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CHEMICAL LABORATORY SAFETY AND METHODOLOGY

M.NAVANEETHAN ¹, R. BARAATHKUMAR ²

1 PG STUDENT 2 ASSISTANT PROFESSOR

INDUSTRIAL SAFETY ENGINEERING

K.S.R. COLLEGE OF ENGINEERING (AUTONOMOUS), TAMILNADU, INDIA

ABSTRACT

The possibility of danger in any circumference is known as Hazard. The hazardous chemicals are the substances used in various engineering industries for production, analysis, research and other usages. Any unexpected event producing injury or damage in engineering industries is referred as an accident. In this study, the review of literature and details of various accidents that had happened due to hazardous chemicals in south India has been studied. Handling and environmental preventive methods for engineering chemicals are mentioned for maintaining safe working environment of the engineering industries.

Keywords : Production, analysis, research and other usages

1. INTRODUCTION

Principal Investigator—is the person to whom the laboratory space is assigned. This person supervises all laboratory workers within the space.

Supervisor—is the faculty or staff member under whom laboratory work or teaching occurs. Supervisors include Senior Lab Instructors, coordinators, managers, and Principal Investigators.

Laboratory Worker—includes any person who has regular or unsupervised access to restricted laboratory spaces for research or learning purposes, including employees (e.g., faculty, staff, teaching assistants, research assistants), post-doctoral fellows, research students, volunteers, adjunct professors, research fellows, and visiting scholars.

1.1 PURPOSE AND POLICY

The University of Northern British Columbia, (UNBC) is committed to providing a safe and healthy environment to all members of the University community. As stated in the University's Occupational Health and Safety Policy, it is the objective of the University to: Protect the safety of employees, students and visitors against accidents and occupational hazards; comply with all relevant statutes, regulations and standards of government agencies and other regulatory authorities relevant to occupational health and safety (which will be considered minimum requirements); give priority to safe working conditions and job safety practices in the planning, budgeting, direction and implementation of the University activities; and formulate and carry out continuing effective safety programs appropriate to University operations.

1.2 GOVERNMENTAL POLICIES AND REGULATIONS

In order to protect against accidents and occupational hazards, personnel at UNBC must comply with all relevant governmental regulations while conducting their various work and research tasks whether they are working on or off-campus. These regulations include, but are not limited to the following.

1.3 RELATED UNBC POLICIES

In addition to government regulations, UNBC laboratory workers are required to comply with UNBC policies. Current policies are located at <http://www.unbc.ca/safety/policy.html> . Some applicable laboratory policies are:

- Occupational Health and Safety Policy
- Hazardous Waste Identification, Reporting, and Disposal Policy
- Radionuclides and Radiation Hazard Policy
- Protective Clothing and Equipment Policy
- Safety Training Policy
- Fire Safety Policy
- Fieldwork Safety Policy
- Peroxide-Forming Chemicals Policy
- Cryogenic Liquids Storage, Handling, and Transport Policy
- Respectful Workplace & Learning Environment Policy

1.4 UNBC SAFETY COMMITTEES

Committees that are mandated to cover specific aspects of safety at UNBC are listed below. Additional information on these committees, including Chair and membership information, can be found at: <http://www.unbc.ca/safety/committees.html>

- University Health and Safety Committee
- Emergency Response Planning Committee
- Research Ethics Board
- Laboratory Safety Committee
- Field Safety Committee
- Radiation Safety Committee
- Green University Committee
- Animal Care and Use Committee (ACUC)
- President's Committee on Wellness

2. RESPONSIBILITIES AND DUTIES

Chemical safety requires several levels of responsibility. The BC Workers' Compensation Board Occupational Health and Safety Regulation (Section 3.4[a]) clearly defines the roles and responsibilities of the employer, employee and students at UNBC. The list below applies these regulations to the roles and responsibilities of groups at UNBC

2.1 EMPLOYER

An employer must: Take every reasonable precaution to ensure the workplace is safe. Train employees about any potential hazards and in how to safely use, handle, store, and dispose of hazardous substances and how to handle emergencies. Supply personal protective equipment and ensure workers know how to use the equipment safely and properly. Immediately report all critical injuries to the government department responsible for Occupational Health and Safety

2.2 SUPERVISOR OR PRINCIPAL INVESTIGATOR

A Supervisor or Principal Investigator must: Ensure that laboratory workers use prescribed protective equipment and devices. Train laboratory workers how to safely use, handle, store, and dispose of hazardous substances specific to duties. Advise laboratory workers of potential and actual hazards. Take every reasonable precaution in the circumstances for the protection of laboratory workers (practice due diligence). Immediately report all injuries to the appropriate Safety Officer and the Risk & Safety Coordinator.

