

Standard Operating Procedure

General Laboratory Safety

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| Facility: | Polymer Reaction Engineering Laboratory Department of Chemical Engineering |
| Lab Director: | Kyu Yong Choi |
| Scope: | This SOP details the Personal Protective Equipment (PPE) requirements for work in the Polymer Reaction Engineering Laboratory |
| Last Revision: | March 9, 2012 |

General:

This procedure addresses general safety & health requirements for work in the laboratory.

Procedures:

- I. HAZARD IDENTIFICATION
 - A. All chemical containers must have a legible, firmly attached label showing the contents of the container.
 - B. Labels on incoming containers of hazardous chemicals must not be removed or defaced. Any labels that are damaged must be immediately replaced with labels containing the same identification, warning and source information.
 - C. Material safety data sheets (MSDS) received with incoming shipments of hazardous chemicals must be maintained and made readily accessible to laboratory employees.
 - D. A hazard review of new materials not previously used in the laboratory must be completed under direction of the LS/PI before actual handling of the material begins.
 - E. Chemical substances (or by-products) developed in the laboratory are assumed to be hazardous in the absence of other information.
 - F. If a chemical substance is produced in the laboratory for distribution outside of the University confines, MSDS and labeling provisions per the OSHA A Hazard Communication Standard apply. An MS DS must be developed by the lab director to accompany the substance during transport.
- II. EXPOSURE MONITORING
 - A. Employee exposures to OSHA-regulated substances shall not exceed the permissible exposure limits specified in 29 CFR Part 1910, Subpart Z:
www.osha.gov
 - B. Employee exposures to any substance regulated by an OSHA standard shall be measured when there is reason to believe that exposure levels routinely exceed the action or permissible level. Lab employees are to notify the LS/PI if there is suspicion for significant exposure. Use of chemicals in a properly-functioning fumehood typically precludes this possibility.
 - C. The Department of Environmental Safety (405-3980) shall be consulted for assistance with exposure monitoring. The LS /PI is responsible for contacting DE S if exposure monitoring is believed to be necessary.

- D. Results of personal monitoring shall be made available to the affected employee and L S/PI within five (5) days of receipt of the results by DES.
- E. The lab director must document that sampling results are reviewed with the affected worker(s).

III. MEDICAL PROGRAM

- A. Medical surveillance, including medical consultation and follow-up, shall be provided under the following circumstances:
 - 1. Where exposure monitoring reveals exposure over the action level (or PEL if there is no action level) for an OSHA regulated substance which has medical surveillance requirements.
 - 2. Whenever a laboratory employee develops signs or symptoms that may be associated with a hazardous chemical to which the employee may have been exposed to in the laboratory.
 - 3. Whenever a spill, leak, or explosion results in the likelihood of a hazardous exposure.
 - 4. For any employees using respiratory protection.
- B. All medical examinations shall be provided by a licensed physician or under direct supervision of a licensed physician, at no cost to the employee, without loss of pay, and at a reasonable time and place. Medical monitoring programs should be coordinated with the Occupational Health Unit at the University Health Center (301-314-8199).
- C. First aid kits are to be supplied and maintained by the LS/PI. Additional non-emergency medical assistance, if required, is available at the University Health Center. Emergency medical assistance is available by calling 911. Emergency phone numbers shall be posted in each lab (UM Emergency Response Guide).
- D. Where medical consultations or examinations are provided, the examining physician shall be provided with the following information:
 - 1. The identity of the hazardous chemical(s) to which the employees may have been exposed.
 - 2. A description of the conditions under which the exposure occurred including quantitative exposure data if available.
 - 3. A description of the signs and symptoms of exposure that the employee is experiencing, if any. If the injured laboratory employee is transported by ambulance and is unable to provide this information at the time of treatment, a coworker should accompany the employee to the hospital.
- E. Medical examinations or consultations provided to employees shall be maintained at the University Health Center and available per the requirements of 1910.20 "Access to Employee Exposure and Medical Records." A written opinion from the examining physician shall be provided to the laboratory supervisor or Chemical Hygiene Officer. It shall include:
 - 1. Recommendations for further medical follow up.
 - 2. Results of the examination and associated tests.
 - 3. Any medical condition that places the employee at increased risk due to exposure to a hazardous substance found in the workplace.
 - 4. A statement that the employee has been informed of the results of the examination or consultation.
- F. Accidents
 - 1. Injuries, which occur in the laboratory must be immediately treated.
 - 2. Injuries requiring first aid may be treated using the first aid kit provided/maintained by the LS/PI in each lab.
 - 3. Emergency transport (ambulance) shall be contacted to respond to injuries requiring more extensive treatment.

