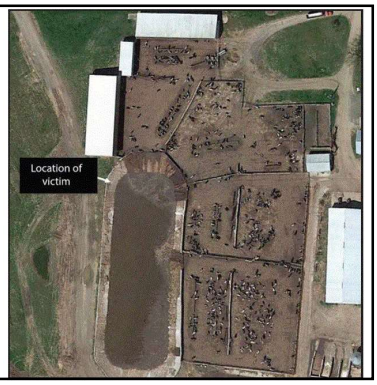
Hydrogen sulfide case study – Amherst, WI



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Hydrogen sulfide case study – Amherst, WI

- August 15, 2016
- 03:00 - 29-year-old male goes out to manure pit to agitate manure pit
- 04:10 victim posts to social media – this is his last communication
- 06:30 victim and 13 cows in adjacent pen are found by another worker on the farm
- Coroner's initial report was methane poisoning as COD
- UW farm safety expert advised to test for hydrogen sulfide levels
- Official COD was ruled as hydrogen sulfide poisoning

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Methane gas exposure case

- 21-year-old male presents to ED with accidental methane gas exposure for 1 minute.
- Signs/Symptoms: drowsiness, shortness of breath, hypoxia
  BP: 160/100 SpO2 75% RA HR:130 RR: 28
- Treatment: immediate ventilatory support with oxygen
- CXR reveals acute pneumonitis
- Spontaneously improves and is discharged after 5 days – pulmonary function tests reveal he is completely resolved in 10 days

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Methane treatment considerations

- Move to fresh air
- Symptomatic care
- High flow oxygen
- Ventilatory support
  - Anticipate difficulty with ventilations even with BVM

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Carbon dioxide treatments

- High levels of carbon dioxide will lead to CNS depression
- Remove victims from environment immediately
- Normal physiological response to increased CO_2 levels is to increase minute ventilation (respiratory rate x amount of air per breath)
- Patients overcome by CO_2 will likely need ventilatory support
- Potential for hypoxia – consider supplemental oxygen as well

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Ammonia poisoning considerations

- Detectable smell at as little as 5ppm
- 1700 ppm associated with coughing, laryngospasm, swelling in airways
- 2500-4500 ppm for > 30 minutes can be fatal.
- > 5000 ppm typically lead to rapid respiratory arrest.
- Treatment:
  - Remove from area
  - Initiate oxygen
  - Airway management – monitor for dyspnea and stridor
  - Irrigate eyes if irritation present

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Carbon monoxide treatment considerations

- Initiate high flow oxygen
- Prepare for ventilations
- Patient likely to vomit – ensure airway patency
- Hyperbaric chamber considerations

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Nitrogen dioxide treatment considerations

- Move to fresh air
- Cross contamination of rescue workers not likely
- High flow oxygen
- Ventilatory support
- Inhaled bronchodilators
- High dose corticosteroids likely necessary
- Supportive care

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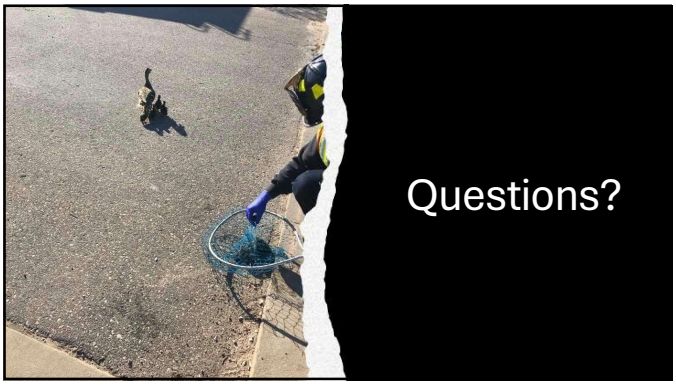

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