HYDROGEN SULFIDE SAFETY AND HEALTH ISSUES

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GENERAL PROPERTIES

- Colorless, transparent gas
- Heavier than air will settle in depressions
- Characteristic rotten-egg odor (low conc.)
- Sweetish odor at higher conc.
- Flammable LEL 4.3% UEL 46%
- Can exist as liquid at low temp and high pressure

TOXIC PROPERTIES

- Extremely toxic and irritating gas
- Can cause instant death
- Blocks the oxidative process of tissue cells
- Reduces the oxygen carrying capacity of the blood
- Depresses the nervous system
- Causes respiratory failure and asphyxiation

Where is Hydrogen Sulfide Found

- Naturally in crude production, natural gas, volcanic gases, hot springs
- Decomposition product from human and animal wastes: sewage treatment facilities, sediments of fish aquaculture, and manure
- Industrial sources include: refineries, natural gas plants, petrochemical plants, coke oven plants, kraft paper mills, food processing plants, tanneries
- Human sources: bacteria in mouth and gastrointestinal tract

HEALTH EFECTS

- Irritating to eyes and respiratory tract
- Conjunctivitis, pain, lacrimation and photophobia may persist for several days
- Coughing, pain in breathing, pain in nose and throat
- Repeated exposure causes headache, dizziness and digestive disturbances
- Collapse and death

PHYSIOLOGICAL RESPONSES

- 10 ppm – eye irritation
- 50-100 ppm - conjunctivitis respiratory irritation
- 100 ppm – coughing, eye irritation - loss of sense of smell 2-15 minutes
- 500-700 ppm – loss of consciousness and death in 30 – 60 minutes
- 700-1000 ppm – Rapid unconsciousness and cessation of respiration and death

Effects of Exposure

- Repeated exposure to low concentrations causes conjunctivitis, photophobia, corneal bullae, tearing, pain and blurred vision
- Exposure to high concentrations causes rhinitis, bronchitis, and pulmonary edema
- Chronic poisoning results in headache, inflammation of the conjunctivae and eyelids, digestive disturbances, weight loss and debility
- Very High concentrations cause death

ODOR THRESHOLD

- 0.13 ppm – minimal perceptible odor
- 0.77 ppm – faint but perceptible odor
- 4.6 ppm – easily detectable moderate odor
- 27 ppm – strong unpleasant odor, but not intolerable
- Odor should not be used as a warning since the gas may deaden the sense of smell

Exposure Level Definitions

- Time Weighted Average (TWA) – 8 hours per day 40 hours per week
- Short Term Exposure Limit (STEL) – 15 min TWA which should not be exceeded more than 4 times per day with 60 minutes between exposures
- Ceiling (C) – a concentration that should not be exceeded during any part of the working exposure assuming direct reading instruments are used
- Peak – a one time spike if no other exposure occurs

OSHA REGULATIONS

- 20 ppm (ceiling)
- 50 ppm (peak – 10 minute exposure allowed only once if no other measurable exposure occurs)

ACGIH TLV's

- Recommended threshold limit values
- 10 ppm (8 hour time weighted average)
- 15 ppm (short term exposure limit above the tlv)
- STEL is defined as a 15 minute TWA exposure which should not be exceeded

