

# Standard Operating Procedures for Working with Organic Solvents

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## 1 INTRODUCTION:

This document describes the safety requirements that laboratory workers and supervisors must follow when non-halogenated organic solvents are used in UPEI laboratories. Its purpose is to minimize risks to the health of UPEI laboratory workers.

## 2 SCOPE:

This SOP is under the control of the UPEI Health and Safety Advisor and may be downloaded from the UPEI Health and Safety Website.

This SOP is appropriate for the handling of most organic solvents used in UPEI laboratories.

These chemicals include methanol, acetonitrile, hexane, acetone, acetates, ethers and others. Most organic solvents are highly flammable.

Halogenated solvents including methylene chloride and chloroform are described in SOP5.103.

This document is meant to inform laboratory workers about the health and physical hazards of organic solvents.

A laboratory worker with a chemical background should be able to read and understand this SOP in about 1 hour.

Laboratory Supervisors should use this SOP as a part of Site Specific training by following *SOP2.103 Site Specific Training Using UPEI Safety SOPs*.

This SOP is meant to compliment, but not to replace, other classes of SOPs which are required in Laboratories (such as those related to analytical procedures) and which must also contain relevant safety information and/or references.

## 3 SAFETY RISKS:

Failure to follow this procedure may result in:

- 1) skin and eye irritation;

2)skin defatting or dermatitis from prolonged or repeated skin exposure<sup>1</sup>;

3)central nervous system depression;

4)Reproductive and fetal effects;

5)chronic toxic effects, such as liver or kidney effects, from inhalation of solvent vapors;

6)Acutely toxic effects, including blindness and death;

7)flash fires and explosions.

#### 4DEFINITIONS:

**Epoxide:** An epoxide is a cyclic ether with only three ring atoms. This ring is an equilateral triangle, i.e. its bond angles are about 60 degrees. The strained ring makes epoxides very reactive and explosive. Many ethers are prone to epoxide formation during storage.

**Flammable** A flammable liquid is one which has a relatively low flash point.

**Flash Back** - When the vapor density of a solvent is heavier than air, solvent vapors from a source such as a leak or spill may travel a long distance along the floor level from the release site. If these vapors reach an ignition source, the resultant combustion may "flash back" to, and ignite, the original source.

**Flash Point** - The flash point is the lowest temperature at which a liquid gives off enough vapors which, when mixed with air, can be easily ignited by a spark. The lower the flash point the greater the risk of fire or explosion.

**Laboratory workers:**Refers to all permanent and temporary UPEI laboratory workers, students, faculty and visitors who make use of UPEI laboratory space.

**Organic solvent:** refers to solvents that contain carbon atoms. Organic solvents usually have a low boiling point and evaporate easily.

**Primary Irritant** A primary irritant causes irritation by direct contact with the skin, eyes, or respiratory system.

**Skin Defatting Agent** A skin defatting agent causes deterioration of the fatty layer of the skin with prolonged or repeated contact.

#### 5RESPONSIBILITIES:

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<sup>1</sup>when the skins' fatty layer is damaged, one becomes more susceptible to dermatitis, and chemicals are more readily absorbed through the skin;

Laboratory Supervisors are required to provide laboratory workers with written standard operating procedures for all hazardous processes using organic solvents.

Laboratory Supervisors are responsible to ensure that all laboratory workers who work with organic solvents have been educated in relevant safety issues.

Laboratory Supervisors are responsible to document and maintain a list of laboratory workers who have had safety training for working with organic solvents, and for checking that only appropriately trained individuals are allowed to work with these chemicals in the areas under their supervision.

The Laboratory Supervisor should follow SOP2.102 for documenting safety training records.

Laboratory Supervisors are responsible for ensuring that adequately ventilated areas are available for operations utilizing organic solvents.

Laboratory Supervisors are required to provide workers with any necessary personal protective equipment.

All laboratory workers who work with organic solvents must be satisfied that they have received sufficient education in safety techniques including: use of personal protective equipment; knowledge of potential hazards; use of spill kits; and appropriate emergency procedures, before working with these chemicals.

Before performing any procedure using organic solvents a laboratory worker must read and be satisfied that they understand the SOP associated with that procedure.

All laboratory workers are required to use due diligence in working with organic solvents.

Additional responsibilities for supervisors and workers are defined in the UPEI Laboratory Safety Manual Chapter 2

## **6.0 REQUIRED SUPPLIES:**

**FUME-HOODS.** A fume-hood shall be used when pouring out organic solvents.

**GLOVES.** Gloves shall be worn whenever organic solvents are handled. Lightweight PVC gloves are sufficient to prevent incidental contact, but should be removed into a fumehood when a solvent is spilled on the gloves. Heavier Nitrile gloves are required for cleaning up spills and are required whenever hands or fingers must be immersed in the solvent.

