

## 1 Health & Safety

### Properties of Fumigants

MeBr, PH<sub>3</sub>, SF<sub>6</sub>, CO<sub>2</sub>, Chloropicrin

## 2 Methyl Bromide

### ■ Health Concerns

- Ingestion (oral intake least likely to occur)
- Inhalation of vapor
- Dermal contact of liquid with skin/ eyes

## 3 MeBr Inhalation

### ■ Lung irritation

- Mild bronchitis to respiratory failure
- Followed by effects on the nervous system

### ■ No noticeable odor at low concentrations

- some people report chlorine like odor
- above 1000 ppm is sweet chloroform odor

## 4 MeBr Dermal Contact

### ■ Causes mild to severe burns from liquid

### ■ High gas concentrations give delayed burns if trapped against skin.

### ■ Do not wear contact lenses when working with MeBr

## 5 Skin Exposure

### ■ MeBr will evaporate from the skin rapidly causing

- tingling
- numbness from cold
- possibly burning sensation
- and aching pain.

### ■ Exposure to small drops will not cause visible injury

## 6 MeBr on Clothing







### ■ Clothing, Gloves, Shoes maintain close contact with the skin.

### ■ Liquid will soak into material and wearer may be unaware of exposure.

### ■ Prolonged contact results in

- Itching skin
- red skin burns
- severe blisters

## 7

- 8  **Do Not wear with MeBr Use**
- Rubber gloves or boots
  - Jewelry, bandages
  - Wallets
  - Tight belts or clothing
  - Contact lenses
- 9  **Blood Bromide Levels**
- Exposure to MeBr will cause bromide levels in the blood to rise.
  - Repeated exposure will result in accumulation of bromide in blood.
  - Blood bromide tests should be done before season and tested periodically if working with MeBr regularly.
- 10  **Threshold Limit Values**
- Time Weighted Average - TWA
    - Concentration allowed for 8 continuous hours /day, 40 hours/week without adverse effect
  - Short Term Exposure Level -STEL
    - Concentration allowed for 15 minutes only without adverse effect, up to 4 times in a day, with 1 hour between exposures
- 11  **TLVs for MeBr**
- TWA - 5 ppm
- 12  **Acute Toxicity**
- Exposure to 100 ppm for 8 hours causes severe poisoning
  - Single exposure to 1000 ppm for 30-60 minutes is dangerous to life
    - LC<sub>50</sub>
      - 3120 ppm-15 min;
      - 2700 ppm/30 min;
      - 1164 ppm/60 min
  - There is a "point of no return", where treatments will not prevent you from dying due to exposure
- 13  **Symptoms of Acute Poisoning**
- Effects on central nervous and respiratory systems- irritation, congestion, edema
  - Nausea, vomiting
  - Dizziness,
  - Blurred vision
  - Staggering walk
  - Slurred speech
  - Symptoms may not show for 48 hours!

14  Symptoms of Chronic Poisoning

- Visual problems
- Slurred speech
- Numbness of extremities
- Mental confusion
- Hallucinations
- Tremors
- Fainting attacks

15  Phosphine

- Health Concerns
  - Ingestion of solid form
  - Inhalation of gas
  - Dermal exposure to liquid form (Eco<sub>2</sub>Fume) or dust

16  Phosphine Dermal Exposure

- Phosphine gas does not penetrate the skin nor does it accumulate in body fat or other tissue.
- Exposure to liquid form from Eco<sub>2</sub>fume can result on freezing skin burns do to evaporation of liquid carbon dioxide
- Residual dust can be transferred from skin exposure to the mouth; may still gas off.
- Burning sensation in eyes from ammonia

17  Phosphine Inhalation

- Pressure in chest; diaphragm pain

Odor

- Solid formulations give off ammonia odor
- Low PH<sub>3</sub> concentrations are not detectable
- Some people smell phosphine due to impurities in gas from cylinder formulations

18  TLVs for Phosphine

- TWA – 0.3 ppm
  
- STEL – 1.0 ppm

19  Acute Toxicity

- Exposures to 7ppm cause definite poisoning symptoms.
- Exposures to 200 ppm is fatal within one hour.
- Exposure to >400ppm is immediately fatal
- LC<sub>50</sub> 190 ppm/ 60 min

