UNIVERSITI SAINS MALAYSIA

LABORATORY SAFETY GUIDELINES

OCCUPATIONAL SAFETY AND HEALTH COMMITTEE
SCHOOL OF CHEMICAL ENGINEERING

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Version 1

Laboratory Safety Guideline
School of Chemical Engineering
Universiti Sains Malaysia

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FOREWORD FROM CHAIRMAN
Occupational Safety & Health Committee

I would like to express my appreciation and congratulations to the Committee of Safety in the School of Chemical Engineering, who have successfully published the Laboratory Safety Handbook, for the laboratory in the School of Chemical Engineering, Universiti Sains Malaysia (USM). I hope this handbook will be a reference and guidance material for all the staff, technicians and students who involve in any laboratory works in the school.

The publication of these guidelines also shows the commitment of the school in ensuring all the activity in the school premises is safe and followed the guidelines provided by DOSH and OSHA. Hence, provide basic knowledge and guidance on the countermeasures that can be implemented by staff and students while in the laboratory to prevent or at least minimize accidents and injuries.

Finally, I would like to say congratulations to the Safety Committee Members, Administration Office, Technician and also fellow academician for their seamless efforts and energy to produce these very useful safety materials.

Thank you.

Professor Ir. Dr. Zainal Ahmad
Chairman,
Occupational Safety & Health Committee,
School of Chemical Engineering,
Universiti Sains Malaysia

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INTRODUCTION

Occupational Safety and Health Policy

School of Chemical Engineering
Occupational Safety and Health Organization Chart

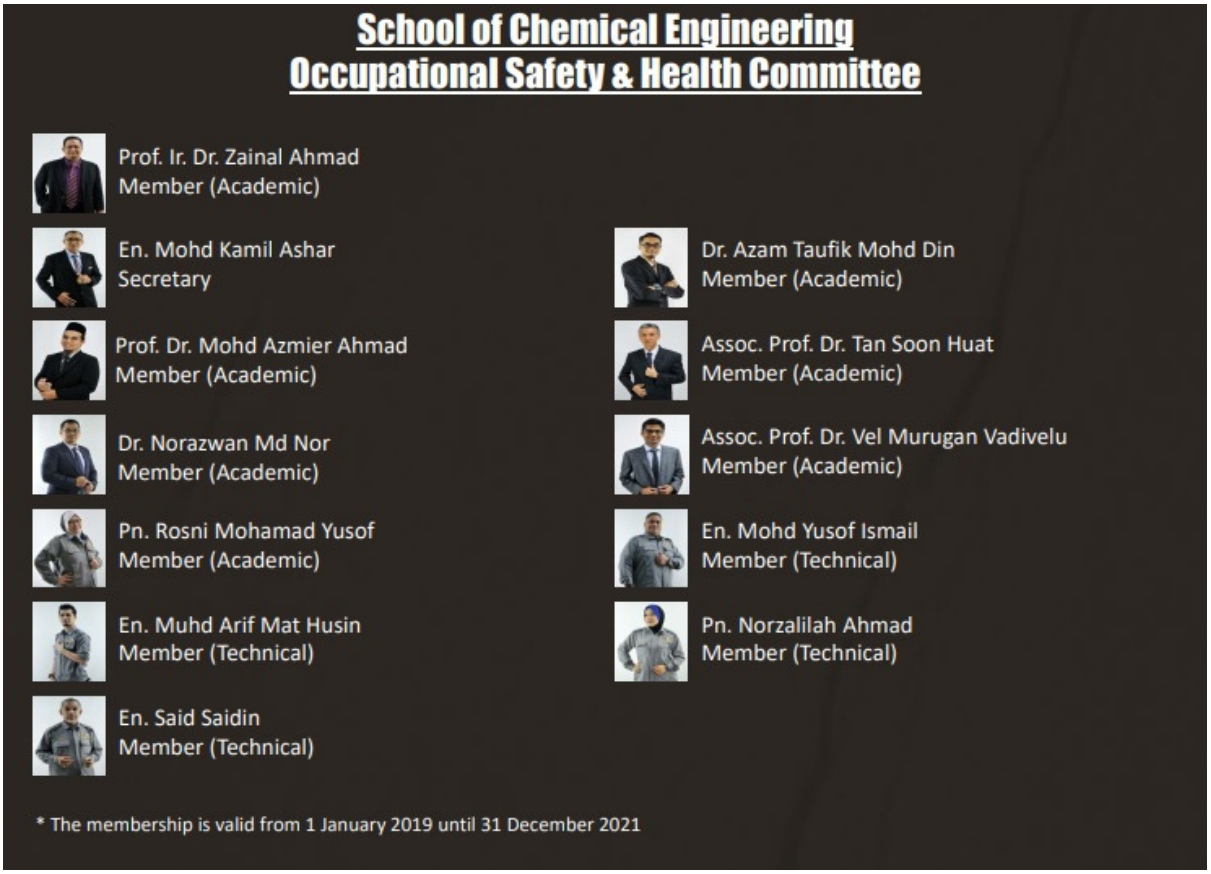

Figure A: Occupational Safety & Health Committee

The Safety Committee Members, provide guidance and assistance to promote a safe work environment.

Duties/ Responsibilities for Committee Members:

• Facilitates productive discussions among employees and management relative to safe workplace practices.

• Identifies and implements new safety outreach and education strategies and approaches.

• Requests and collects employee feedback and suggestions on safety procedures.

• Identifies opportunities to minimize workplace injuries, accidents, and health problems.

• Conducts or facilitates employee training on applicable safety standards.

• Reviews current safety training and recommends revisions, improvements, and updates.

• Conducts safety inspections and audits.

School of Chemical Engineering
Building Evacuation Committee

Figure B: Building Evacuation Committee

Fire Evacuation Officers and each Floor Representatives are members of staff who have been nominated to act as responsible persons during a fire alert evacuation. They are allocated specific tasks to ensure a safe, effective and quick evacuation of the premises during an emergency.

Floor Representatives may be responsible for checking floors or sections of the premises and where required may help to prevent entry to the premises by acting as door/lift wardens.

Evacuation Officers are responsible for the evacuation of the whole premises, supervising the assembly point and collating information received from Floor Representatives in order to account for all building occupants, including any who may need assistance to evacuate.

Fire Wardens and Evacuation Officers need to be easily recognized by both their colleagues and students during an evacuation. Evacuation Officers should therefore wear an ORANGE high visibility coat or vest, Floor Representatives should wear a YELLOW high visibility vest. There must be sufficient Evacuation Officers and Floor Representatives along with nominated deputies to cater for absences so that a full evacuation team is available during office hours.

Laboratory Rules Regulation and Safety Contract

SAFETY REMINDER

1. Beware of any source of hazard/risk in the working space. Focus and pay full attention on the assigned task.
2. Wear proper personal protective equipment (PPE) while working in the lab/workshop. A lab coat, safety shoes, goggles/safety glasses and protective gloves MUST be worn when handling the chemicals. Wear respirator while using volatile chemicals. Always refer to safety data sheet (SDS)/material safety data sheet (MSDS) if in doubt.
3. If you are doing a job above the ground level, safety helmet is a MUST.
4. No jewellery or accessories are allowed to be worn during lab works.
5. All related safety documents, such as SDS/MSDS of chemicals to be handled/used in the experiment, MUST be read and understood before starting any lab.
6. Walk carefully while working in the lab/workshop. Do not run.
7. No horse-play is allowed in the lab. m
8. Strictly NO food and drink is allowed inside the lab.
9. The laboratory/workshop is a NO smoking zone.
10. Identify all emergency exit doors available in the lab/workshop prior to work. Ensure all the doors are accessible and can easily open in case of fire.
11. Ensure all chemicals are properly labeled.
12. Follow correct procedure while diluting high concentration acids. Add acid to water cautiously. Conduct this procedure in the fume hood (including handling of toxic or any health hazard chemicals and solvents).
13. Mouth-pipette technique is strictly PROHIBITED.
14. Avoid to taste or sniff any chemicals intentionally.
15. All the chemical spillages MUST be cleaned immediately. Get assistance from technician on duty if you are in doubt.
16. Do not discard chemical wastes in the laboratory sink or laboratory drainage. Follow proper guidelines available in 'Prosedur Pengurusan dan Pelupusan Sisa Kimia Universiti'.
17. All broken glassware should be disposed separately into a proper 'sharp' bin.
18. Ensure that all equipment, gases and power utilities are properly switched off or shutdown upon completion of work.
19. Only authorized personnel are allowed to work in the lab. Get permission from safety representative officer prior to work. Disciplinary action will be taken to those violated the rules.
20. Do not work alone in the lab. Ensure you comply with ‘Peraturan Bekerja di Makmal/Bengkel USM Selepas Waktu Pejabat’.
21. Staff/students will be responsible for any unwarranted event happening in the lab after office hours.
22. Ensure all equipment, gases, lights and power utilities are properly switched off or shutdown upon completion of work. Lock the door before leaving.

EMERGENCY CONDUCT

23. In case of general accident, get help from the people nearby. All injuries must be treated accordingly. Inform technician on duty for further action.
24. In case of fire, shout 'Fire! Fire! Fire!' as loud as you can. Leave the lab immediately. Do not attempt to save your personal belongings. Consider to break fire alarm glass to alert the whole School.
25. In case of chemical splash, shout 'Help! Help! Help!' as loud as you can to attract people nearby. They should immediately attend the injured person while the others try to get help from technician on duty. If you have been trained, bring the injured person to the nearest emergency shower to rinse the chemical out from the affected area.
In case of EMERGENCY, follow the escalation level below.

Table A: Emergency Contact Number

Level	Person-in-charge	Name	Contact No (Ext.)
1	Technician On-Duty		-
2	Technical Assistant	Mr. Mohd Yusof Ismail	6436
3	Safety Representative PPKK	Dr. Azam Taufik Mohd Din	6466
4	USM ERT Safety Department	Pejabat Am	5033
5	Pusat Kesihatan USM Kampus Kejuruteraan	Dr. Farhi Abidin	5206
6	Unit Keselamatan & Kesihatan Pekerjaan Universiti (UKKP)	Mr. Asif Abdul Rahim	5523

VIOLATION
26. In case of violation on any rules and regulations stated above, stern action will be taken including instant removal from the lab, stop work order, expulsion from the course and dismissal from university, by advice from Dean's Office and/or University Legal Office.