**GLASSES.** Safety glasses are necessary for most solvent operations. Laboratory workers who do not wear glasses or who wear contact lenses must be provided with splash-proof chemical goggles or face shields when handling flammable solvents.

**FACE SHIELDS.** Face shields may be necessary when there is a potential for splashes or explosions from use of large quantities of solvents.

**SPILL MATERIALS.** Spill kits should be available in the laboratory. Paper towels or adsorbent materials such as spill control pillows, and chemical resistant gloves should also be available. Where quantities of flammable solvents can produce an explosive mixture with air in the laboratory, special absorbent materials such as activated carbon (available through Lab Safety Supply) must be considered to eliminate the explosion hazards.

**PROTECTIVE CLOTHING.** A lab coat is required when working with organic solvents.

## **7.0 GENERAL PROCEDURES:**

### **4.3 GENERAL REQUIREMENTS FOR WORKING WITH ORGANIC SOLVENTS**

- 1) Read the MSDS sheets for the solvents to be used prior to its initial.
- 2) Inspect the area for ignition sources such as live electrical circuits, electric sparks, propane torches, welding activities, and hot surfaces. No activities involving an ignition source, such as a propane torch, may be performed in the vicinity of operations using flammable solvents.
- 3) Never use any solvents in a confined, or any other poorly ventilated, area. If such work is required, ask the supervisor to review the proposed procedure.
- 4) Store flammable liquids away from oxidizing agents including bleach, peroxides and acids.
- 5) Any work with organic solvents in unsealed containers is to be done in a fumehood.
- 6) In cases where it is not possible to use a fume-hood (eg HPLC systems) the analyst must take measures to ensure that their exposure and their coworkers exposure is minimized.
- 7) Ensure that adequate spill kits and absorbent material are available before initiating work
- 8) Ensure that an eyewash station is located nearby.
- 9) Ensure that gloves, labcoats and eye protection are worn where required.
- 10) All laboratory workers working with organic solvents may request to be trained in using respirators and should be provided with their own personal respirator for use in minimizing exposure and for cleaning up spills outside of a fume-hood.
- 11) Any unattended containers must be labeled according to WHMIS workplace labeling procedures.
- 12) Select and when possible, modify, procedures to use compounds with lower hazards.
- 13) Scale methods down to use lower quantities of solvents.
- 14) Minimize as far as possible the use and storage of solvents which form explosive peroxides.

## **8.0 STORAGE**

Store solvents in tightly closed containers in cool dry well ventilated areas away from incompatible substances. Keep away from heat, sparks and sources and ignition. Peroxide forming ethers have a short shelf life. Refer to reference 4. p 258-259 for particulars on safe storage periods.

## **9.0 TRAINING:**

All laboratory workers are required to have up to date WHMIS and a site specific safety orientation

All laboratory workers must be made aware of and have easy access to the UPEI Health and Safety Policy and the UPEI Laboratory Safety Manual

The supervisor shall supply this procedure to laboratory workers, verify that they understand it through either an oral or a written Quiz (SOP2.103), and document this process, before the laboratory workers are authorized to work with non-halogenated organic solvents in UPEI laboratories.

### **10.0 SPILL PROCEDURES:**

Refer to the product Material Safety Data Sheet, the UPEI Laboratory Safety Manual and the instructions on spill kits before using these chemical to understand and be prepared for proper spill clean-up procedures.

**SMALL SPILLS** (generally less than 100ml):

- 1) Small spills generally consisting of only a few ml may be wiped up using paper towels or other absorbent pads. This should be done as quickly as possible, while minimizing any exposure to vapors. After absorbing any excess liquid, clean-up materials should be placed in the fume-hood and allowed to evaporate.

**MANAGEABLE CHEMICAL SPILLS** (Rule of thumb 100ml – 500ml):

- 1) Eliminate sources of ignition.
- 1) Alert others working in laboratory. Keep people out of the immediate area.
- 2) Establish barriers if the spill has occurred in public passageways.
- 3) If unsure how to proceed seek help and retrieve the necessary MSDS sheets.  
The person cleaning up the spill should wear a respirator and gloves.
- 4) Transfer the material containing the spill to a plastic container and carry to a fume-hood for later disposal. Allow fumes to evaporate in the fume-hood overnight or over a weekend.
- 5) If the residual waste is hazardous, package all contaminated material in a suitable container, attach a label and submit for waste disposal.

### **MAJOR CHEMICAL SPILLS**

(eg. A full bottle of an organic chemical dropped and smashed on the floor)

- 1) Alert others working in laboratory and adjacent areas to evacuate the building.
- 2) Eliminate sources of ignition.
- 3) Pull the fire alarm. Phone security 0384 from a safe area eg. an office area; advise them of your name and give a quick summary of the details of the spill.
- 4) Retrieve the necessary MSDS sheet(s) if safe to do so.