2.3 LABORATORY USERS

Laboratory users will: Use personal protective equipment and clothing as directed by the employer. Report workplace hazards and dangers. Work in a manner as required by the employer/Supervisor/Principal Investigator and use the prescribed safety equipment.

2.4 CHEMICAL SAFETY OFFICER

The Chemical Safety Officer is the individual assigned to manage chemical safety issues and is a member of the UNBC Laboratory Safety Committee: Identify laboratory hazards and potential hazards and take steps to mitigate these hazards. Take steps to mitigate hazards identified by laboratory users, supervisors, and principal investigators. Develop and implement emergency procedures for chemical incidents. Act as point of contact in case of chemical emergencies (accidental spills, personnel contamination). Train personnel on general laboratory and chemical safety practices and procedures. Inform and educate employees and laboratory workers regarding laboratory and chemical safety issues. Provide technical advice regarding safe handling, storage, and disposal of chemicals. Maintain UNBC's chemical inventory database. Enforce institutional regulations, under the jurisdiction of the UNBC Safety Committee and the UNBC Joint Health and Safety Committee.

2.5 LABORATORY SAFETY COMMITTEE

As indicated in its mandate, the Laboratory Safety Committee will: Make recommendations through the UNBC Joint Occupational Health and Safety Committee for changes to university policies and procedures to be adopted in departments conducting investigations involving laboratory work. Establish strategies to ensure ongoing and adequate surveillance, hazard identification, and risk evaluation of laboratory activities. Advise and assist all members of the university who have a role in promoting and communicating laboratory safety awareness. Receive and review reports concerning services, activities, incidents, and interventions involving laboratory activities and/or field work and to recommend corrective strategies where appropriate.

3. LABORATORY SAFETY INSPECTIONS

3.1 DAILY INSPECTIONS

All laboratory workers must inspect their work area prior to conducting any work, to identify and correct hazardous conditions. Hazardous conditions should be reported to supervisors/Principal Investigators or appropriate safety personnel if they cannot be remedied immediately.

3.2 ANNUAL INSPECTIONS

The university safety officers will conduct an annual inspection of each laboratory on campus. This group should attempt to arrange a time when the Principal Investigator or laboratory supervisor is available, but may conduct an inspection at any time during the calendar year. The inspection template is available from the Risk and Safety office.

3.3 SPECIAL INSPECTIONS

Inspections will be conducted in a reasonable timeframe after an incident or after new equipment are introduced to the campus. After an incident, the safety officers will conduct a review of the laboratory in an effort to prevent similar incidents from occurring. The results of this review is to be provided to the Principal Investigator or Supervisor. When new pieces of equipment that could pose a safety threat are introduced to the campus (e.g., mercury analyzers, equipment that creates low oxygen atmospheres, radiation exposure devices), the safety officers will conduct a laboratory review. The results of this review will be provided to the Principal Investigator or laboratory supervisor. No work may be initiated on the new equipment until the review is complete and any concerns have been satisfactorily resolved.

4.1 DISPOSAL OF HAZARDOUS MATERIALS

Proper disposal of hazardous materials is an important part of UNBC's role as a green institution. Improper disposal of wastes can result in environmental damage, health damage, and economic damage. For example, sending hazardous chemicals to a landfill can result in long-term environmental damage and health damage from leachates entering ground water. Likewise, unnecessarily entering non-hazardous wastes into energy and resource intensive waste streams can result in much larger carbon footprints and economic costs. Unlabelled materials pose the greatest potential for environmental, health, and economic damage.

4.2 RESPONSIBILITY FOR DISPOSAL

It is the responsibility of the person generating the waste or their authorized designate to ensure appropriate disposal of laboratory materials.

4.3 CHEMICAL EXCHANGE PROGRAM (HAZARDOUS WASTE REDUCTION)

When chemicals have been identified as unwanted surplus within a laboratory, the Principal Investigator or Laboratory Supervisor responsible for the chemicals should attempt to locate other Principal Investigators or Laboratory Supervisors within the UNBC community who may be able to use some or all of the chemicals. The Dispensing Chemist can provide assistance with finding new homes for old chemicals. Similarly, researchers who need small quantities of a chemical should check the campus inventory prior to ordering the chemical to determine if it is available on campus already.

4.4 DISPOSAL

Laboratory and Field Research Chemicals must be disposed of in accordance with UNBC's Hazardous Waste Identification, Reporting, and Disposal policy. A guide for determining if a waste is hazardous is included in the appendix.