References:

· Peraturan Keselamatan Umum di Makmal/Bengkel USM (Approved in the 18th JKKPU
· Meeting on the 23rd April 2003)
· UTP Laboratory Rules and Regulations (LFSU-LUF-01)
· http://www.usm.my/ukkpu/

For further inquiries or suggestions, contact:
Dr. Azam Taufik Mohd Din at chazam@usm.my or 04-599 6466. Thanks

Table B: Safety Contract Signature

I acknowledge that I have read, understand and do hereby accept all the Laboratory Rules and Regulations imposed in School of Chemical Engineering, Universiti Sains Malaysia.	Witnessed by:
_____ Name: Student ID: Date:	_____ Safety Representative PPKK Date:

CHAPTER 1
HANDLING OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) is safety equipment that must be worn and used when performing operational work in the laboratory. It is important to avoid injuries to limbs and health while working. The personal protective equipment used must be appropriate for the work being performed.

1.1 Eye Protection Equipment

There are two types of eye protection equipment that are commonly used:

- Safety glasses
- Goggles

Safety Glasses

Safety glasses are used to protect the eyes. Some models are made of a material that can withstand UV radiation and protectors on the right and left sides of the frame. Glasses are used when handling chemicals

Figure 1.1.1: Safety Glasses

Goggle

Goggles protect the entire eye area. Goggles protect the eyes from impact, dust and splashes of chemicals and fumes coming from all directions. There are frames on the left and right that protect the eyes and the skin surface at the edges of the eyes.

Figure 1.1.2: Goggle

1.2 Face Protection

The three types of safety equipment for face protection that are commonly used are;

- Face shield
- Surgical Face Mask
- N95 face mask

Face Shield

The face shield provides comprehensive protection on the face when handling chemicals that produce splashes or floating particles. However, this face shield cannot protect the eyes from UV rays. Therefore, this device should be worn in conjunction with 'safety glasses' or 'goggles'.

Figure 1.2.1: Face Shield

Surgical Face Mask
The face mask serves to protect the nose and mouth from pungent odors and dust. This face mask can only filter out large-sized particles in the air. The main function is to prevent any biological particles from the mouth and nose from being spread by the wearer to the environment

Figure 1.2.2: Surgical Face Mask

N-95 face mask
This type of face mask is to filter out particles over 5 micrometers such as bacteria, spores, fungi and solid and liquid substances. The letter 'N' refers to the non-oil resistant nature of the filter, and '95' refers to the level of filter efficiency which is a minimum of 95% efficient. The type of filter depends on the durability, namely R-oil-resistant and P- is believed to be oil-proof

Figure 1.2.3: N-95 Face Mask

1.3 Respirator

Respirators are only used when engineering controls such as fume chambers cannot be used handling certain chemicals. It is specially designed to protect the respiratory system from exposure to chemicals present in the form of gases or small particles in limited concentration rates.
The type of respirator chosen for use is based on the following functions, namely filtering the air by decontaminating harmful gases and fumes or providing ventilation. Respirators have two type which

- Half face respirator
- Full face respirator

Figure 1.3.1: Half Face Respirator

Figure 1.3.2: Full Face Respirator

1.4 Hand Protection Equipment

Hand protection devices can protect hands from direct contact with chemicals, biological substances or substances at extreme temperatures that cause irritation or burning sensation on the skin. Through the wearing of appropriate gloves, the risk of direct exposure can be reduced. The selection of the type of glove is based on the suitability of the work to be done as well as the size that suits the user.

Rubber gloves (Latex)
Rubber (latex) gloves can protect hands from certain microorganisms and chemicals. These gloves are suitable for single use only.

Figure 1.4.1: Rubber Gloves (Latex)

Neoprene Gloves
These gloves are made of synthetic rubber that protects the hands from hydraulic fluids, gasoline, alcohol, organic acids and alkalis.

Figure 1.4.2: Neoprene Gloves

Nitrile Type Gloves
Gloves made of polymers provide protection from chlorinated solutions, oils, greases, acids and alcohols but cannot protect from strong oxidizing agents, ketones and acetates.

Figure 1.4.3: Nitrile Type Gloves

Butyl Type Gloves
Made from synthetic rubber and provides protection against various types of chemicals such as peroxides, corrosive acids, strong alkalis, alcohols, aldehydes, ketones and esters.

Figure 1.4.4: Butyl Type Gloves

Leather Type Gloves
This type of glove can protect the skin from rough surfaces, sparks and hard objects.

Figure 1.4.5: Leather Type Gloves

Padded Cloth Gloves
This type of glove can protect hands from sharp edges, broken glass, dirt and vibration. Suitable for handling cold materials or in cold weather.

Figure 1.4.6: Padded Cloth Gloves

Cryogenic Gloves
These cryogenic gloves are used for handling cryogenic materials at extreme cold temperatures such as liquid nitrogen, oxygen, argon.

Figure 1.4.7: Cryogenic Gloves

Heat Resistant Gloves
These gloves protect the hands from heat while operating appliances such as ovens, furnaces and hot apparatus/ samples.

Figure 1.4.8: Heat Resistant Gloves

1.5 Laboratory Safety Coat

Laboratory safety coats are worn to protect from direct contact with chemicals through splashes or spills. Laboratory safety coats should not be worn outside the laboratory. There are several types of lab safety coats. It depends on the use and the type of operation performed.

The characteristics of wearing a suitable laboratory coat are;

a. Comfortable to wear
b. Made of fairly thick fabric material
c. Light colored (white)
d. Arm length should cover the wrist and length up to knee level.
e. Easily removed
f. Appropriate size and not too small or too large.

Figure 1.5.1: Laboratory Safety Coat

1.6 Safety Helmet

Helmets create an additional layer for the head and thus protect the wearer from some of the more severe forms of traumatic brain injury. A helmet aims to reduce the risk of serious head and brain injuries by reducing the impact of a force or collision to the head.

Figure 1.6.1: Safety Helmet

1.7 Hearing Protection

1. Protect the ears from the effects of sound
noisy that may have an impact
negative on the auditory system.
2. Worn in accordance with the work done.
3. Cover the entire ear
for hearing protection.
4. Wearing hearing protection
is subject to disclosure
noise in excess of 80 dB (A).

Figure 1.7.1: Hearing Protection

CHAPTER 2
HANDLING OF LABORATORY SAFETY EQUIPMENT

The availability and use of a number of types of safety equipment is essential to the lab practice. Safety equipment should be present in well-marked, highly visible, and easily accessible locations in or near all laboratories that use hazardous chemicals.

2.1 First Aid Kit

1. Make sure the first aid kit in each laboratory.
2. Check the contents from time to time to ensure it is complete.
3. Place in a place that is easily accessible and visible.
4. Used to store medicated swabs and first aid kits which takes the form of initial treatment only. Not allowed to store medicine
5. Take the victim immediately to see a doctor for further treatment.

Figure 2.1.1: First Aid Kit

2.2 Eye Wash

1. Specially used for rinsing and washing eyes exposed to chemical splashes. Do not try to neutralize the eyes with acids or alkalis.
2. In the event of a chemical splash into the eyes, make sure the victim is taken to a nearby eye wash and help the victim open the eyes to be rinsed and washed for 10-20 minutes. Victims are advised not to rub their eyes.
3. Do not use water if there are foreign objects such as glass in the eyes. Victims are prohibited from attempting to dispose of such foreign matter
4. Take the victim to see a doctor.
5. Make sure the eye wash is ready to use and clean.
6. Eye wash should be checked at least once a month.

Figure 2.2.1: Eye Wash

2.3 Emergency Shower

1. Dedicated to cleaning and rinsing parts of the body/ clothing affected by chemical spills in large quantities/ high concentrations.
2. Pull the opening button down. Make sure the water that comes out wets the parts of the body or clothing that has been exposed to the chemical spill.
3. If a chemical spill hits the skin, make sure that plenty of water flows to the skin for 10 -20 minutes.
4. Take the victim to a doctor immediately.
5. Make sure it is always in a ready -to -use and clean condition.
6. Perform an inspection at least once a month.

Figure 2.3.1: Emergency Shower

2.4 Fire Extinguisher

1. Fire extinguishers are labeled based on the standard symbols or letter usage for each class of fire that can be extinguished.
2. Posters related to how to use fire extinguishers should be affixed to the fire extinguisher.
3. Ensure that the fire extinguisher and hydrant system are always usable and in good condition.
4. Prepare a fire safety plan /emergency route.
5. Routine inspection of wiring in the laboratory as a precaution.

Figure 2.4.1: Fire Extinguisher

Figure 2.4.1: Table Class of Fire and Type of Fire Extinguisher

Class of Fire and Type of Fire Extinguisher		
Class of Fire	**Type of Fire Extinguisher**	**Type of Fire**
CLASS A	DRY POWDER	Solids such as wood, paper, cloth and any flammable materials.
CLASS B	DRY POWDER	Liquids such as oils, varnishes, plastics and others.
CLASS C	DRY POWDER AND CARBON DIOXIDE	Gases and electricity such as butane gas, acetylene gas, wiring, fuse boxes, electrical appliances and others.
CLASS D	DRY POWDER	Metals such as potassium, sodium, calcium and magnesium.
CLASS E	DRY POWDER	Oils are like oils that are used commercially.

1) Pull

Remove the safety pin on the fire extinguisher

2) Aim

Aim the fire extinguisher nozzle towards the source of the fire. Make sure the spray does not go against the wind current. Instead follow the wind direction.

3) Squeeze

Press the lever

4) Sweep

Fly left and right

Figure 2.4.2: How to Use Fire Extinguisher (PASS)

2.5 Fire Blanket

1. Make sure each lab provides a fireproof blanket, which is made from that type of fabric
2. Used to envelop victims and extinguish small fires on limbs, clothing/solvent fires in sinks.
3. It should be stored in a place that is easily accessible.
4. Pull the blanket from its sheath and wrap the victim in the burned area as soon as possible.
5. Make sure the fire on the victim is completely extinguished.
6. Take the victim to see a doctor immediately for further treatment.

