1.0 Introduction

Benzene exposure has been associated with aplastic anemia and blood cancer. The Occupational Safety and Health Administration (OSHA) have promulgated an expanded Benzene Standard Title 8 of the California Code of Regulations, Section 5218(OSHA 29 CFR 1910.1028), which outlines the regulatory requirements for the safe handling and use of benzene. The Sunbelt Controls Benzene Safety Program explains the OSHA requirements, explains how you can protect yourself, and explains how to be in compliance with this OSHA standard.

Benzene is a colorless, highly flammable liquid chemical with a sweet odor. It has been produced from coal since 1849 and from petroleum since 1941. Oil workers produce 95 percent of the benzene used in the U.S. and chemical workers know benzene as the building block for many other organic chemicals.

Benzene is a valuable raw material and intermediate in the production of other organic chemicals. These chemicals include ethylbenzene, phenol, cyclohexane, styrene and maleic anhydride. Smaller amounts of benzene are used in manufacturing detergents, explosives, pharmaceuticals and dyestuffs. Benzene has become almost indispensable to the chemical industry and the wide range of its applications makes it especially imperative that every precaution be observed in its use.

2.0 Objectives

After completing this module, you should know the following information:

- **the symptoms and health hazards associated with exposure to benzene**
- **the OSHA Permissible Exposure Limits for benzene**
- **when exposure to benzene should be measured by SRS**
- **the safe work practices that can be used to reduce exposure**
- **the basic requirements of the OSHA Medical Surveillance Program**
- **what should be done in the event of a spill or other accident in my work area**
- **the appropriate requirements for safe storage and disposal of benzene**

3.0 Hazards

3.1 Signs and Symptoms of Exposure – Chronic Health Effects

Chronic effects are various blood disorders, ranging from aplastic anemia to leukemia (blood cancer), that may appear over a relatively long period of time, usually after repeated and prolonged exposures above the OSHA permissible exposure limits (PEL). Benzene exposure has been associated with human cancers such as myeloid leukemia, acute lymphocytic and/or myelogenous leukemia, hairy cell leukemia, myelodysplastic syndrome, Hodgkin's disease and lymphomas. The hematopoietic (blood forming) system is the chief target for benzene's chronic toxic effects which are manifested by alteration in the levels of formed elements in the peripheral blood.

3.2 Routes of Entry

Benzene can affect your body through inhalation, skin/eye contact or accidental ingestion. The dose, or amount of exposure, determines the type and degree of beneficial or adverse health effects.

3.3 Signs and Symptoms of Exposure – Acute Health

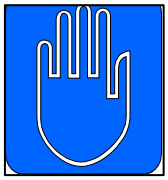
3.3.1 Effects

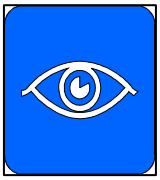
Acute effects are symptoms that occur at very high concentrations of exposure.

3.3.2 Inhalation

Exposure to high concentrations of benzene may cause breathlessness, irritability, euphoria, giddiness, headache, dizziness, nausea, intoxication, or otherwise affect central nervous system functions. It may cause severe irritation of the eyes, nose and respiratory tract. Severe exposures can also lead to convulsions and loss of consciousness. Aspiration of small amounts of liquid benzene into the lungs immediately causes pulmonary edema and hemorrhage of pulmonary tissue.

3.3.3 Skin Absorption and Eye Contact





Contact with benzene may cause severe irritation of the skin and eyes. Benzene can be absorbed into the skin and cause dermatitis and erythema. Direct eye contact may result in temporary corneal damage.

3.3.4 Ingestion

Benzene ingestion may cause nausea, vomiting, headache, dizziness and gastrointestinal irritation.

4.0 Physical Properties

Benzene poses a serious fire and explosion hazard when exposed to heat or flame. Benzene vapor is heavier than air, travels for some distance on top of the ground, and may come into contact with ignition sources. The flame may then be propagated along the vapor trail back to the source and cause an explosion. For this reason, smoking is never allowed in storage or process areas where benzene is located.