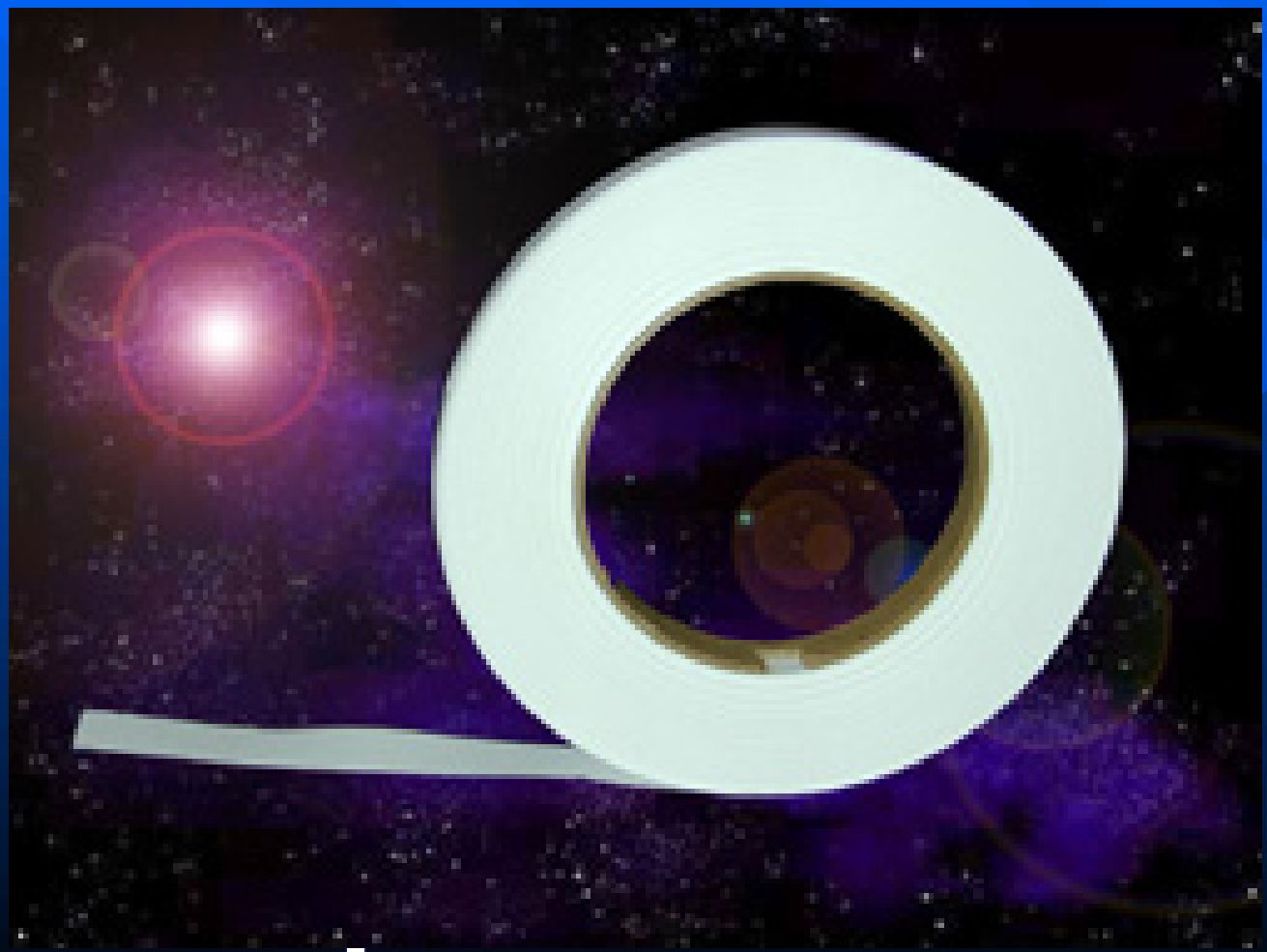
DETECTION OF HYDROGEN SULFIDE

- detector tubes indicate amount of gas by color change of chemically coated granules in a glass tube
- Electronic monitors

Electronic Monitors

- Diffusion
- Internal sampling pump
- Single or multiple sensors
- Sensors require periodic replacement (1-2 years)
- Electronic Monitors must be calibrated with a known gas concentration

IMPREGNATED TAPE



Electrochemical Monitors

DETECTOR TUBE PUMPS

EXPOSURE PREVENTION

- Conduct air monitoring before entering any confined space that may contain hazardous atmospheres
- Entering a confined space may require special confined space training
- Special procedures must be followed
- An entry permit may be required
- Rescue procedures must be in place

Definition of Confined Space

- Contains or has the potential to contain a hazardous atmosphere
- Contains a material that has the potential for engulfing an entrant
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross section
- Contains any other recognized safety or health hazards

Confined Space Requirements

- Training (entrants, rescuers, attendents and competent person)
- Permit vs. non-permit
- Air monitoring (continuous)
- Ventilation
- Rescue procedures in place

ENGINEERING CONTROLS

- If a confined space contains hydrogen sulfide on a regular basis as determined by periodic monitoring then the employer must implement engineering controls
- Exhaust or fresh air ventilation systems must be installed to remove the hydrogen sulfide gas and make the area safe for entry

AIR MONITORING

- Must be conducted prior to entry, and periodically (continuous monitoring is recommended)
- Monitor confined space from the outside or use extension probe or lower monitor into space
- Monitor must be calibrated for accuracy
- Conditions may change suddenly

AIR MONITORING (CONT)