- 5) Meet security to inform them of the details.
- 6) Formulate a clean-up plan in consultation with the UPEI Safety Officer, Security Officers and/or the fire department.

*The plan may involve two people wearing SCBA's. A chemist, with knowledge of the chemical that was spilled and who is also educated in the use of SCBA's will do the clean up; while a Safety or a Security officer observes from a safe distance.*

#### **11.0 FIRST AID PROCEDURES:**

- 1) Any splash or exposure of the skin should be immediately, thoroughly flushed for 5 - 15 minutes. Do not allow contaminated clothing to remain in contact with the skin.
- 2) If skin irritation or dermatitis develops, the affected individual must be examined at a Medical Facility.
- 3) In the event of eye contact, flush for 15 minutes of flushing with water.
- 4) If an individual ingests an organic solvent have them rinse their mouth out with water and call the **poison control center 1-800-565-8161**. (They may direct you to give milk, water, or activated charcoal to help soak up toxins, or syrup of ipecac to induce vomiting). **DO NOT** give anything by mouth unless instructed to do so by the poison control center, or by a physician.
- 5) **DO NOT** give anything by mouth if victim is unconscious. Remove victim to fresh air and Dial 0384 for emergency assistance.

#### **12.0 WASTE DISPOSAL PROCEDURES:**

Place organic solvent wastes into clearly labeled, appropriate containers for Hazardous waste disposal. Do not mix different kinds of organic solvents together unless instructed to do so by the supervisor.

#### **13.0 REFERENCES:**

1. HALE, J. R. Inherent Safety and Pollution Prevention Strategies for the Analytical Laboratory. Managing the Modern Laboratory Vol. 6, No. 4, 2004
2. CHILDS, B., ECKMANN A., Standard Operating Procedure for Flammable Solvents and Products Containing Flammable Solvents., Plasma Science and Fusion Center, MIT, Office of Environment, Safety, and Health
3. SHEMATEK, G; WOOD, W. Laboratory Safety Canadian Society of Laboratory Technologists Guidelines 4<sup>th</sup> ed. 1996
4. FURR, KEITH A., CRC HANDBOOK OF LABORATORY SAFETY, 5<sup>th</sup> Edition, CRC Press, Boca Raton 2000
5. The Chemical Institute of Canada. LABORATORY HEALTH AND SAFETY GUIDELINES, 4<sup>th</sup> edition. Ottawa, ON, 2003.

#### **14.0 ADDITIONAL INFORMATION:**

Diethyl ether is highly flammable. Its vapors are denser than air and will accumulate if proper ventilation is not present. Simple static electricity will ignite ether vapors. Diethyl ether vapors ignite explosively, and should only be used inside a fume hood

All ethers are prone to peroxide formation, and can form explosive ether peroxides. Ether peroxides are higher boiling and are contact explosives when dry. Never distill ether to dryness, as the risk of explosion increases dramatically. Diethyl ether is typically supplied with BHT (2,6-di-tert-butyl-4-methylphenol), which reduces the formation of peroxides. Bottles older than 3 months should be routinely tested for peroxides. An iron wire, releasing Fe(III) ions catalyzing the peroxide decomposition, was often added to bottles with diethyl ether as a preventive measure, however, Fe(III) ions also strongly enhance peroxide formation. Storage over NaOH precipitates the intermediate ether hydroperoxides.

Ethers should be bought in the smallest practical containers appropriate to the rate of usage and their safe shelf-life is quite short. Refer to reference 4. p 258-259 for particulars on safe storage periods.

## 15.0 COMMENTS AND SUGGESTIONS:

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**16.0 QUESTIONS ON NON-HALOGENATED ORGANIC SOLVENTS:** These questions should be used by Supervisors for assessing laboratory workers safety skills by following SOP2.102 = *Site Specific Training Using UPEI Safety SOPs*.

1. Name three common organic solvents?
2. What is an epoxide? Why are epoxides hazardous?
3. Where are the spill kits for organic solvents kept in your area?
4. Describe how you would respond if someone spilled 500ml of diethyl ether in a laboratory equipped with an ignition source?
5. What would you do first if you are directed to work with an organic solvent that you are unfamiliar with?
6. Where should methanol be stored?
7. Where are the eyewash stations in your Area?
8. Where would you find the phone number to the poison control center in an emergency?
9. What PPE should you wear when working with organic solvents?
10. What would you do if there was inadequate ventilation in an area where you were told to work with caustic chemicals?

Signature (Primary Author) \_\_\_\_\_ Date

Signature: Health and Safety Advisor \_\_\_\_\_ Date

REVISION NUMBER: \_\_\_\_\_

Effective Date