Benzene is colorless, and has an aromatic odor. Benzene is not soluble in water.

5.0 Safety Data Sheet (SDS)

You will find more information on the hazards of benzene in the Safety Data Sheet (SDS) for the specific chemical you are working with. An SDS is a chemical information sheet provided by the manufacturer containing safety information about the chemical such as the health hazards, symptoms of exposure, fire and reactivity data, personal protective equipment and engineering controls required for safe handling and use, accident/spill procedures and storage and disposal guidelines. A SDS for the benzene product you are using should be available in your work area at all times.

6.0 Measuring Exposure

6.1 What are the OSHA exposure limits for Benzene?

OSHA has issued several types of limits for employee exposures to trigger various regulatory requirements. These are specified as the action level (AL), the time-weighted average limit (TWA) and the short-term exposure limit (STEL).

7.0 Action Level (AL)

A limit defined as 0.5 parts benzene per million parts of air (5 ppm) calculated as an eight (8) hour time-weighted average. If employees are exposed at or above this concentration for more than 30 days per year, OSHA mandates that employers initiate certain required activities such as annual exposure monitoring and medical surveillance.

7.1 The Time-Weighted Average (TWA) and Short Term Exposure Limit (STEL) and Permissible Exposure Limits (PEL)

The TWA limit is defined as one part benzene per million parts of air (1 ppm) as an 8-hour time- weighted average. The STEL limit is defined as 0.5 parts benzene per million parts of air (5 ppm) averaged over any 15-minuite period. Above either of these PEL's, employers are required to provide protective equipment such as respirators, must study and install engineering controls, if feasible, establish regulated areas, and perform other OSHA-required procedures and duties.

7.2 How is exposure to Benzene determined?

7.2.1 Air Monitoring

If benzene is used in a work area, then initial air monitoring should be conducted by Sunbelt Controls safety personnel to determine benzene exposures for each job classification in each potentially affected work area. Contact Sunbelt Controls Safety department to arrange for a industrial hygienist to utilize special sampling equipment to collect representative air samples for laboratory analysis of the airborne benzene.

If employee exposures are found to be above the action level, then air monitoring will be repeated on an annual basis. If exposures are above either of the PEL limits (TWA and/or the STEL), then air monitoring will be conducted at least every six (6) months. Exposure monitoring will continue until exposures are reduced below these limits, by either engineering or administrative controls. Air monitoring should be repeated in an area each time there is a change in equipment, processes or controls

which may result in additional exposure to benzene, and if employees are experiencing signs or symptoms of benzene exposure.

8.0 Reducing Exposure

8.1 What can be done to help prevent exposure to Benzene?

8.1.1 Standard Operating Procedures

Working with benzene requires a written Standard Operating Procedure that addresses the following:

- The hazards of benzene
- What containment devices (e.g., chemical fume hoods, glove boxes) and/or Personal Protective Equipment (PPE) will be used or required when working with benzene
- Designated storage and use areas
- How to properly dispose of waste solutions containing benzene
- Decontamination and spill clean-up procedures

8.1.2 Container Labels

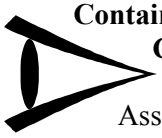
The OSHA Hazard Communication regulations require that all chemical containers must be labeled with the name of the chemical and any of the hazards associated with that chemical. All benzene-containing (>0.1%) solutions should have a warning label stating, at a minimum, "Contains Benzene, Cancer Hazard", because OSHA has designated benzene as a carcinogen.

If a chemical product containing more than 0.1% benzene is transferred into a container other than the original container from the manufacturer, it must be labeled, at a minimum, with the following information:

DANGER!

Contains Benzene

Cancer Hazard



When labeling containers of benzene with a National Fire Protection Association (NFPA) system, use the following hazard ratings:

HEALTH – 3
FLAMMABILITY – 3
REACTIVITY – 0

Protective Equipment - this will vary based on the use and must be at least a B. (B indicates appropriate gloves and safety goggles are required.)