Figure 2.5.1: Fire Blanket

2.6 Spill Kit

This tool is a complete set of chemical spill control in the workspace/laboratory. This set should be used immediately in the event of a chemical spill. This set equipped with a material that can absorb chemical spills quickly and further minimizing pollution. The hardware in this set is like a rubber gloves, absorbent pads, absorbent pillow and absorbent powder (for natural, acid and alkali).

Figure 2.6.1: Spill Kit

Figure 2.7.1: Fumehood

2.7 Fumehood

1. The fan is turned on 15 minutes before use.
2. The mirror (sash) of the fume chamber is always clean and lifted not more than 45cm (yellow line) during use and always closed when not in use.
3. Chemicals and equipment are placed 15 cm into it (yellow line).
4. It is forbidden to store chemicals or experimental samples.
5. Make sure it is clean of solid waste that can enter the fume chamber sink. Any chemical spills and splashes should be cleaned up immediately.
6. Ensure that the equipment/apparatus installed in it does not interfere with the opening/closing of the mirror (sash) or obstruct the exhaust slots.

7. The quantity of hazardous chemicals, equipment and apparatus used in the fume chamber is minimal.
8. It is forbidden to insert the head into the fume chamber.
9. Adjacent doors and windows are always closed when using the fume chamber.
10. Use a perchloric type fume chamber if it involves hydrofloric acid and perchloric acid.
11. Close the mirror (sash) first before the fume chamber fan is turned off to prevent chemical vapors stored in it from escaping and entering the air space in the laboratory.

2.8 Biohazard Safety Cabinet

1. Make sure the cabinet used is appropriate to the level of danger of a microorganism.
2. It is forbidden to handle toxic, flammable and explosive materials
3. Make sure the position is away from the main passage and avoid moving too fast while working to ensure the airflow inside the cabinet is not disturbed.
4. Users need to ensure the work zone is disinfected before and after doing work.
5. All apparatus and tools must be disinfected before being brought in and before being removed from the cabinet.
6. Install the blower before and after use of the cabinet to ensure clean air from contaminants and test materials.
7. Make sure the mirror (sash) is raised to a normal level when working.
8. Bring only the necessary equipment and apparatus in the minimum quantity to ensure the effectiveness of the function of the cabinet and not obstruct the passage of air in and out.
9. Practice aseptic techniques in doing work in a cabinet.

Figure 2.8.1:
Biohazard Safety Cabinet

2.9 Laminar Airflow Cabinet

Figure 2.9.1: Laminar Airflow Cabinet

1. It is forbidden to handle toxic, flammable and explosive materials in it.
2. It is only suitable for media preparation work for subcultures and preliminary preparation work for a practical work in the laboratory.
3. Make sure that air from outside will not enter it to avoid contamination for the initial sample preparation.
4. Avoid moving too fast while working to ensure airflow is not disturbed.
5. Make sure the work zone is disinfected before and after doing the work.
6. All apparatus and tools brought in must be sterilized before being brought in and before being removed from the cabinet.
7. Blowers should be installed before and after use to ensure clean air from contaminants and test materials.
8. Bring only the necessary equipment and apparatus in the minimum quantity to ensure the effectiveness of the function of the cabinet and not obstruct the passage of air in and out.
9. Practice aseptic techniques in doing work in the cabinet.

2.10 Local Exhaust Ventilation System (LEV)

LEV is an engineering system designed to reduce employee exposure to airborne contaminants (dust, mist, fume, vapour, gas) in the workplace by capturing the emission at source and transporting it to a safe emission point or to a filter/scrubber. The purposes of ventilation are to provide a continuous supply of fresh outside air, to maintain temperature and humidity at comfortable levels and to reduce potential fire or explosion hazards.

Figure 2.10.1: Local Exhaust Ventilation System (LEV)

2.11 Waste Containers

Figure 2.11.1: Glass Waste Box

• Used Glass Waste

A glass waste box is used to collect broken glass waste to prevent accidents in the laboratory. When this special box is full, the rest should be disposed of according to the prescribed glass waste disposal schedule

• Used sharp material residue

Sharp material waste containers are used to dispose of sharp clinical waste such as needles and glass slides.

Figure 2.11.2: Sharp material waste containers

• Biohazard Waste Barrels

These waste bins are used to collect biohazard waste to prevent biohazard contamination in the laboratory. Waste should be disposed of according to a prescribed biohazard disposal schedule with proper handling.

Figure 2.11.3: Biohazard Waste Barrels

2.12 Fire Detectors

These fire detectors are used to detect smoke and high heat in buildings. The device is placed on the ceiling in most corridors of the building and in the laboratory. This device will send a signal to the building's safety panel if it detects the presence of smoke and high heat. Next the security panel will sound the fire bell automatically as a signal to all users in the building to evacuate the building. Fire detectors are divided into 3 types, namely smoke detectors, heat detectors, heat and smoke detectors.

Figure 2.12.1: Smoke Detector

Figure 2.12.2: Heat Detector

Figure 2.12.3: Heat and Smoke Detectors

2.13 Safety Equipment Symbols

•There are several safety equipment symbols that are often displayed in the laboratory area to inform laboratory users of the location of the equipment such as fire extinguisher symbol , fire blanket symbol, safety eyewash symbol and shower symbol safety water.

Figure 2.13.1: Fire Extinguisher Symbol

Figure 2.13.2: Fire Blanket Symbol

Figure 2.13.3: Safety Eye Rinse Symbol.

Figure 2.13.4: Safety Shower Symbol

CHAPTER 3
SIGN & SYMBOL IN SAFETY

3.1 Introduction

Safety symbols and signs in the laboratory are very important for convenience users identify the types of hazards and hazards in the work area as well as indirectly reduce the risk of accidents. Occupational Safety and The Health Act (OSHA) has already issued uniform standard symbols for used throughout the country. Each symbol has its own meaning.

3.2 Classification of hazardous substances

In general, hazardous substances are divided into 9 main classes, namely:
i) Class 1: Explosives
ii) Class 2: Gas
iii) Class 3: Flammable Liquids
iv) Class 4: Flammable Solids
v) Class 5: Oxidizing Substances and Organic Peroxides
vi) Class 6: Toxic Substances and Infectious Substances
vii) Class 7: Radioactive Materials
viii) Class 8: Corrosive Materials
ix) Class 9: Other Hazardous Materials and Articles.

Class 1 - Explosives

This material is a hazardous chemical and should be handled with care. Storage of chemicals in this group should be kept in a space separate from other materials and has a stable temperature. Chemicals inside this group is easily exploded in the event of vibration, friction, knocking as well as there sparks and even heat. Among the examples of chemicals that belong to this group is like ammonium nitrate.

Figure 3.2.1: Explosive Sign

Class 2 - Gas

There are 3 subclasses of gases, namely flammable gases, non-flammable gases and toxic gases. The gas used in the laboratory is usually filled in a steel cylinder at high pressure. Therefore, the gas cylinders in the laboratory should be in an upright position and chained to ensure the safety of users in the laboratory. Compressed gas storage requires a room that is well ventilated and separate from other materials or gases that can produce a reaction to prevent any fire from occurring.

Figure 3.2.2: Non-Flammable Gas Sign

Figure 3.2.3: Flammable Gas Sign

Figure 3.2.4: Inhalation Hazard Sign

Figure 3.2.5: Flammable Sign

Class 3 - Flammable Liquids

Chemicals in this group produce flammable vapors at temperatures lower than 61 ° C

There are 3 subclasses that are separated according to flash point, namely:

i) Liquids with flash point less than 18 ° C

ii) Liquids with flash point between 18 ° C to 23 ° C

iii) Liquids with a flash point between 23 ° C to 61 ° C

Storage and handling of chemicals in this group must follow the above subclasses to prevent any fire. Users should use this material in a place away from sparks as well as heat.

Class 4 - Flammable Solids

Hazards in Class 4 are divided into three subclasses, namely:

i) Class 4.1: Flammable Solids

Chemicals in this subclass are highly flammable solids even without a source of flame. Other factors such as friction and heat that exist during the process of transferring the material from one container to another can also cause an immediate fire. Examples of flammable solids are sodium, potassium, hydride and nitrocellulose products.

Figure 3.2.6: Flammable Solid Sign

ii) Class 4.2: Materials May Burn Spontaneously

Pyrophoric liquids or solids exposed to oxygen, water or air moisture for 5 minutes can cause an explosion and spontaneous burning even if the material is in small quantities and without a source of fire. Pyrophoric materials have an auto-ignition temperature below room temperature which when exposed to air or water can easily cause spontaneous fire. Examples of materials for this subclass are sodium metal, fertilizer, activated carbon, phosphorus, and Raney Nickel (catalytic materials made of alloys, aluminum and nickel).

Figure 3.2.7: Spontaneously Combustible Sign

iii) Class 4.3: Easy Gas-Releasing Materials Burns Upon Contact With Water

A substance that when exposed to water can spontaneously burn or emit flammable and toxic gases at a rate greater than 1 liter/ kilogram of material/ hour. Examples of materials in this group are sodium metal, calcium hydride, calcium carbide, barium and aluminum powder. Storage for Class 4 must be stored in accordance with the prescribed chemical hazard classification. Among the precautions that need to be taken when handling chemicals in Class 4 are:

- keep the material away from sparks and heat sources.
- never heat the material in an open flame and should be done in a fume chamber and use a steam bath, water bath or oil bath.

Figure 3.2.8: Dangerous When Wet Sign

Class 5 - Oxidizing Substances and Organic Peroxides

i) Oxidizing Substances

An oxidizing substance is a substance that can produce oxygen through the process of oxidation to cause fire and spread to other substances and is known as an oxidizing agent. Oxidizing materials are highly incompatible with chemicals from Classes 3 and 4. Oxidizing materials should be stored separately from flammable solids or liquids.

Figure 3.2.9: Oxidizer Sign

ii) Organic Peroxide

Organic materials containing a bivalent structure (-O-O-) derived from hydrogen peroxide, one or both hydrogen atoms have been replaced by organic radicals. Organic peroxides have unstable thermal properties causing exothermic decomposition processes when exposed to heat or flammable liquids.