4. All injuries shall be investigated by the employee's immediate supervisor (or designate) and reported to the UM Chemical Hygiene Officer.
5. Lab incidents (without injury) should also be reported and reviewed with the Chemical Hygiene Officer.

IV. EMERGENCY EQUIPMENT

- A. Each laboratory employee shall be familiar with the location, application, and correct ways to operate the following equipment.
 1. Fire extinguishers
 2. Fire alarms
 3. Safety showers
 4. Eye wash stations
 5. First aid kits
 6. Chemical response spill kits
 7. Emergency shut-off on equipment
 8. Location of emergency telephone numbers and telephones.
- B. Safety Showers and Eyewashes
 1. Safety showers and eyewashes should be within the work area for immediate emergency use if required.
 2. Inspections:
 - a. Access to the eyewash should be checked at the beginning of each shift by a lab employee. A clear path must be maintained at all times.
 - b. Adequate eyewash flow should be observed by operating the device at least weekly for a one minute period. This flow test also serves to clear sediment or rust that may accumulate in piping.
 3. Safety showers and eyewashes will be inspected annually by the Department of Facilities Management.
- C. Fire Extinguishers
 1. It is the responsibility of the Department of Facilities Management to oversee, select, maintain, and properly locate the fire extinguisher(s) in each laboratory.
 2. Fire extinguishers should be provided within 30 feet of travel from the fire hazard(s) and located along normal paths of travel.
 3. Access to fire extinguishers must be maintained and the location should be conspicuously marked.
 4. The fire extinguisher type and size must be selected for the appropriate hazards. If combustible metals are present in a lab facility, the LS/PI must ensure that a class D extinguishing agent is available.
 5. Each laboratory is responsible to notify the Department of Facilities Management (301)405-2222 if:
 - a. Facility modifications require movement of the extinguisher
 - b. A different type of fire extinguisher is necessary due to the fire hazards present
 - c. An extinguisher has been discharged, or
 - d. An extinguisher needs service or repair.
 6. The following items should be inspected monthly by laboratory personnel:
 - a. Extinguisher(s) are in designated locations.
 - b. Clear unobstructed access is maintained.
 - c. The pin should be in place and attached with an unbroken wire.
 - d. The indicator should be on full.
 - e. There should be no indication of physical damage.

- D. Fire Alarms
 - 1. Fire protection design and procedures are the responsibility of the University Fire Marshal.
 - 2. The Department of Facilities Management, Life Safety Shop shall ensure that the following items are periodically inspected:
 - a. Fire alarms should be conspicuously marked.
 - b. Fire alarms will be activated to insure proper operation.

- E. First Aid Kits
 - 1. First aid kits should be available and maintained for treatment of minor injuries or for short-term emergency treatment before getting medical assistance.
 - 2. First aid kits are to be inspected monthly and re filled as necessary.

EMERGENCY PROCEDURES

Prevention is necessary to ensure that emergencies do not occur. No emergency plan will do all things for all emergency situations. Preventive measures include: employee training, facility inspection programs, and engineering design of hazardous materials processes. Laboratory risks include accidents or injuries, chemical releases, release of radioactive or infectious aerosols, fires, explosions or other emergency situations.