8.2 Substitution

When possible, substitute a less hazardous chemical into the procedure or revise the process to reduce or eliminate benzene exposures.

8.3 Engineering Controls

When possible, use chemical fume hoods and/or local exhaust ventilation to reduce exposures to benzene. Local exhaust is used to capture and exhaust benzene vapors from

the worksite, thereby preventing the accumulation of high exposure levels in the employee's breathing zone.

8.4 Personal Protective Equipment (PPE)

Contact with the eyes or skin with liquids containing benzene will be minimized by the use of protective garments and equipment. Of the various materials tested, it has been determined that PVC is the most resistant to penetration by benzene. The type of PPE necessary will vary depending on the concentration, amount used and the potential for splashing. It may include goggles, face shields, gloves, gowns, lab coats, aprons and arm sleeves. Sunbelt Controls safety department personnel can assist with guidance on the appropriate PPE for your area.

8.5 Respirators

If employee exposures are found to exceed either of the PEL's, respirators will be provided until feasible engineering or administrative controls can be implemented. Respirator use and type will be determined by SRS industrial hygienists based on air monitoring results. If respirator use is necessary, employees must be medically cleared by their employee health service to wear a respirator. Employees must also be fit-tested and trained by SRS personnel before using a respirator.

9.0 Medical Surveillance

9.1 Medical Surveillance Program

Employees found to have exposures that exceed the benzene action level 30 or more days per year or above the PEL's 10 or more days per year, will be included in a medical surveillance program. These employees will complete a medical questionnaire annually and receive a physical examination by their employee health service. The physical will include blood tests to determine if any blood disorders may exist.

Employees exposed to benzene must also receive medical attention in accordance with OSHA requirements under the following circumstances:

- Whenever an employee has developed signs or symptoms associated with exposure to benzene
- Whenever an employee is involved in a spill, leak or other occurrence resulting in a possible overexposure to benzene

9.2 Medical Removal Plan

If any of three specific blood abnormalities are found as a result of blood tests, the employee will be referred to a hematologist or an internist and shall also be removed from work areas, where benzene exposures may exceed the action level, to work areas where there is no benzene exposure for the duration recommended.

10.0 Disposal and Storage

10.1 Storage

Benzene shall be stored in a flammable storage cabinet within an unbreakable, chemically resistant secondary container to contain spills. Benzene is classified as a 1 B Flammable liquid for the purpose of OSHA regulation 29 CFR1910.106. Do not store benzene with acids or oxidizing agents.

10.2 Disposal

Benzene waste should be stored in a labeled waste container in a flammable storage cabinet.

11.0 Emergencies

11.1 What do I do in the case of a spill in my work area?

Trained field personnel can clean up the vast majority of chemical spills that occur in the lab. The individual(s) who caused the spill is(are) responsible for prompt and proper clean-up. It is the responsibility of the supervisor and/or chemical safety officer to have spill control clean-up materials and personal protective equipment, which are appropriate for the chemicals being handled, readily available. Supervisors are also responsible for ensuring that spills are cleaned up as soon as possible. The types and quantities of hazardous chemical substances used by Sunbelt Controls may require preplanning in order for accidental chemical releases to be handled in a safe manner. Two categories of chemical spills and response procedures are identified for the purposes of this Sunbelt Controls Benzene Safety Plan.

11.1.1 Minor Spills

Minor spills can be cleaned up with absorbent material. The appropriate PPE such as respirator, safety glasses and benzene resistant gloves, must be used to minimize inhalation and skin contact with the benzene.

11.1.2 Major Spills

Employees should not attempt to clean up large quantity spills (more than 5 gallons) of benzene, particularly in confined or restricted spaces, unless special training has been received, appropriate spill cleanup material are available in a spill cleanup kit, and personal protective equipment are readily available. If an area contains large quantities of benzene, emergency procedures must be included as part of the Standard Operating Procedures for benzene use in your area, and all employees should be trained in proper spill cleanup procedures. Otherwise, in the event of a very large or major spill for which you are not properly trained or prepared, evacuate the area and call 911.