Among the characteristics of organic matter in this subclass are:

a) Decomposable substances cause explosions
b) May burn quickly
c) Sensitive to friction
d) Produces hazardous reactions with other materials
e) May cause damage to eyes.

Figure 3.2.10: Organic Peroxide Sign

Examples of chemicals in this subclass are hydrogen peroxide, iron nitrate, lithium nitrate, lead perchlorate, benzoyl peroxide and other organic peroxide solids and liquids. Storage of chemicals should be stored in a separate place with flammable materials or liquids that have a low flash point. Storage rooms should have a good ventilation system and air conditioning to prevent decomposition of materials.

Class 6 - Toxic Materials & Infectious Materials

Hazard Class 6 is divided into two other subclasses, namely:

i)Class 6.1-Toxic Substances

Chemicals in this subclass include toxic, poisonous and hazardous substances. Examples of chemicals include metal bromide, bromoacetone, bromobenzyl cyanide and tear gas. Avoid contact with limbs as it can cause severe or severe damage. Storage areas for toxic chemicals should be separate from strong acids and oxidizing substances and have good ventilation. Volatile toxic substances should be stored in a storage box at room temperature (-20ºC) to prevent the evaporation process from occurring. Chemical containers that have been opened should be tightly re-closed and sealed to prevent leakage.

Figure 3.2.11: Toxic Sign

II) Class 6.2-Infectious Materials

An infectious substance is a substance that is likely or carries a pathogen. Pathogens are foreign substances that can cause disease in humans or animals. Examples of pathogens include bacteria, viruses, fungi and other infectious agents. Examples of materials for this subclass are medical waste, biological waste, forensic materials and used health care products.

Figure 3.2.12: Infectious Substance Sign

Class 7 - Radioactive Materials

Radioactive material means solid, liquid and gaseous materials that can spontaneously emit ionizing radiation such as alpha, beta and gamma radiation. This material is available in either a sealed source and an unsealed source:

i) Sealed sources are a radiation source consisting of radioactive material that is firmly consolidated in a solid and inactive material or sealed in an inactive container that has the strength to prevent the dispersal of its contents.

ii) Unsealed sources are radioactive materials in a form that can be dispersed either in the form of liquids, solids and gases.

Figure 3.2.13: Radioactive I Sign

Figure 3.2.14: Radioactive II Sign

Figure 3.2.15: Radioactive III Sign

Examples of radioactive materials are uranium, thorium, radium and tritium. This radioactive material is very dangerous and can cause disruption to the biological systems of living organisms especially humans. Radiation exposure at high levels can cause death and destruction at the cellular level. Safe handling of this material is to use appropriate PPE (Personal Protective Equipment) such as radioactive lab coats, gloves and safety goggles.

Class 8 - Corrosive Materials

Corrosive material means a material that can cause visible damage or permanent changes to the surface of skin tissue and metal surfaces. Classifications of corrosive chemicals are strong acids, strong bases and dehydrating agents. Corrosive materials can cause damage to skin tissues as well as eyes through direct contact. Consumers who ingest these types of chemicals can cause damage to the respiratory and gastrointestinal tracts. Examples are hydrochloric acid, sulfuric acid, sodium hydroxide and hydrogen peroxide. Safe handling of this material is to use appropriate PPE such as laboratory coats, nitrile type gloves, face masks and safety glasses. The handling of this type of chemical should also be done in the fume chamber.

Figure 3.2.16: Corrosive Sign

Figure 3.2.17: Other Hazardous Materials and Articles Sign

Class 9 - Other Hazardous Materials and Articles

Environmentally hazardous material means material that can pose a risk of contamination to soil, water and air. Materials that are harmful to the environment can cause destruction to aquatic life and should be disposed of in accordance with established disposal rules. Examples of chemicals of this class are ammonium hydroxide, benzene chloride and heavy metals (lead and chromium).

3.3 Hazard pictograms

These hazard pictograms are usually found on the labels of bottles or containers of chemicals. This symbol carries the meaning of hazard classification if using such chemicals. Commonly used pictograms in the international classification of hazardous substances are as follows.

Explosives

- Unstable explosives
- Explosives; danger of a large explosion
- Explosives; severe gliding hazards
- Explosives; fire, explosion or slide hazards

Figure 3.3.1: Explosive Pictograms

Flammable

- Flammable gas
- Flammable aerosols
- Flammable liquids and vapors
- Flammable solids

Figure 3.3.2: Flammable Pictograms

Gases, liquids or solids oxidize (Flame on a circle)

- May cause or ignite fire; oxidizer
- May cause fire or explosion; strong oxidizer
- May start a fire; oxidizer

Figure 3.3.3: Oxidize Pictograms

Toxic and Highly Toxic (Skull and crossbones)

- Acute toxicity (oral) - Fatal if swallowed /toxic if swallowed
- Acute toxicity (skin) - Fatal if in contact with skin/toxic if in contact with skin
- Acute toxicity (inhalation) - Fatal if inhaled/toxic if inhaled

Figure 3.3.4: Toxic Pictograms

Corrosive

- Skin corrosion or irritation
- Serious eye damage or eye irritation
- Corrosive to metals

Figure 3.3.5: Corrosive Pictograms

Harmful to the Environment

• Harmful to the aquatic environment — acute hazard
• Harmful to the aquatic environment — chronic hazard

Figure 3.3.6: Harmful to Environment Pictograms

Health hazards

• May cause cancer (carcinogenic)
• Germ cell mutagenicity (can cause genetic defects)
• Reproductive toxicity (may damage fertility/fetus)
• Specific organ toxicity (causes organ damage)
• Aspiration toxicity (may be fatal if swallowed and enters the respiratory tract

Figure 3.3.7: Health Hazards Pictograms

Compressed gas

• Contains gas under pressure; can explode if heated
• Contains cold gas; can cause burns or cryogenic injury.

Figure 3.3.8: Compressed Gas Pictograms

Exclamation point

• Causes skin irritation
• Causes respiratory tract irritation
• May cause allergic skin reactions
• Harmful in contact with skin / if inhaled / if swallowed
• Acute toxicity (harmful)
• Narcotic effects (causes drowsiness or dizziness)

Figure 3.3.9: Exclamation Pictograms

3.4 Classification and symbols for pesticides

• There are 3 types of pesticides, namely insecticides, fungicides and herbicides.
• Each user must first read the label on the pesticide before using it
• Each poison is different according to the classification as shown in Table 3.4

Table 3.4: Classification and symbols for pesticides

Class	Description	Level	Stripes	Symbol
1a	Black stripes with skull and crossbones symbols	Very toxic		
1b	Red stripes with skull and crossbones symbols	Toxic		
ii	Yellow stripes	Harmful		
iii	Blue stripes	Caution		
iv	White or colorless stripes like insecticide in the house			

CHAPTER 4
HANDLING OF HIGH RISK EQUIPMENT

Equipment operators need to receive adequate training from responsible staff before operating high-risk equipment. Report immediately to laboratory staff if there is any damage to the appliance.

4.1 HIGH TEMPERATURE EQUIPMENT

Equipment using high heat that is often found in the laboratory is like furnace (Figure 4.1.1), oven and water boiler (Figure 4.1.2).

1. Users should wear personal protective equipment (PPE) when handling hot equipment.
2. Proper wear in the handling of hot equipment is important to prevent injury to the victim or to avoid any negligence that could result in an accident.
3. Usually, the use of suitable gloves to wear is heat resistant. Avoid wearing wet gloves because the steam resulting from the reaction of heat with water will cause burns.
4. Heat resistant gloves can protect hands from hot heat while operating high temperature equipment.
5. Laboratory coats should be worn properly while carrying out work in the relevant laboratory to protect the limbs.

Figure 4.1.1: Furnace

Figure 4.1.2: Water Boiler

4.2 VACUUM EQUIPMENT

Examples of appliances such as vacuum desiccator, rotary evaporator (Figure 4.2.1), vacuum flask, vacuum oven, vacuum evaporator, ultracentrifuge and freeze dryer. (Figure 4.2.2)

Rotary evaporator

1. Make sure it is inspected before use to prevent it from being damaged (implode) during use.
2. Make sure it is always closed properly by using special approved protective equipment. Make sure the value of vacuum used does not exceed the allowable limit.
3. After use, make sure the pressure in the equipment is equal to the atmospheric pressure before the protector.
4.Waste containers should be emptied after completion of analysis.

Figure 4.2.1: Rotary evaporator

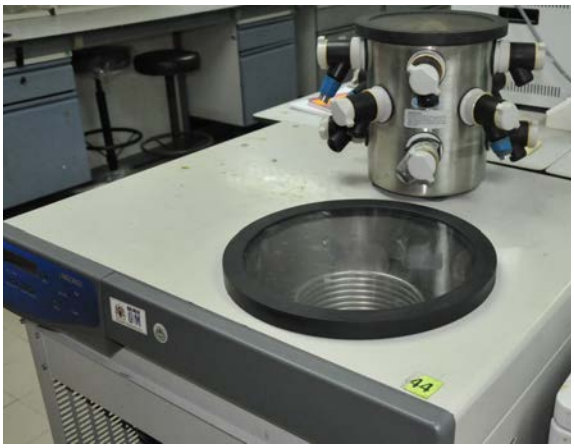

Figure 4.2.2: Freeze Dryer

4.3 HIGH PRESSURE EQUIPMENT

Examples of devices such as autoclave (Figure 4.3.1), air compressor (Figure 4.3.2), centrifuge (Figure 4.3.3) and hydraulic press.

1. Make sure it is checked at all times before use to prevent it from exploding (explode) while using it.
2. Ensure adequate workspace to ensure safety while operating the equipment.
3. Make sure the value of the pressure applied does not exceed the allowable limit.
4. After use, make sure the pressure inside the equipment is equal to the atmospheric pressure before opening the protector.

