




Health & Physiology of Industrial Chemicals and Pesticides

Shelley DuTeaux, PhD MPH
California Air Resources Board
Office of Emergency Response


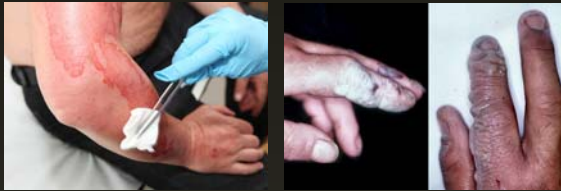
And this ...





Why should we be concerned?



And this ...





... Because of this



Chemical Safety Day
November 2013

And this ...



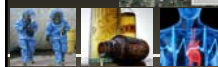
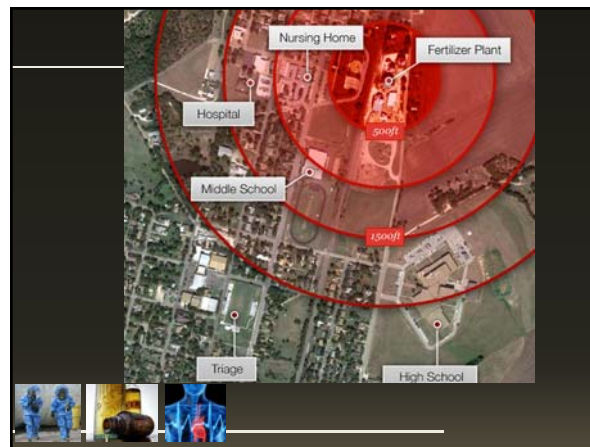
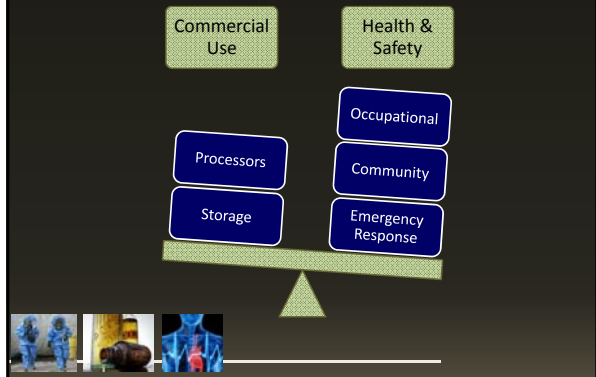
And this ...



Potential Impacts

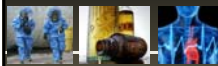


Using industrial chemicals is a balancing act



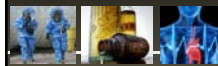
Potential Impacts

First responders maybe unaware of potential dangers	Evacuation, injuries at facility	
Offsite consequence; Access to surrounding homes, businesses	Decontamination; Safe to re-enter and re-open?	




We can't change the properties of the chemicals we work with


So we have to protect against them!



Toxicity







- Symptoms and effects depend on type of chemical
- Effects depend on concentration and length of exposure
- Effects range from mild to severe to even death



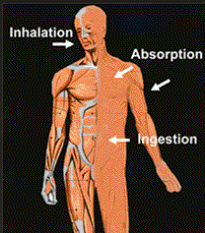


Properties of Ammonia

Ammonia loves water

- "Anhydrous" = without water (so it will seek water)
- Binds to water in our body (eyes, nose, mouth, throat, lungs, skin) and creates strong base

Routes of Exposure


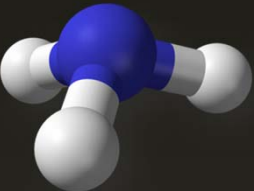




Health (blue)
3 = Extreme Danger
Colorless gas with a strong, suffocating odor; Causes skin, eye, and respiratory tract burns, even blindness; High concentrations may be fatal; Sufficient ventilation to prevent vapor build-up


Fire Hazard (red)
Flash point temp
1 = above 200 F

Stability (yellow)
0 = stable

Anhydrous Ammonia
CAS No. 7664-41-7






Anhydrous Ammonia



Ammonia Toxicity – Inhalation

- Odor threshold = 5 ppm
- Low concentrations can cause coughing and sore throats (as low as 20 ppm)
- Medium concentrations can cause swelling of throat and upper airways
- High concentrations can cause fluid to accumulate in the lungs (after 18-24 hrs)

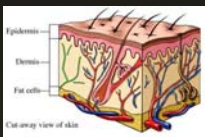





Ammonia Toxicity – Skin

- Pain, inflammation, blisters, necrosis; deep penetrating burns especially on wet skin
- Boiling point is -28°F



frostbite

- Long term exposure can cause dermatitis


Sulfur Dioxide (SO₂)

- Colorless gas or liquid with characteristic irritating, pungent odor (3-5 ppm threshold)
- Effects include contact burns to the eyes and skin, frostbite, difficulty breathing, pulmonary edema.
- Severe throat & eye irritation at 50 ppm
- 400 ppm for 1 min can be lethal



Sulfur Dioxide

Colorless gas with a sharp, pungent odor. Compressed gas. May cause frostbite. Highly irritating to eyes, skin and respiratory tract. May cause burns by forming sulfuric acid on contact with moist skin or mucous membranes. Lung damage may occur.