- A. An emergency response team has not been established at the University of Maryland. The University relies upon the local fire authority (Prince George's County) for any emergency response action. Laboratory occupants must call 911 for any situation that is determined to be an emergency. More information concerning emergency response is available from the Emergency Response Guide which is to be posted in each laboratory.
- B. Chemical Spills
 - 1. Laboratory personnel, upon experiencing a spill of hazardous material during normal laboratory activities, which is beyond their capability to safely clean up, and which presents an acute fire or health hazard shall contact 911 to report the spill as an emergency.
 - 2. Examples of laboratory spills, which may be handled by lab personnel routinely include, but are not limited to: broken thermometer, countertop spill of a hazardous chemical, and breakage of glassware containing small quantities of hazardous chemicals. The Department of Environmental is available for consultation and assistance.
 - 3. Large spills may require special training and compliance with the OSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER).

VI EMPLOYEE TRAINING

- A. Training
 - 1. All laboratory employees shall be trained on the hazards of chemicals present in their work area. The LS/PI is responsible for assuring all lab employees are appropriately trained.
 - 2. The aim of the training program is to assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs. Training in the requirements of the OSHA Chemical Hygiene Standard is also required.
 - 3. This training shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present. It shall also be provided prior to assignments involving new exposure situations. The training shall be arranged by the LS/PI. Orientation training the first week of fall and spring semesters is recommended for new graduate assistants and technicians.

4. All employees must also be trained and oriented by the LS/PI concerning lab standard operating procedures.
- B. Reference Materials
1. Reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals are located at (specify locations).
 2. Material safety data sheets (MSDS) shall be provided by the LS/PI (or designee) for all hazardous chemicals used in the laboratory at (specify location and/or access instructions).
 3. The written Chemical Hygiene Plan and MSDS shall be available at all times that personnel are working in the laboratory.

VII WASTE DISPOSAL PROCEDURES

- A. Broken Glass Equipment (broken beakers, pipets, etc. that are waste) should be promptly swept up and disposed of in rigid cardboard containers. When the container is full tape it shut. Place the box into the building's dumpster. Chemically-contaminated glassware may require handling and disposal as hazardous waste. Consult the LS/PI or DES for additional guidance.
- B. Broken Thermometers (Mercury) - Immediately clean up broken glass and spilled mercury from broken thermometers. Do not handle mercury by hand. Enclose thermometer pieces in a sealed jar with a small amount of water over the mercury and follow chemical waste packaging instruction for disposal by DES. For larger spills that may require environmental monitoring and respiratory protection contact DES.
- C. Chemicals
1. Each person working in the laboratory is responsible to ensure that all wastes are disposed of properly.
 2. Waste disposal procedures must be in compliance with University, State and Federal regulations. All waste containers must be labeled with the contents and the date of accumulation. UM waste disposal procedures must be followed.
 3. All lab employees responsible for packaging and processing wastes must take the Waste Generator training offered by DES on its web page.
 4. Hoods shall not be used for disposal (i.e., evaporation) of volatile chemicals.
 5. Drains shall not be used for disposal of chemicals unless it has specifically been approved by DES.
 6. Chemical waste is removed from laboratories by DES who is also responsible for regulatory compliance once the waste is removed from the generation site.
 7. Chemical waste generators are responsible for preparing and packaging chemical waste according to the "UM Hazardous And Regulated Waste Procedures Manual" available on the DES web page.
 8. Container integrity is the responsibility of the generator. Containers must be compatible with the material inside and must be leak proof. Waste containers must be placed in secondary containment. Secondary containers (tubs) are available from DES.
 9. Costs incurred as a result of packaging failure are the responsibility of the generating department.
 10. All wastes given to DES for disposal must be identified. The cost for determining the identity of "unknowns" lies with the department. All departments are responsible for the proper disposal of any wastes left by faculty or staff who have left UM.

11. Any person shipping hazardous chemicals from the site of generation must have specific training for safe transportation of those hazardous materials.
12. Special waste disposal such as low level radiation, infectious material, lead, asbestos as other regulated waste should be disposed of per UM procedures and according to applicable regulations. Contact DES for assistance.