Autoclave

1. Before using the autoclave for the first time, be sure to read the SOP provided.
2. Make sure that the lid of the liquid bottle to be autoclaved is closed loosely so that the pressure from the water vapor generated during heating does not cause an explosion.
3. Observe the water level before the sterilization process is done.
4. Do not autoclave flammable or volatile liquids as these materials may explode.
5. Make sure the autoclave door is locked before operating. This is to prevent the sudden release of high pressure steam.
6. Do not open the autoclave before the pressure drops to empty or the temperature is below 100 ° C
7. Use heat-resistant gloves when removing the bottle from the autoclave after sterilization is done.

Figure 4.3.1: Autoclave

Figure 4.3.2: Air Compressor

Air Compressor

PRE-OPERATIONAL SAFETY CHECKS

1. Check compressor and motor oil levels and top up as required. (For petrol powered motor and electric powered compressors). Refer to operator manual.
2. Examine power lead for obvious damage (for electric motor compressors)
3. Check that drive belt and pulley guards are fitted, secure and functional.
4. Check the drive belts are properly tensioned.
5. Examine all air hoses, connections and couplings.
6. Check any air tools and accessories for serviceability.
7. Locate and be familiar with ON/OFF controls.
8. Faulty equipment must not be used. Report faulty machinery immediately.

OPERATIONAL SAFETY CHECKS

1. Start the compressor noting the pressure gauge increase and the cut-in / cut-out pressure levels.
2. Always operate as directed in the operation manual.
3. Listen for any air leaks from all airlines or hoses. Do not continue if there are any leaks.
4. Adjust the pressure regulator to suit the particular work requirements.
5. Always check these pressures at regular intervals during normal operation.
6. Air hose connections must be secured and checked prior to being pressurized. 7. If portable, position the compressor unit in an area that will not disturb or obstruct the workshop environment.
8. Use compressed air power tools responsibly and within manufacturers' recommended guidelines.
9. Compressed air cleaning of machine parts must only be undertaken after all PPE and general workshop safety precautions have been observed.
10. Never use the compressed air to clean down work benches, floors or dust from clothing.
11. Never kink or cut off an air hose to restrict the flow of air.
12. Never direct compressed air towards the body.
13. When inflating tyres, inflate in 5 PSI (34.5 kpa) increments.
14. Do not stand in front of tyre walls or leave inflating tyres unattended.
15. Only inflate split rim tyres in a tyre cage. 16. DO NOT fill / refuel hot motor or with motor running

Centrifuge

1. Before using the centrifuge for the first time, make sure you read and understand the SOPs provided.
2. Avoid using cracked centrifugal tubes. This is to prevent the tube from breaking while the centrifuge is operating.
3. The weight/ volume of the sample in each centrifugal tube must be balanced.
4. Avoid filling the tube containing the sample until it is full.
5. Centrifugal tubes containing harmful microorganisms should be opened in the biological safety cabinet.
6. When the rotor stops, do not open the centrifuge, leave it for a while to prevent aerosol from spreading.
7. When opening the tube, make sure gloves are worn if the sample contains harmful microorganisms. This is because the cover of the tube has the potential to be contaminated by the sample.
8. After using the centrifuge, the centrifugal parts such as the centrifugal tube and rotor must be sterilized if the device is centrifugal samples containing microorganisms.

Figure 4.3.3: Centrifuge

4.4 CUTTING EQUIPMENT

Examples of electric cutting equipment are grinder (Figure 4.4.1) and metal cut off machine (Figure 4.4.2).

Grinder

1. Read the tool manual before using any equipment. Plan each job. Think about what might fail and determine the factors that make it possible.
2. Make sure the location of the main switch of the power supply and the work place is in a dry condition.
3. Ensure that the equipment to be used is in a safe and functional condition.
4. Do not work with wet hands or stand on damp floors when using electrical appliances.
5. Turn off the power source switch and remove the plug from the electrical socket before making a connection or any changes to the circuit or equipment.
6. Make sure the appliance switch is turned off and the plug is removed from the electrical socket before any appliance cleaning work is done.
7. Wear PPE that is appropriate for the equipment used.

Figure 4.4.1: Grinder

Metal Cut off Machine

1.Locate and ensure you are familiar with all machine operations and controls.

2. Ensure all guards are fitted, secure and functional. Do not operate if guards are missing or faulty.

3.Ensure the saw is properly secured to a worktable by bolts/clamps at approximately hip height.

4. Ensure the saw is operated on an Residual Current Device (RCD) protected circuit.

5. Use abrasive cut off wheels with the correct size arbor hole.

6. Use abrasive cut off wheels with a maximum safe operating speed greater than the “no load” marked on the machine’s nameplate.

7. Inspect the cut off wheel for chips and cracks.

8. Check workspaces and walkways to ensure no slip/trip-hazards are present.

9. Ensure the depth stop is properly adjusted.

10. Keep table and work area clear of all tools and off-cut material.

OPERATIONAL SAFETY CHECKS

1. Ensure all adjustments to machine are secure before making a cut.

2. Use the vice to clamp the work and properly support the over-hanging portion of the workpiece level with the base of the machine.

3. Allow the machine to reach full speed before contacting the workpiece.

4. Ease the abrasive disc against the workpiece when starting to cut.

5. Keep hands away from the blade and cutting area.

6. After finishing the cut, release the switch, hold the saw arm down and wait for the disc to stop before removing work or off-cut piece.

7. Before making any adjustments, disconnect the plug from the power source and bring the machine to a complete standstill.

Figure 4.4.2:
Metal Cut off Machine

CLEANING UP

1.Remove foreign material from in and around ventilation openings and switch levers.

2. Leave the machine in a safe, clean and tidy state.

4.5 LOW TEMPERATUE EQUIPMENT

Low temperature equipment that is often found in the laboratory such as Freezer with temperature (-20ºC), (-40ºC) and (-80ºC) (Figure 4.5.1) as well as Cold Room (Figure 4.5.2).

How to operate:

1. Use personal protective equipment such as Cryogenic gloves when taking or storing samples/materials in low temperature equipment.
2. Do not open the freezer door too long.
3. If you need to be in a cold room, don't stay for too long.

Figure 4.5.1: Freezer -80ºC

Figure 4.5.2: Cold Room

CHAPTER 5
HANDLING OF GLASS EQUIPMENT

5.1 Heating and Cooling Techniques of Glass Apparatus

1. Use a heat-resistant glass apparatus during heating. It is not allowed to heat the cracked/ scratched glass apparatus because the resistance to heat has been reduced.
2. Do not heat the glass apparatus to the maximum temperature as it may cause it to break.
3. When evaporating the liquid, the temperature should be allowed to drop slowly according to the decrease in the liquid level to avoid cracking on the glass apparatus.
4. Do not place hot glass utensils on cold surfaces or vice versa.

5.2 Glass Apparatus Connection And Disassembly Techniques

1. Users should be careful when making connections involving glass apparatus. Use grease to facilitate connection.
2. Seek the help of a laboratory assistant if there is difficulty opening the connection.

5.3 Extraction / Reflux Techniques

1. Ensure that the rubber tube connection from the condenser to the water source is non -detachable and in good condition.
2. The heating mantle can be used for extraction work as it can be heated with uniform and controlled heat.

5.4 Glass Waste Disposal Techniques

1. If glassware breaks in a watery sink, remove the liquid in the sink before collecting the glass fragments using appropriate gloves.
2. All glass -based waste should be wrapped with paper and placed in a box lined with polybag plastic (Figure 5.4). All broken glass waste containers should be clearly labeled. Make sure the waste container is not overloaded. When the waste container is ¾ full, the glass waste container must be sealed and disposed of. Chipped and broken glassware cannot be reused. Keep discarded glassware in a dry condition.

Figure 5.4: Broken Glass Box

CHAPTER 6
HANDLING OF CHEMICALS

6.1 PURCHASE OF CHEMICALS

1. All chemicals must be purchased from a qualified supplier (chemical supply field code, good service record, appropriate delivery method).
2. The quantity of chemicals ordered must be suitable for use within a year only or the completion of a project.
3. It is forbidden to buy chemicals without any specific purpose.
4. Ensure that the packaging package of the chemicals ordered should be in accordance with the existing storage place or store. Avoid ordering chemicals in packaging of 10 Liters and above.
5. Avoid buying chemical solutions (solvents) stored in cans because they are easily corroded and subsequently leak.
6. If you want to buy chemicals that are categorized as controlled/prohibited substances by the authorities, make sure to get approval first, before the sale and purchase is made.
7. Ensure that the chemicals to be purchased can be used safely by the existing laboratory environment.
8. Before buying chemicals, make sure that safe use control measures have been established.

6.2 RECEIVE OF CHEMICALS

1. It must be ensured that the specifications of the chemicals received are the same as the purchase order.
2. It is forbidden to accept unordered chemicals.
3. The supplier must attach a complete Safety Data Sheet (SDS - Safety Data Sheet) for each chemical shipped.
4. SDS must be provided in bilingual. The SDS should be documented and easily accessible to all laboratory users.
5. Make sure the chemical received is perfect in terms of packaging, cover, labeling and physical exterior.
6. If the container/ bottle is damaged, do not confirm receipt. Chemicals received should be stored in the store immediately in a suitable space.
7. Not allowed to accept chemicals belonging to others.
8. Promptly register the chemicals received in the Chemical Inventory Record.
9. The Department must prepare a Register of Chemicals Hazardous to Health (Chemical Register).
10. The Department must also prepare a List of Chemicals that require Medical Supervision.

6.3 STORAGE OF CHEMICALS

1. The most suitable place to store chemicals is a Chemical Store complete with fire prevention and other safety systems.
2. The store must have adequate ventilation (equipped with an exhaust fan).
3. Chemical stores should have inventory records of incoming and outgoing chemicals.
4. Chemicals shall be stored according to proper isolation and storage methods (Table 6.3a)
5. Chemicals can be classified according to their physiochemical properties, namely explosive, oxidizing, highly flammable, highly flammable, flammable.
6. Chemicals can also be classified according to their health effects which are highly toxic, toxic, harmful, corrosive, irritating.
7. Danger emblems or danger signs (based on physiochemical properties should be affixed outside the store door as a warning.
8. In a chemical store the liquid chemicals are arranged according to the physiochemical compatibility and location provided and are not arranged alphabetically.
9. Physiochemical compatibility refers to similar hazards being put together or different hazards but no reaction.
10.Good chemical storage location refers to the use of shelves, cabinets, refrigerators, freezers, chemical safety cabinet (Figure 6.3.1) and Corrosive cabinet (Figure 6.3.2), Bad storage location is on the table (bench top), fume chamber , under laminar flow, on the floor, drawers, under sinks, places higher than eye level.
11. A good chemical store must be equipped with acid cabinets, flammable materials cabinets, chemical storage cabinets, freezers etc. The internal temperature of the store must be controlled so that it does not overheat, as well as the ventilation system.