- LD<sub>50</sub> 11.5 mg/kg for ingestion of solid formulations

## 20 Symptoms of Acute Poisoning

- Effects nervous system, kidney liver
- Diarrhea – loss of sphincter muscle control
- Nausea, vomiting
- Ringing in the ears
- Chest pain- difficulty in breathing
- Weakness to the point of collapse
- Irreversible tissue damage
- Drowsiness/ tiredness
- Narcosis, Unconsciousness

## 21 Symptoms of Chronic Poisoning

- Phosphine shows no evidence of chronic poisoning

## 22 Sulfuryl Fluoride

- Health Concerns
  - Inhalation
  - Dermal exposure

## 23 Sulfuryl Fluoride Inhalation

- Odorless gas
- Some people smell chlorine like odor from impurity
  
- Affects Respiratory system
- Central nervous system
- Kidney

## 24 SF Dermal Contact


- Will cause frost bite effect from liquid exposure to skin
  
- Can cause serious permanent damage to eyes from freezing burns. Wear protective goggles

## 25 SF on Clothing

- May cause frostbite effect from liquid contacting clothing against skin
- Do not wear tight fitting clothes
- Do not wear rubber boots or gloves

## 26 TLVs for Sulfuryl Fluoride

- TWA – 5.0 ppm
- STEL – 10.0 ppm
- Label Re-entry will be 1.0 ppm for Vikane as well as Profume

27  **Symptoms of Acute Poisoning**

- Nausea
- Slowing of speech and movement
- Abdominal pain
- Numbness of extremities
- Difficulty in breathing
- LC<sub>50</sub> – 1000 ppm/ 4 hours

28  **Symptoms of Chronic Poisoning**

- No effect is shown with small exposures over long periods.

29  **Carbon Dioxide**

- Health Concerns
  - Inhalation of vapor
  - Dermal contact to liquid form
- Carbon dioxide occurs in air at about 300ppm or 0.03%
- Totally odorless

30  **Carbon Dioxide Inhalation**

- Increased respiration
- Headaches
- Dizziness
- Ringing in ears
- Nausea
- Vomiting
- Unconsciousness

31  **TLVs for Carbon Dioxide**

- TWA – 5,000 ppm
- STEL – 30,000 ppm

32  **CO<sub>2</sub> Dermal Exposure**

- Contact with Liquid form will cause
  - freezing skin burns due to evaporation

- Exposure to Dry Ice
  - Aching pains to skin
  - freezing skin burns due to evaporation

33  **Symptoms of Acute Poisoning**

- At concentrations of 3-5% mild symptoms
  - Headache
  - Increased breathing rate
  - Dizziness
- At 8-15% concentrations
  - Nausea, vomiting
  - Unconsciousness

34  **Symptoms of Chronic Poisoning**

- Exposure to 0.5 – 1% for extended periods
  - Increased levels of calcium in body, especially the kidneys

35  **Chloropicrin**

- Health Concerns
  - Inhalation of vapors
  - Dermal exposure to liquid and vapors
  - Ingestion

- Tear Gas causes watering of eyes.
- Smells like chlorine

36  **Chloropicrin Inhalation**

- Concentrations are tolerable at 7ppm
- Tearing of eyes starts at 0.25 ppm
- 350ppm exposure can cause death from lung edema in one minute
- Symptoms may last from hours to days

37  **TLVs for Chloropicrin**

- TWA is 0.1 ppm

38  **Symptoms of Acute Poisoning**

- Small concentrations cause
  - Tearing of eyes
  - Coughing
  - Dizziness
  - Headache
  - Nausea, vomiting

- Fatigue

39  Symptoms of Chronic Poisoning

- Nausea
- Vomiting
- Diarrhea

■ Even small exposures would be noticeable over time.