VIII VENTILATION

A. General

1. General laboratory ventilation shall provide airflow into the laboratory from non-laboratory areas and out to the exterior of the building (lab under negative pressure in general) through fume hoods or dedicated exhausts.
2. All laboratory doors should remain closed, except when being used for entrance.
3. Local exhaust ventilation should not be located near doors, windows, air diffusers, fans or other sources of cross drafts.
4. All reactions that produce unpleasant and/or potentially hazardous fumes, vapors, or gases must be run within local exhaust systems (e.g., fume hoods).
5. Reactions or operations that produce corrosive vapors should be conducted in a hood lined with corrosion resistant material.
6. The sash of the hood is to be positioned to ensure adequate capture velocity. An inspection sticker from DES will indicate the maximum vertical sliding sash height or maximum number of horizontally-sliding doors to be opened when the hood is in use. Fume hoods are not to be used unless an inspection sticker indicates it is acceptable for use with hazardous materials.
7. Installation of local exhaust ventilation must be in accordance with air emission regulations. Technical assistance is available from DES and Facilities Management.
8. No devices or ducts are to be installed into existing exhaust or HVAC systems without the approval of the UM Facilities Management Department.
9. Do not install unsafe devices in hoods, such as extension cords or electric switches that are not "explosion proof" by design.
10. Perchloric acid must only be used in specialized hoods that are equipped with plumbing fixtures that wash the ductwork and internal hood surfaces to prevent deposition of explosive perchlorates. See DES for assistance.

B. Maintenance & Inspections

1. Daily Inspections by Lab Personnel
 - i. Visually inspect the hood area for excessive storage and other visible blockages.
 - ii. Observe the flow alarm (if so equipped) to ensure the device is performing properly. In the absence of a flow alarm, a piece of tissue paper may be taped to the bottom of the hood sash to visually confirm operation of the fume hood.
 - iii. Fume hood alarm systems must not be disabled or modified. If deficiencies are suspected, contact the Facilities Management Work Control Center (x522 22) to report the malfunction.
2. Equipment installation/repairs are the responsibility of Facilities Management and periodic inspections are the responsibility of DES.

- C. Ventilation Failure
1. Employee s should initiate the following procedures when hood failure occurs or is suspected:
 - i. Close down or postpone the experiment if possible.
 - ii. Notify the LS /PI.
 - iii. Notify Facilities Management (x52222) to check and repair hood.
 - iv. Notify DES if consultation is needed.

VIII CHEMICAL HANDLING PROCEDURES

- A. In general, know as much as possible about the chemical you are handling. Read the label on the container, material safety data sheets, literature in the library, and consult with your peers or DES staff. Do not use any chemical material if you are unaware of the hazards associated with all avenues of exposure.
- B. Flammable Liquids
1. Hazards
 - i. Vapor can form an ignitable mixture in air.
 - ii. Many flammable liquids are solvents and are potentially hazardous by inhalation.
 - iii. Skin contact should be avoided, irritation or skin absorption are possible with some chemicals in this group.
 - iv. Damage to the eyes range from irritation to severe damage.
 2. Controls
 - i. Work in the hood as much as possible.
 - ii. Contact DES if materials will be transferred from drums into smaller containers to assure that proper anti-static measures are implemented.
 - iii. All spills must be cleaned up immediately and the spill area properly decontaminated.
 - iv. Emergency showers and eyewashes shall be used when skin or eye contact occurs. Get first aid attention immediately.
- C. Corrosive Chemicals
1. Hazards
 - i. Contact with the skin, eyes, respiratory, or digestive tract causes severe irritation, tissue damage, or burns. Burns may not be readily apparent after exposure to some acids (e.g., hydrofluoric).
 2. Storage
 - a. Store concentrated acids and bases in appropriate drip trays or plastic carrier if used frequently.
 - b. Concentrated acids and bases should be transported in a plastic carrier.
 - c. Oxidizing acids (nitric, sulfuric, perchloric) must be stored a way from organic chemicals, paper, wood, or other flammables.
 - d. Drip-tray residue must be removed daily.
 3. Controls
 - a. In case of splashing to skin: Flush affected area with large amounts of water for at least 15 minutes. Remove contaminated clothing and discard during flushing process. Seek medical attention.
 - b. Never add water to concentrated mineral acids or bases.
- D. Compressed Gases
1. Hazards