4.5 GREEN TIPS FOR THE LABORATORY

When using biomedical waste buckets, fill them completely before sealing them. To reduce issues with odors or microbial growth, seal individual waste components into Ziploc bags prior to adding. If large quantities of a specific waste will be produced, plan for an efficient manner of disposal. Examples of this may be:

- Placing waste in a labeled dedicated bulk container

- Identifying procedures for neutralizing the waste as it is produced or in batches

- Identifying alternative uses for the wastes generated or ways wastes can be combined for neutralization

Laboratory glassware can be recycled, but it must be clean of chemical or biological contamination to avoid alarming or injuring recycling centre staff.

Close containers in fume hoods when they are not in use. Actively evaporating chemicals in fume hood is referred to as atmospheric disposal and can be environmentally damaging and cause formation of reactive crystals in some solvents. If it does not result in a hazard, turn off fume hoods when they are not in use. Fume hoods use considerable quantities of energy when left running continuously.

5. SPECIFIC CHEMICAL SAFETY

5.1 COMPRESSED GASSES

Compressed gases present substantial stored energy and a physical danger that result from the sudden, out-of-control release of these materials from their containers. This release can occur with enough force to propel the cylinder through cinder block walls, and there are accounts of cylinders reaching an altitude of 140ft before falling back down, causing more damage on return. The release of the gas inside the cylinder can also create a low oxygen atmosphere by displacing the atmosphere from a room, resulting in an acute asphyxiation hazard.

Compressed gas cylinders must be firmly strapped or chained to a wall or laboratory bench to prevent the cylinders from falling over

Compressed gas cylinders should be transported using a cart specifically designed for this purpose
 Compressed gas cylinders must be capped when in transport or when not in use
 Dry ice block or flake makers must be properly ventilated to prevent asphyxiation
 When empty, compressed gas cylinders must be marked at "Empty" or "MT"
 Empty or unused cylinders should be returned to Chemstores promptly

5.2 CRYOGENIC GASES

Liquefied non-flammable gases, such as nitrogen, argon, or helium, present both an asphyxiation and explosion hazard.

Liquefied gases must be stored in purpose-built double walled metal containers. Gloves designed for handling cryogenic liquids and a face shield should be used whenever transferring liquefied gases from one container to another.

Containers holding liquefied gases must be kept covered with a loose-fitting cap to prevent air or moisture from entering the container, and to allow built-up pressure to escape.

Liquefied gases must be properly ventilated to prevent asphyxiation.

More information is available in the Cryogenic Liquids Storage, Handling, and Transport Policy and Procedures.

****Low Oxygen atmospheres pose a serious hazard. As few as two breaths (5-9 seconds of exposure) of a zero oxygen atmosphere can result in unconsciousness due to deoxygenation of blood passing through the lungs to the brain.**

5.3 FLAMMABLE MATERIALS

Flammable materials are substances that form vapors that can burn or explode. In order for a fire to occur, three conditions must be present, oxygen, a fuel source, and an ignition source.

Examples of substances that are included in this classification are:

- Flammable gases
- Flammable liquids
- Flammable solids
- Spontaneously combustible substances
- Flammable aerosols
- Air reactive
- Water reactive

6. SPECIFIC EQUIPMENT SAFETY

6.1 REDUCED PRESSURE OPERATIONS

Glass vacuum containers, such as desiccators and flasks, should be wrapped with tape to prevent glass from flying in the event of an implosion or explosion. When carrying out filtration or distillation procedures under reduced pressure, the heavy-walled glassware and tubing must be undamaged and able to withstand the conditions of reduced pressure. Cold traps should be used to prevent leaking of vapors from the experiment to the oil of the vacuum pump or the water passing through a water aspirator. Rotoevaporation of solvents using a water aspirator is not appropriate where the vapor being removed is highly odorous or toxic unless a suitable cold trap is available to capture them. Alternative enclosed systems are recommended.

6.2 Flammable, Toxic and Corrosive Gases

For mixed gas occupancy of hazardous gases, there is maximum separation required between cylinders as defined by the BC Fire Code. Highly toxic gases are kept and used in a continuously operating fume hood or in a specialized gas storage cabinet with an exhaust to the outside. A sign is located on the outside door of any room and adjacent to equipment where a hazardous gas is being used, advising occupants of potential hazards and emergency procedures to follow if a leak or other incident occurs. Gas detectors and alarm systems are installed where cylinders of compressed toxic gases are being used, or an equivalent means of managing an accidental release is implemented.

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