40  Properties of Fumigants

- Density of gases
- Sorption
- Effects of Temperature
- Reactions

41  Density of Gases


- Air = 1
- Phosphine = 1.17
- Carbon dioxide = 1.56
- Sulfuryl fluoride = 2.88
- Methyl bromide = 3.27
- Chloropicrin vapor = 5.68

42  Sorption

- Adsorption
  - gas molecules stick (adhere) to surfaces of materials. More surface to air means more sorption.
- Absorption
  - gas molecules enter the material pores or gaps
- Desorption
  - Process of gas being released from materials

43  Effects of Temperature

- As temperature the rate of adsorption increases (less fumigant in air)
- Less gas absorbs into product as temp (less penetration into material)
- As temperature the rate of adsorption decreases (more fumigant in air)
- More gas absorbs into product as temp (more penetration into material)

44  Effect of Temperature

- Desorption decreases with lower temperatures

- Desorption increases with higher temperatures.

- Aeration time is very dependent on temperature and air movement and commodity/material density

#### 45 Reaction to Materials

- Reactions can be temporary or permanent
  - Odor change
  - Taste change
  - Change in inherent property (eg baking)
  - Melting/pitting/etching
  - Color change
  - Corrosion
  - Flammability

#### 46 MeBr

1

- Natural hair, wool or feather
  - Furs, horsehair stuffing
  - Angora wool especially
- Leather clothing or on antique furniture
- Natural rubber
- Foam rubber under carpets or in cushions, pillow, mattress
- Sponge rubber
- Salt blocks
- Iodized salt, or ingredient
- Baking soda,
- Powdered soaps
- Viscose Rayon

2

- Cinder block construction
- Charcoal (e.g. cigarettes)
- Some paper cured with sulfur
- Silver polishing paper
- Photographic chemicals
- Vinyl, Cellophane
- **Spontaneous combustion** *on contact with Aluminum or Magnesium*
- High fat content foods
- Any sulfur compounds
- Plastics affected by liquid
- Hydrobromic acid from flames or heat corrode metals

#### 47 Phosphine

1

- Precious metals
  - Copper
  - Gold
  - Silver slightly
  - Brass
- Electrical circuits /PLCs
- Exposed copper wiring
- Telephone /Alarm wiring

2

- Flammable gas at concentrations above 17,900 ppm
- Spontaneous combustion
- Solid formulations react with water to produce gas

#### 48 Sulfuryl Fluoride

- In the presence of flames or very high heat Sulfuryl fluoride forms HF acid gas which is extremely corrosive to metal and other materials like glass, ceramic, and tile
- SF will react with photo developing solutions/ strong bases

49  **Chloropicrin**

- Severely corrosive to metal with
  - Aluminum or Magnesium and their alloys
  - Other metals such as iron in the presence of water

50  **Types of Fumigations**

- Soil in greenhouses
  - Methyl bromide with chloropicrin

51  **Types of Fumigations**

- Burrows of rodents e.g. mice Norway and Roof rats, ground squirrels, chipmunks, gophers, woodchucks and voles OUTDOORS > 15 feet from buildings.
  - Phosphine (mole burrows not legal in IN)

52  **Types of Fumigations**

- Beehives –Phosphine;
  - honey cannot be sold

53  **Types of Fumigations**

- Tarpaulin
  - Methyl bromide, phosphine, SF

54 

- Fumigation of a hospital
- Fumigation of a feed mill

55  **Types of Fumigations**


- Trailer, railcar, vault , shipping container
  - Methyl bromide, phosphine, SF, CO2

56  **Types of Fumigations**


- Railcar in transit – phosphine only

57  **Types of Fumigations**

■ Ship -MeBr and Ph<sub>3</sub>; in transit -phosphine only

58  **Types of Fumigations**

■ Airplane -Vikane™

59  **Types of Fumigations**


■ Grain Bins- phosphine, SF, CO<sub>2</sub>

60  **Types of Fumigations**

■ Flat grain storage, bunkers  
– Phosphine and sulfuryl fluoride

61  **Types of Fumigations**

■ Residential structures - Vikane™

62  **Types of Fumigations**

■ Commercial Structures e.g. flour mills, food plants, seed warehouses, distribution centers  
– Phosphine, Sulfuryl fluoride, and methyl bromide where there are critical use exemptions from Montreal protocol.