Figure 6.3.1:
Chemical safety cabinet

Figure 6.3.2:
Corrosion cabinet

Table 6.3a: Steps to isolate and store chemicals in the store

Chemical Category	Storage suggestions
Hazard, Environmental Toxins (Solis/liquid), pesticides	Store in a separate section. Hazardous liquids are placed in a secondary container and stored on shelves/ cabinets/refrigerators/freezers. Eg: Arsenic, mercury, radioactive Gramoxone@Harquat®, OZA 276
Solids are not oxidized, not flammable	Stored on a shelf or cabinet with its group (alphabetically)
Flammable solids	Stored in a Flammable Storage Cabinet (other flammable materials can be housed together). Eg: camphor, naphthalene, potassium sulphide.
Flammable liquid	Stored in a flammable cabinet (steel cabinet), do not store in the home refrigerator. Eg: ether, methanol, ethanol, acetone, toluene
Inorganic acid	Stored in a secondary container (to separate with acids & other bases) and placed in an acid/corrosive cabinet. Eg: nitric acid, sulfuric acid, hydrochloric acid
Organic acid	Stored in a secondary container (to separate with other acids and bases) and placed in an Acid/Corrosive cabinet. Eg: lactic acid, acetic acid, formic acid, oxalic acid, benzoic acid.
Organic Peroxide	Stored in secondary containers (to separate with organic & inorganic matter) Eg: has a peroxide name- benzoyl peroxide, hydrogen peroxide etc.
Pyrophoric/active water	Stored under paraffin oil, isolated from easily oxidized materials.
Oxidizing Agent (oxidizer/oxidant)	Stored in secondary containers (to separate with organic & inorganic materials). Eg: Potassium permanganate, potassium

12. Pesticides should also be handled as hazardous chemicals and can be classified according to their level of toxicity as per table 3.4
13. Pesticides are stored according to their function, namely insecticides, fungicides and herbicides.
14. Users should segregate the use of spraying equipment, measuring according to pesticides, weeds, and fungi.

6.4 USE OF CHEMICALS

General rules of chemical handling:
1.Users must refer to the Safety Data Sheet (SDS) before using chemicals.
2. Consumers should understand the warning label on the bottle before using the chemical.
3. Use appropriate personal protective equipment before working. Please refer to the relevant Safety Data Sheet for more information.
4. Users must label all containers containing chemicals (name of substance, concentration, date of preparation, provided by as in the example (Figure 6.4):

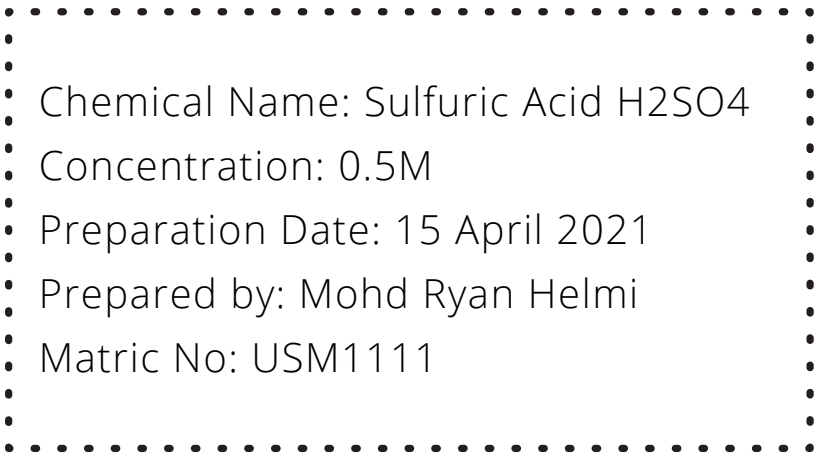

Figure 6.4: Chemical Label

5. Avoid handling flammable chemicals near sources of ignition. Examples: acetaldehyde, dimethyl sulfide, diethyl ether, ethylene oxide, propane, pentane.
6. Users are not allowed to touch, feel and smell the chemicals directly.
7. Consumers need to plan the quantity required of chemicals. It is important to avoid waste.
8. During solution preparation, make sure that the high concentration solution is poured into the low concentration solution. Acid or alkaline solutions should be poured into water, it is forbidden to pour otherwise.
9. Experiments involving the use of organic solvents, or volatile, odorous, acidic, concentrated alkaline substances shall be carried out in a fume chamber.
10. If a flammable chemical solution is prepared, make sure it is stored in a dark bottle and at a low temperature.
11. If over-taking chemicals, do not put them back in the original container (avoid contamination).
12. Every pesticide user must wear proper safety clothing when transporting, mixing, spraying and washing poisoning equipment.
13. Personal protective equipment (PPE) should be cleaned after use and stored separate from pesticides.

6.5 RULES FOR THE USE OF CRYOGENIC LIQUIDS

1.Cryogenic is a material that has an extremely low temperature below -150ºC.
2.When handling cryogenic liquids must adhere to the following rules.
i) Avoid contact between limbs with cryogenic liquids or containers.
ii) Wear personal protective clothing and equipment (PPE) especially gloves, face shields, goggles and laboratory coats. Be sure to wear safety shoes.
iii) Ensure good air circulation.
iv) Use the correct container. Cryogenic liquids should be used in containers that can contain rapid temperature changes.
v) Do not mix different cryogenic liquids as they have different freezing points.
vi) Examples of cryogenic liquids are nitrogen, oxygen, and helium liquids. The characteristics of cryogenic liquids are as in Table 6.5

Table 6.5 : Characteristics of Cryogenic liquids

Types of cryogenic liquids	Features
Oxygen	Mixing between oxygenated liquids with flammable organic materials can result in a great explosion and cause a fire.
Nitrogen	Gases from liquid nitrogen can fill space quickly. Although nitrogen gas is not dangerous, but this gas will replace oxygen in an enclosed space. This will cause difficulty breathing. Good air circulation is essential during the handling of liquid nitrogen.
Carbon dioxide	Carbon dioxide is in the form of dry ice that can release carbon dioxide gas to cause difficulty breathing. The use of dry ice is done in a place with good air circulation.
Hydrogen	Liquid hydrogen that releases hydrogen gas can cause suffocation because it replaces the oxygen in the air. Hydrogen gas is flammable, odorless and nontoxic.

4. The safety of handling cryogenic materials/liquids is to use cryogenic gloves and goggles.
5. The use of cryogenic fluids can result in permanent damage to body tissues which is similar to a cold fire accident.
6. In addition, it can cause numbness in the hands if cryogenic liquid comes in contact with the skin surface.
7. Never massage or rub the area exposed to cryogenic liquids.
8. Do not allow the victim to smoke or drink alcohol.
9. If the victim has difficulty breathing, take the victim to an area with good air circulation and loosen the victim's clothing.
10. Seek medical attention immediately.

How to handle liquid nitrogen:

a. Liquid nitrogen should be handled with extreme care as its overly cold nature (-196ºC/77.3K) can cause frost bite to the user and explosion if placed in an unsuitable container.

b. Guidelines for handling liquid nitrogen:

i. Carefully handle liquid nitrogen and samples cooled with liquid nitrogen.

ii. Avoid liquid nitrogen from contact with worn clothing.

iii. Wear special eye, face protection and gloves when handling liquid nitrogen and touching samples cooled with liquid nitrogen.

iv. Use only suitable containers to fill with liquid nitrogen to prevent explosion.

v. Do not dip any perforated tubes into a container filled with liquid nitrogen.

vi. Handle liquid nitrogen in a spacious room and have air circulation in and out/ open space to prevent suffocation.

vii. Do not pour liquid nitrogen on the floor.

viii. Do not store liquid nitrogen in an uncovered container for too long. However, the container used should not be completely closed to prevent explosion.

ix. If there are symptoms such as dizziness and unconsciousness to the operator, take the operator to an open area and contact the officer on duty.

x. If the operator experiences a frost bite, expose the affected area to a normal temperature (37ºC). Loosen the operator's clothing to allow active blood flow to the affected body area and contact the officer on duty (Figure 6.5).

Figure 6.5: Liquid Nitrogen Handling

CHAPTER 7
HANDLING OF BIOLOGICAL MATERIALS

7.1 GENERAL HANDLING METHODS

1.Surfaces and workplaces should be wiped with disinfectant before and after.
2.Ensure that students/laboratory users do expose bandaged wounds before carrying out laboratory work.
3.Use appropriate gloves when handling biological specimens such as laboratory animals, blood & urine sample, bacteria and fungi.
4. All spills and accidents must be reported even if they do not involve any injuries.

7.2 CONTROL OF MICROORGANISMS AND TISSUE CULTURE (ANIMALS & PLANTS)

1.Microorganisms (viruses, bacteria and fungi) are harmful. Aseptic techniques need to be applied when conducting experiments using microorganisms.
2.Bacterial and tissue culture cells from various sources should be controlled from contamination with any potential agents in the laboratory. Cell cultures either containing the viruses or not, need to be handled in the Biological Safety Cabinet. The safe handling procedures is as in Table 7.1.
3.Cultures of microorganisms and animal/plant cells should be disinfected before disposal.
4.It is forbidden to open petri dishes containing cultures of microorganisms other than in Biological Safety Cabinet in order to prevent the occurrence of any dangerous infections.
5.Wash hands with antiseptic detergent after every experiment involving microorganisms.
6.Inform laboratory staff in the event of any spillage.
7.If the spillage culture comes into contact with the skin, wash with liquid soap and water immediately. Seek medical help immediately if necessary.