Ammonia Toxicity - Eyes

- High concentrations cause swelling and sloughing of the surface of eye
- Ulceration and perforation of the cornea can occur weeks, months after exposure
- Cataracts, glaucoma, and even permanent blindness

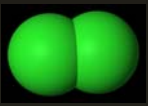





Chlorine gas (Cl₂)


Yellowish-green gas usually shipped as a liquefied compressed gas; Denser than air

Range of Toxicity:


- Highly irritating to mucous membranes including eyes, upper airways, and lower respiratory tract
- 30 ppm causes immediate chest pain, vomiting, dyspnea, and cough
- 35 – 50 ppm is lethal in 60-90 min
- 1000 ppm is lethal within a few minutes


Range of Exposure and Effects




5 ppm



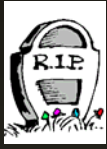
20-100 ppm




300 ppm IDLH



2700 ppm 10 min AEGL-3







5000 ppm





If exposed...

To ammonia, SO₂ or Cl₂

- Irrigate eyes for at least 15 min
- Flush exposed skin with lukewarm water and treat for possible frostbite
- Remove contaminated clothing during shower – not before!
- Move to fresh air







Pesticides


Symptoms "SLUDGE-M"

- Salivation
- Lacrimation - Tear production
- Urinary incontinence
- Defecation
- GI upset/Diarrhea
- Emesis – Vomiting
with or without
- Miosis – Diminishing vision



Pesticides


Organo-phosphates	Carbamates
Organo-chorines	Pyrethroids
Fungicides and Antimicrobials	





Organophosphate Example: Malathion

Colorless to light amber	Skunk like odor
Acutely toxic	OSHA PEL =15 mg/m ³ (skin)





Mechanism of Toxicity

Organochlorines (e.g. DDT): Disrupt the sodium/potassium balance of the nerve fiber, forcing the nerve to fire continuously

Organophosphate and carbamates: Inhibit the action of acetyl cholinesterase (AChE) in nerve cells



Both lead to cascade of effects involving nerve conduction.

Malathion, *continued*

Symptoms:

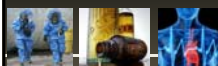
- Irritates eyes, skin; nasal discharge
- Miosis, aching eyes, blurred vision, tearing
- Chest tightness, wheezing, laryngeal spasm
- Salivation, nausea, vomiting, abdominal cramps, diarrhea
- Dizziness, confusion, ataxia

Fumigant example: Aluminum phosphide



Phostoxin®
PHOSTOXIN® TABLETS AND PELLETS
 FOR USE AGAINST INSECTS WHICH INFEST STORED COMMODITIES AND CONTROL OF BURROWING PESTS
 Active Ingredient: Aluminum Phosphide 25.0%
 Inert Ingredients 75.0%
 Total 100.0%
KEEP OUT OF REACH OF CHILDREN
DANGER - POISON - PELIGRO
THE USE OF THIS PRODUCT IS STRICTLY PROHIBITED ON WINGS AND NESTS, FAMILY RECREATIONAL PROPERTIES AND RESIDUAL WOODS. SUCH USES ARE LEFT UNLIT. PLEASE CONTACT DEALERS AND DISTRIBUTORS.



Phosphine Toxicology & Symptoms

Eyes:

- Severe conjunctivitis or cornea injury; possible permanent vision loss

Ingestion:

- Vomiting, abdominal pain, restlessness, tachycardia, hypotension
- Patients remain mentally clear till cerebral anoxia causes drowsiness, delirium and coma

Inhalation:

- Delayed onset with mild initial irritation
- After lag time, phosphine inhalation may cause tightness of chest and cough, headache, dizziness, nausea, vomiting, tremor, loss of coordination, diarrhea



Aluminum/Zinc Phosphide

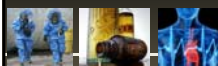


Phosphine gas



Phosphine Exposure

- Vapor Density (Air=1): 1.17 heavier than air
- **Odor threshold 0.03 ppm** (smells like rotten fish or garlic)
- OSHA PEL 0.3ppm
- **Symptoms at 10 ppm**
- IDLH 50 ppm



Treatment

- Get to fresh air
- Apply lots of water!



Decontamination

- Lead or carry victim to fresh air and designated safe zone
- Rapid skin decon is critical
- Irrigate eyes and skin with plain water or saline for 15 mins (60-100°F)
- Remove clothing during decon (not before)
- Double-bag clothing and personal belongings for disposal



What you have to know to stay safe

Hazard Communication

Workers have the right to know and understand the hazardous chemicals they use and how to work with them safely.

www.osha.gov/hazcom 800-321-OSHA (6742) TTY 1-877-889-9627

Workers must be trained to understand these pictograms and the hazards they represent. To learn more about training, labeling, and safety data sheet requirements, scan the QR code.



Transport & Hospital Considerations, *continued*

Depending on the exposure (chemical or pesticide), victims may pose a significant risk of contamination

REMEMBER:

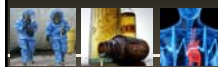
You cannot decontaminate in the ambulance, only before and after arrival to hospital



Know your Chemicals



Section 1. Hazard Identification		Section 2. Hazardous Ingredients	
Product Name	Signal Word	Ingredient Name	Concentration
...



Transport & Hospital Considerations

- Victim Contamination
 - Chemical specific
 - Internal & external
- Responder exposure
 - Need PPE while driving?
- Hospital/ER cross contamination
- Negative pressure rooms



Know your chemicals, *continued*

Front Panel Organization

1. Product name, brand or trademark

2. Signal word

3. Hazard statement

4. Precautionary statements

5. First aid

6. The chemical name

RESTRICTED USE PESTICIDE

PRODUCT NAME

SIGNAL WORD

PRECAUTIONARY STATEMENTS

DIRECTIONS FOR USE

GENERAL INSTRUCTIONS AND INFORMATION

STORAGE AND DISPOSAL

WARRANTY STATEMENT



Know your required PPE and Safety Areas



Save your life!!

Questions?



Shelley DuTeaux
ARB Office of Emergency Response
sduteaux@arb.ca.gov 916.324.1149