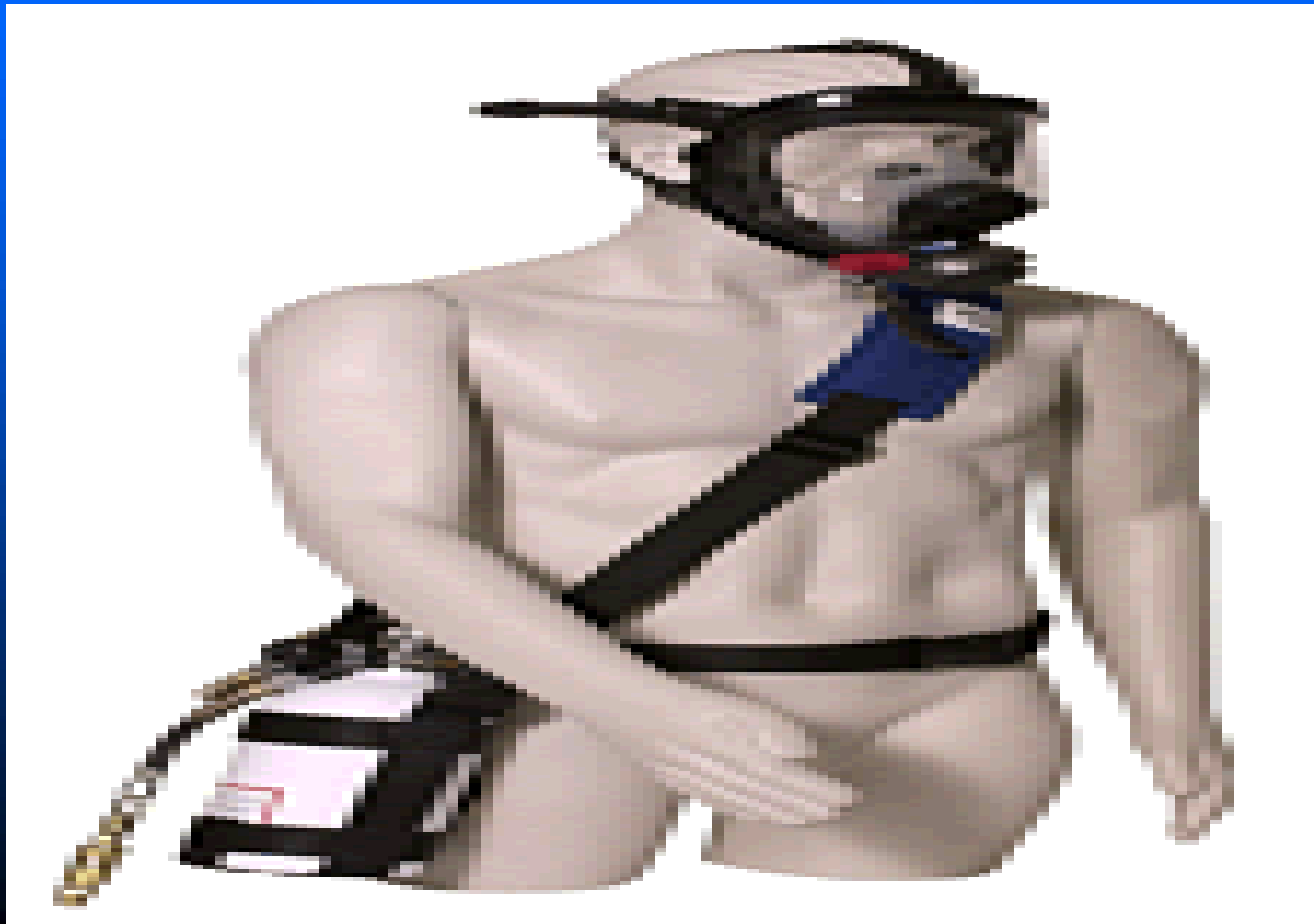
- Monitor alarms may be set or preset
- Have back-up or stand-by equipment
- Be sure batteries are charged
- Electrochemical sensors will require periodic replacement
- Detector tubes have a 1-3 year shelf life
- Sensors will last 1-2 years

RESPIRATORY PROTECTION

- In air concentrations of 300 ppm or less
- Use an air-supplied respirator with full facepiece, helmet or hood
- Or use a self contained breathing apparatus with full facepiece
- In concentrations over 300 ppm use a SCBA full face in positive pressure mode

SCBA

AIR SUPPLIED RESPIRATOR



MEDICAL EMERGENCY

- If someone is exposed to a large amount of hydrogen sulfide move the person to fresh air at once
- If breathing has stopped perform artificial respiration
- Get medical attention as soon as possible

MEDICAL EMERGENCY

- Hydrogen sulfide is classified as a chemical asphyxiant and similar to carbon monoxide and cyanide gases.
- Hydrogen sulfide inhibits cellular respiration and uptake of oxygen, causing biochemical suffocation

EMERGENCY RESCUE

Should a co-worker ever be overcome by hydrogen sulfide gas, **do not attempt a rescue until you are properly protected yourself**

Remember at concentrations above 1000 ppm, collapse, coma, and death due to respiratory failure can occur within seconds after only a few breaths

Conclusion

- Hydrogen sulfide gas is a real danger in certain operations and confined spaces
- Hydrogen sulfide gas is deadly and kills workers annually
- Early recognition and detection are critical to prevent employee exposures
- Hydrogen sulfide causes health effects which employees should recognize

Conclusion

- OSHA requires that exposures be below 20 ppm with a one time peak of no more than 50 ppm
- If hydrogen sulfide is measured in excess of the OSHA PEL then engineering controls must be implemented
- Respiratory protection should only be used if engineering controls are not effective