7.3 HANDLING OF BIOLOGICAL AGENTS (ANIMALS & PLANTS)

1.Animal/plant samples brought to the laboratory should be properly handled and controlled. Equipment used for handling animal/plant samples should not be mixed with equipment used for other samples.
2.Samples of animals/plants handled must be based on the class (Biosafety Level - BSL) that has been set;

- **BSL-1**

a. Suitable for practice when handling animal/plant samples that do not have infectious diseases and have the potential to cause minimal harm to humans.

b. Operators should have basic techniques for handling animal/plant samples and must be supervised by officers knowledgeable and experienced in the relevant field.

- **BSL-2**

a. Suitable for practice when handling animal/plant cells that have infectious diseases and have the potential to cause infections and moderate danger to humans.

b. Operators should have basic techniques in handling samples of infectious and pathogenic animals/plants. Operators must be supervised by officers knowledgeable and experienced in related fields such as handling samples with potential diseases, microbiological agents, animal manipulation and livestock. Sample control must be performed in a Biological Safety Cabinet.

Table 7.1: Guidelines for personal protection when handling samples of microorganisms and animal cells

BSL-1	BSL-2	BSL-3
Operators wear a labcoat to prevent any contamination from clothing. Eye, face and respiratory protection should be worn in the animal sample handling chamber. Eye protection should be worn to prevent microbiological splashes or hazardous materials. Operators wearing contact lenses should wear protective equipment when entering the handling area of samples that could potentially have 'airborne disease'. Gloves should always be worn when handling animal samples.	Users must wear a labcoat when handling animal samples. Face and eye protection (masks, goggles, face shields) must be worn to keep splashes of hazardous and infectious materials from animal samples. Operators who wear 'Contact lenses' should wear eye protection when entering the handling chamber of samples that have a high potential to have 'air-borne disease'. Gloves should always be worn when handling animal samples.	Operators wear disposable personal protective equipment before entering the handling area (*buttoned labcoat on the front is not suitable to be worn while handling this sample) Face and eye protection (masks, goggles, face shields) must be worn to keep splashes of hazardous and infectious materials from animal samples. Samples must be controlled in a biological safety cabinet. Operators wearing contact lenses should wear eye protection when entering a sample handling chamber with a high potential for 'air-borne disease'. Gloves should always be worn when handling animal samples. Shoes should be completely covered with shoe covers to avoid cross -contamination.

CHAPTER 8
HANDLING OF LABORATORY WASTE

There are various types of waste generated from research, teaching and learning activities. Among them:
1. Chemical waste
2. Biological waste
3. Public waste
4. Machinery Waste

8.1 CHEMICAL WASTE

1. Chemical waste refers to chemicals that;
i) Results from experiments (chemicals that have been used)
ii) The composition is unknown due to not being labeled
iii) Chemicals spilled
iv) Expired
v) Has changed physical or chemical properties (due to oxidation/degradation)
2. Consumers should dispose of chemical waste in appropriate bottles (Refer to Safety Data Sheet). Chemical waste is not allowed to be dumped in sinks or trash cans.
3. Users are not allowed to mix or collect incompatible chemical residues in one container. Users must refer Classification of chemical waste (Table 8.1) for segregation.
4. Consumers should ensure that only ¾ the volume of the bottle is filled with chemical waste.
5. Consumers must label each waste bottle with the following information (Table 8.2)
i) Waste Name
ii) Date Generated
iii) Name of Waste Generator
iv) Telephone Number
v) Name of Laboratory

Table 8.1: Classification of Chemical Waste Kualiti Alam Sdn. Bhd

Group	Type of waste
A	WASTE MINERAL OIL Waste contains lubricating oil, hydraulic oil, soil contaminated with oil and the like.
B	ORGANIC CHEMICAL WASTE CONTAINING HALOGEN AND/ OR SULFUR> 1 % Freon, PVC waste, chloroform, solvents, capacitors and transformers containing printed circuit boards and the like.
C	SOLVENT WASTE CONTAINING HALOGEN AND/OR SULFUR <1 % Acetone, alcohols (eg ethanol, methanol), benzene, turpentine, xylene and the like. The waste should be pumpable, contain <50 % water and a calorific value of 18 MJ/kg.
H	ORGANIC CHEMICAL WASTE CONTAINING HALOGEN AND/ OR SULFUR <1 % Glue, latex, paint, phenol, printing ink, synthetic oil, soap, epoxy and the like.
K	WASTE CONTAINING MONSTER Mercury, steam lamps, COD liquids, batteries containing mercury and the like.
T	PESTICIDE WASTES Insecticides, fungi, weed killers, rat poisons etc.
X	WASTE IS NOT ORGANIC Acids, alkalis, sodium hypochlorite, inorganic salts, metal hydroxide sludges, chromate and cyanide residues and the like.
Z	OTHERS Medical waste, lab - packs, asbestos waste, mineral sludge, isocyanate (MDI, TDI), batteries and the like.

Table 8.2: Scheduled Waste Label

SCHEDULED WASTE LABEL

Waste Code: (fill by Assistant Engineer)	
Waste Name:	
Date Generated:	
Name of Waste Generator:	
Telephone No:	
Name of Laboratory:	

6. Waste hydrofluoric acid and its compounds should be stored in plastic bottles.
7. Cyanide waste and its compounds shall be bottled separately.
8. Users are not allowed to store chemical waste bottles in an enclosed space (such as in a laboratory desk shelf/ drawer) or chemical store. However, chemical waste should not be exposed directly to sunlight.
9. Chemical waste bottles can be reused as chemical waste waste containers.
10. Unused plastic bottles should be punched at the bottom to prevent reuse as beverage containers.
11. Unused glass bottles are separated from their lids and discarded to prevent reuse.
12. Consumers must immediately transfer chemical waste to the chemical waste collection point and labeled the type of waste (Figure 8.1).
13. Chemical waste will be packaged by Assistant Engineer according to the specifications set by the appointed contractor, then transported by the contractor to the landfill.

Figure 8.1: Chemical Waste Collection, Segregation and Transfer to Chemical Waste Store

8.2 BIOLOGICAL WASTE

Biological wastes can cause harm is called biological hazard. These biological materials include waste products, tissues, carcasses and pathogens either from animal or plant sources. Every microorganism in the laboratory must be considered potentially pathogenic and thus, must be treated like biological material. Biological waste disposal procedures are not only limited to biological materials but include their carrier materials such as steel bars, plastic containers and glass. Therefore, the disposal of biological waste should take into account the type of carrier used.

1. Types of biological waste

i) Waste contains infectious material. Examples include; medical waste, medical specimens, waste from pathology and research laboratories. It also includes culture plates, equipment used to transfer, inoculate and mix cultures as well as live/attenuated vaccine waste.
ii) Pathological waste resulting from surgical activities, autopsies, teaching and research activities such as blood, blood products, tissues, organs and body fluids
iii) Clinical waste such as sharp objects that have been contaminated with biological waste. Examples are needles and syringes, scapels, knives, broken glass and glass slides.
iv) Other laboratory waste contaminated with biological waste such as specimen containers, disposable gloves, tissues and materials used to clean-up spills.
v) Plant/animal waste used in experiments or research.

2. Waste segregation methods must be performed according to the following categories:

i) Contaminated materials for autoclaving and recycling.
ii) Contaminated materials for disposal.
iii) Sharp materials.
iv) Uncontaminated material (plant/animal waste).

3. Safe disposal of biological waste can be carried out by referring to the Safety Data Sheet. Among the commonly used methods are as follows:

i) Combustion using an incinerator. This method is conducted to dispose off a single biological waste that has no other method of disinfection.

ii. Autoclave

The autoclave method is applied to biological waste and containers to inactivate any pathogens. (Examples: petri dishes, bottles, urine strips or used-blood, blood, urine, animal/plant cells)

a. Separate used-specimen containers, petri dishes and bottles.

b. Collect leftovers (used agar plates) in an autoclave bag. Make sure the autoclave bag is filled only to ¾.

c. Waste that continues to be disposed off after autoclaving should be separated with recyclable equipment.

d. For the disposal of infected liquid waste (culture broth) it should be placed in a container reserved for infected waste and autoclave.

e. The container filling the waste shall be tightly fastened to prevent spillage from occurring during the transfer of the container to the autoclave room.

f. Waste that has been properly autoclaved can be disposed off as ordinary garbage after the Biohazard mark is removed.

8.3 PUBLIC WASTE

Consists of packaging materials, packaging waste, food waste, animal waste, plant waste and other waste that do not have/give problems or danger to human health or the environment.

a. Food waste must be collected and placed in covered plastic bins and disposed of at landfills. The cleaning contractor will dispose of the waste according to the prescribed method.

b. Diseased plant waste can be used as compost, fodder and mulch and used as an extract for fertilization purposes.

c. Treated animal waste can be used for organic manure purposes.

8.4 MACHINERY WASTE

a. Machinery waste in the form of liquid (lubricating oil) is disposed of in a proper manner (refer to chemical waste disposal method)

b. Solid type machinery waste (rubber, iron, plastic, glass, textiles) is collected and disposed of in a proper manner at an authorized place such as a Recycling Center or a registered buyer.

CHAPTER 9 :
HANDLING OF COMPRESSED GAS

9.1 SAFETY OF USE OF COMPRESSED GAS CYLINDERS

Compressed gas cylinders that are usually found in the laboratory are such as helium, oxygen, nitrogen, carbon dioxide, acetylene, argon, liquefied petroleum gas, nitrous oxide and purified air (purified water).
Compressed gases are classified as Class 2 i.e. gases that are liquefied or dissolved under a certain pressure. The Class 2 classification is as per table 9.1:

Table 9.1: Compressed Gas Class 2 Classification

	Class	Gas Properties	Description	Gas Example
1	2.1	Flammable	Lights up when in contact with a fire source	Acetylene, propane, hydrogen, oxygen, argon, helium
2	2.2	Not flammable	Non -flammable and non -toxic gas.	Carbon dioxide
3	2.3	Toxic	Toxic gases can cause death or serious injury if inhaled.	Arsenic

9.2 Installation of regulator (gas regulator) on the gas cylinder

a) Different directions of rotation.

i. Flammable gas: Rotate to the left (left hand thread)

ii. Non -combustible gas: Turn to the right (right hand thread)

b) The use of a gas regulator is reserved for only one type of gas to be used. Sharing of gas regulators is strictly prohibited.