- a. Compressed gases contain gas under extreme pressure that could cause injury and physical damage. Compressed gases may also be flammable, toxic, or corrosive.
 2. Storage
 - a. Compressed gases must be stored in the upright position with caps in place and secured with a strap, chain, base stand, or rack.
 - b. Storage of quantities of flammable compressed gases requires segregation of cylinders and specific storage methods (29 CFR 1910.101 (b)): -separate oxygen from fuel gases
 - Proper use of regulators and gauges
 - Properly labeled cylinders
 - Cylinders must be properly secured during transport and stationary use
 - Cylinder delivery issues (like left free standing in a hallway) must be established
 - Static testing of cylinders
 3. Controls
 - a. Transport only with cap in place on suitable carrier.
 - b. Use only appropriate fittings and regulators.
 - c. Each gas type has special fittings.
 - d. Do not permit gases of one type to contaminate another type.
 - e. Use check valves and/or regulators.
 - f. Always open valves slowly and cautiously.
 - g. Do not let cylinder go completely empty.
 - h. Return "empty" cylinders to storage, clearly marked.
 4. Examples
 - Hydrogen
 - Argon
 - Acetylene
- F. Carcinogens, Mutagens, and Teratogens
1. Exposures can potentially induce carcinogenesis, mutagenesis, and adverse reproductive outcomes.
 2. Storage
 - a. Store these chemicals in the hood.
 - b. Maintain the minimum quantity necessary.
 3. Controls
 - a. Work in a designated and labeled area required by Chemical Hygiene Standard.
 - b. Wear protective clothing.
 - c. Work only with adequate engineering controls, such as hoods, glove boxes, etc.
 4. Examples
 - Benzene
 - Vinyl chloride
 - Lead
- G. Toxic Metals
1. Hazards
 - a. Toxic by inhalation, ingestion, and possible skin absorption.

2. Storage
 - a. The minimum quantity necessary should be kept on hand.
 - b. Store in specially designated area.
3. Controls
 - a. Work in the hood as much as possible.
 - b. Spills should be cleaned up immediately, with the work area properly decontaminated.
 - c. Designate a specific area (and label) for hazardous work or carcinogen work.
4. Examples
 - Lead
 - Mercury
 - Cadmium

VIII WORK WITH SUBSTANCES OF MODERATE TO HIGH CHRONIC TOXICITY OR HIGH ACUTE TOXICITY (PARTICULARLY HAZARDOUS MATERIALS)

- A. Use of designated areas
 1. A designated area must be established for work with "select carcinogens", reproductive toxins, and substances, which have a high degree of chronic or acute toxicity.
 2. This laboratory facility DOES use Particularly Hazardous Materials.
 3. The following procedures must be developed for all work with Particularly Hazardous Materials.
 - a. The establishment of a "designated area". This may be an entire laboratory, an area of a laboratory or a device in the laboratory, such as a hood. This area must be clearly marked. The designated area(s) in this laboratory facility is:
identify designated area(s) or specify "Not Applicable"
 - b. The control equipment required for use of Particularly Hazardous Materials in this facility are:
(Chemical Hood)
 - c. Proper storage procedures for Particularly Hazardous Materials are:
(Place the material in the labeled drawers, place flammables in the cabinet marked "flammable", Place odorous materials under the chemical hood)
 - d. The personal protection required for use with Particularly Hazardous Materials are:
(Safety glasses with side shields and nitrile gloves)