Ethylene Oxide (EtO)

Mark Wilson, CIH
Environment, Safety and Health Compliance Office
Industrial Hygiene Team
What is EtO?

- Chemical used to sterilize sensitive instruments and materials that are not suited for other sterilization methods
  - Steam may damage sensitive equipment
  - Liquid disinfectants may not kill all microorganisms
- EtO kills all known viruses, bacteria, bacterial spores without damaging the material
EtO use is regulated by:

- Standard requires and establishes:
  - Permissible exposure limits
  - Exposure monitoring
  - Control measures
    - Engineering controls
    - Administrative & work practice controls
  - Medical surveillance
  - Training
**Material Safety Data Sheet**

- **Chemical Name**: Ethylene Oxide
- **Weight By %**: 84 to 97%
- **Chemical Family**: Epoxide
- **Formula**: \((\text{CH}_2\text{)}_2\text{O}\)
- **Molecular Weight**: 44.06 gms/mole
- **CAS Number**: 75-21-8
- **CAS Name**: Oxirane
- **Synonyms**: EO, EtO, Dihydroxirene, 1-2 Epoxethane, Dimethylene Oxide, Oxane, Oxirane, Alkene Oxide, Alpha/Beta-Oxidoethane, Oxacyclop propane.
- **Product Uses**: Chemical intermediate for production of antifreeze, polyester resins, non-ionic surfactants and specialty solvents; sterilizing agent for controlling microorganisms in health care applications; fumigant for controlling insect infestation in whole and ground spices and cosmetics.
- **Exposure Limits**:
  - NIOSH REL: Ca TWA <0.1 ppm (0.18 mg/m³) C 5 ppm (9 mg/m³) [10-min/day] See Appendix A
  - OSHA PEL: [1910.1047] TWA 1 ppm 5 ppm [15-minute Excursion] IDLH Ca [800 ppm] See: 75218 Conversion 1 ppm = 1.80 mg/m³
- **Physical Description**
  - Colorless gas or liquid (below 51°F) with an ether-like odor.
  - MW: 44.1  BP: 51°F  FRZ: -171°F
  - Sol: Miscible  VP: 1.46 atm  IP: 10.56 eV
  - RGasD: 1.49  Sp.Gr: 0.82 (Liquid at 50°F)
  - Fl.P: NA (Gas) -20°F (Liquid)  UEL: 100% LEL: 3.0%
  - Flammable Gas
- **Incompatibilities & Reactivities**
  - Strong acids, alkalis & oxidizers; chlorides of iron, aluminum & tin; oxides of iron & aluminum; water
Physical Characteristics of EtO

- Volatile - gas at room temperature
- Flammable - flash point -0.4 degrees F
- Reactive - polymerizes upon exposure to heat, acids, bases
- Odor - ether like odor at 200-700 ppm
  - Permissible exposure limit = 1 ppm
  - Inadequate warning properties
Health Hazards

- Acute exposures (short term)
  - Irritating to eyes, nose, respiratory tract
  - Skin-severe irritation and blistering
  - Inhalation may cause headache, nausea, pulmonary edema

- Chronic exposures (long term)
  - Cancer (carcinogen)
  - Reproductive hazards (mutagen, teratogen)
How can you be exposed?

Routes of Exposure

- Inhalation
- Skin contact
- Eye contact
Inhalation is Primary Route of Exposure
EtO Exposure limits

- OSHA
  - Permissible exposure limit (PEL - 8 hr TWA) = 1 ppm
  - Action level = 0.5 ppm
  - Excursion limit (15 minutes) = 5 ppm
- ACGIH TLV = 1 ppm
- NIOSH IDLH (immediately dangerous to life and health) level = 800 ppm
Methods to detect presence of chemicals

- Warning properties
  - Odor (odor threshold) - Inadequate for EtO
  - Visual appearance

- Monitors

- Direct reading instrumentation

- Personal/area monitoring
  - Normally requires lab analysis
Exposure Monitoring

- Determination of concentrations present (parts per million) to determine whether exposures and levels of EtO are within acceptable limits
- Personal monitoring
- Area monitoring
  - Installed monitor to continuously measure concentrations
  - Alarm at elevated levels
Exposure Monitoring

- Direct reading
- Lab analysis
Personal Monitoring

- Monitor worn by worker in the breathing zone during normal or high risk procedures
  - Full shift (8hr TWA) → PEL
  - 15 minutes during brief/intense exposures → Excursion Limit
    - During unloading of sterilizer
    - Older sterilizers using large tanks required cylinder changes
Monitoring specific tasks
EtO Passive Monitor

Badge must be worn in the operator’s breathing zone*

*OSHA Small Business Guide for Ethylene Oxide, p.41
Area Monitoring

- Monitors placed in the area during normal or high risk procedures
- Installed monitors
  - Draeger PointGard II EtO monitor
  - Gives continuous digital readout of EtO concentration in the area of the sterilizer
  - Set to alarm at 1.0 ppm (loud audible alarm)
Area Continuous Monitor
Control Measures

- Engineering controls
  - Ventilation (sterilizer is connected to exhaust duct to the outdoors)
  - Interlocks (door will not open until cycle is complete)

- Administrative controls
  - Small quantity of EtO in cartridge
  - Only trained individuals use system

- Work practices
Medical Surveillance

- Required if:
  - Exposure above the allowable limits
  - Following accidents, spills, releases, system failures resulting in single high exposure
  - Worker develops signs and symptoms believed due to EtO exposure
Provided by the CDC Occupational Health Clinic

Workers should report to their supervisor:

- Illness, signs, symptoms related to EtO
- Accidents, releases, equipment failure, etc
Response to Emergencies

- In event of alarm:
  - Exit area
  - Notify supervisor
  - Possibly notify Anderson if equipment problem

- In the event of exposure
  - Move to fresh air
  - Seek medical attention