9.3 The following rules must be observed when operating a compressed gas cylinder

i) Make sure the gas cylinder is properly fastened to the work table or conveyor trolley (wheel cart).

ii) Identify the type of compressed gas to be used.

iii) The store of compressed gas cylinders must have good air circulation from the top and bottom. (Figure 9.1)

iv) Storage of gas cylinders in the open, must be protected from proper sunlight.
v) Use personal protective equipment such as cotton gloves and safety shoes.
vi) Use respiratory protection for toxic gases.
vii) It is not allowed to remove or tear the identification number or label on the gas cylinder.
viii) Must not remove the safety cap (cap) on the gas cylinder valve without the instruction of the Assistant Engineer.
ix) It is not allowed to unplug, install or adjust the regulator and gas pipeline valve that has been connected to the cylinder without the permission of the Assistant Engineer in charge.
x) Make sure there is no ignition source and all types of electrical switches except fire retardant type electrical switches are close to the flammable gas cylinder.
xi) Make sure the gas cylinder valve is closed properly without adjusting the regulator.
xii) Ensure that the gas cylinder is closed with a safety cover (cap) at all times if not connected to the equipment.
xiii) Empty gas cylinders are clearly labeled and placed separately from full cylinders.
xiv) Avoid any gas leakage. Gas leaks can be detected by using a soap solution or 5% teepol solution on the gas connection.
xv) Keep gas cylinders away from heat sources (furnaces, boilers and radiators). If the gas cylinder is exposed to heat, the cylinder wall will become weaker, and the gas pressure will increase. This will increase the danger.
xvi) Assistant Engineer will install full tank compressed gas at store gas. (Figure 9.2)

Figure 9.3.1: Compressed Gas Cylinder Store

Figure 9.3.2: Compressed Gas Installation by Assistant Engineer

Figure 9.3.3: Compressed Gas Installation by Assistant Engineer

Each cylinder will be painted with a different color to distinguish the gas content in it as shown in Figure 9.3.

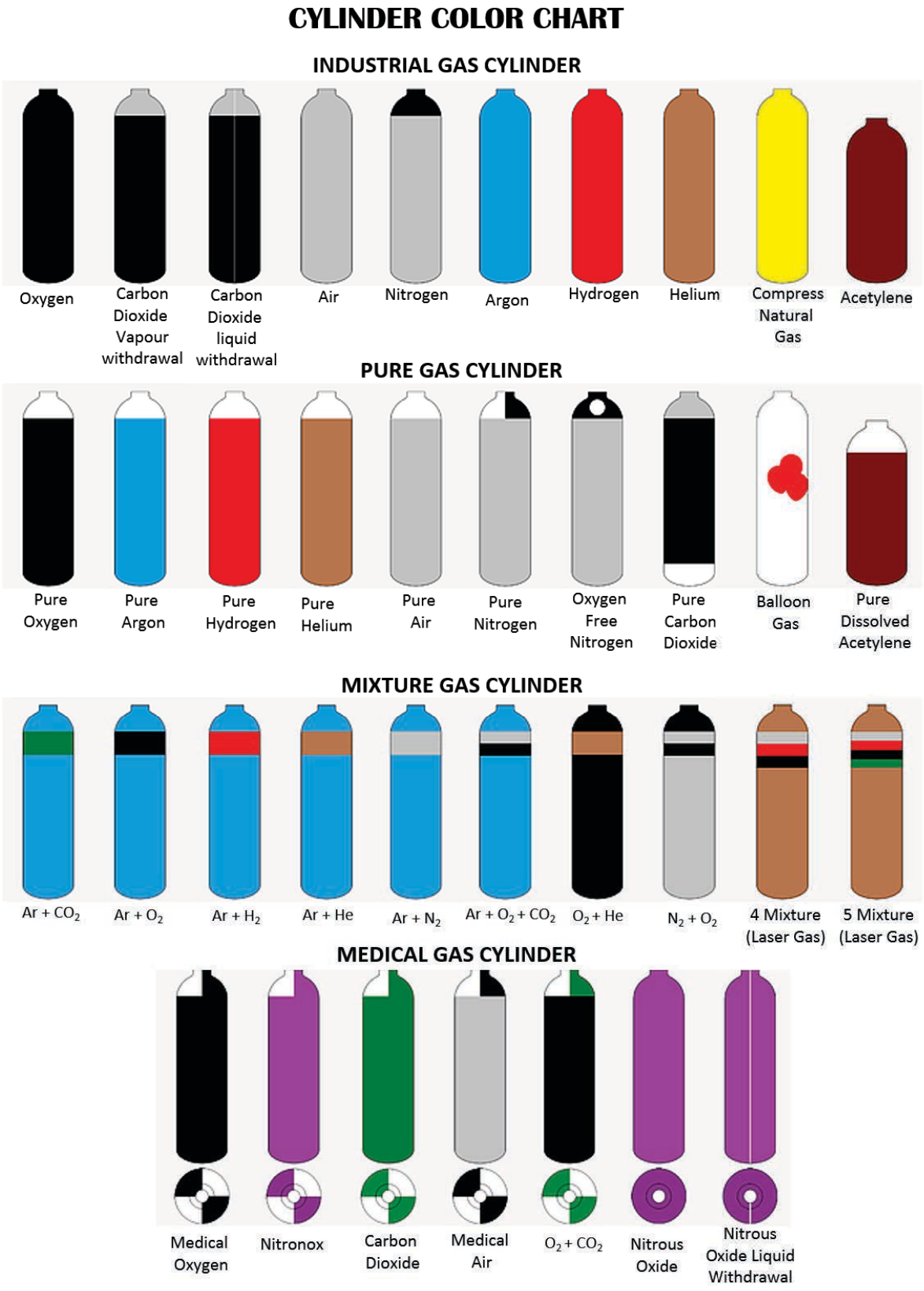

Figure 9.3: Color code of a gas cylinder

CHAPTER 10 :
EMERGENCY ACTIONS

10.1 General Rules

1.Inform the laboratory staff immediately of any accidents/ emergencies that occur.
2.The emergency bell should be pressed immediately in the event of a fire.
3.Emergencies or minor accidents such as injuries, can use the first aid kit provided before seeking further treatment at the Health Unit, Engineering Campus.
4.Contact USM ERT Security Department (04-5995033) or Health Unit Engineering Campus (04-5995206) in the event of a serious emergency.

10.2 Action In The Event Of Fire

a) When the fire bell sounds as a signal of a fire, all staff/ students/ contractors/ suppliers/ visitors must perform the following actions:

i) Stop all work immediately.
ii) Turn off all electrical power.
iii) Keep gases and all flammable materials from being exposed.
iv) Close all windows and doors.
vi) Exit via safe passage and do not use the elevator.
v) Do not run.
vi) Do not push push each other.
vii) Do not intentionally make noise.
ix) Do not turn back to pick up leftover items.
x) Gather at a designated place (assembly point).
xi) Cooperate and follow the instructions of the incident officer or security guard.

b) Among the fire prevention measures are as follows:

i) Make a work plan.
ii) Minimize the use of flammable materials.
iii) Store flammable materials in a designated safe place.
iv) Ensure the use of electrical appliances is switched off after use.
v) Report any damage immediately to laboratory staff or incident officers.
vi) Ensure that the flame used for experimental purposes is under controlled conditions.
vii) Ensure that flammable equipment is not in close proximity to heat or fire sources.

c) Guidelines for rescuing oneself if caught in the smoke of a fire are;

i) Move out to a safe place by humbling yourself like crawling.
ii) Breathe briefly through the nose until you reach a safe place.
iii) If possible, cover the nose with a towel or wet cloth.
iv) Use the back of the palm of your hand to grope along the wall until it meets the exit.

d) Guidelines for rescuing yourself if trapped in a burning building are;

i) Close all the doors between to prevent the fire from spreading quickly.
ii) Fill all door slits and vents with cloth or the like to reduce smoke and heat.
iii) Go to the window to ask for help by waving a brightly colored cloth or pinch lamp.
iv) Do not jump from the window, wait for the rescue team to arrive.

10.3 Action in the Event of an Electric Shock

a) The action if the victim is still attached to the source of the electric current is:

i) Screaming for help
ii) Turn off the electrical source switch
iii) Do not pull the victim with your hands
iv) Keep the victim away from the source of electrical current using insulating material such as wood or plastic
v) Check breathing and pulse and report to the incident officer for further action

10.4 Chemical Spills

a) Spill means something that comes out of its container accidentally. Spilled chemicals may be in liquid or solid form and require action to control the source of the spill. A chemical is said to be dangerous if the chemical causes physical damage, human health, the environment and property such as;

i) flammable
ii) produces harmful vapors and dusts
iii) corrosive
iv) toxic

b) Action in the Event of a Chemical Spill

i) If splashed on the eye area;

1) Immediately go to safety eye wash
2) Run water into the eyes for 15 to 20 minutes
3) If the victim uses contact lenses, remove the contact lenses immediately
4) Hold the eyelids with your fingers to allow the eyes to open
5) Move the eyeball so that the water can flow all over the eye
6) Leave eyes open after rinsing.
7) Wrap the injured eye with sterile gauze
8) Report the incident to the Assistant Engineer in charge.
9) Seek treatment from a medical officer.

ii) If the spill is on a body part;

1) Run water for 20 minutes on the part affected by the chemical to prevent damage to the tissue.
2) Remove clothes that are soaked in chemicals.
3) If the part burns, wash the part with the following neutralizer.
a. If acid - use an alkaline solution for example sodium bicarbonate lotion with a concentration of 5%
b. If alkaline - use an acidic solution for example dilute citric acid or table vinegar.
4) Report the incident to the Assistant Engineer in charge.
5) Seek treatment from a medical officer.

iii) If exposed or ingested chemicals

1) The action to be taken varies according to the type of chemical. Therefore, each emergency action of such chemicals should be referred to the MSDS of each chemical.

10.5 Action If Exposed to Pathogens

Users handling pathogens must get immunized first. If the user falls ill, seek treatment immediately and inform the pathogen used.

10.6 Action If Injured At Work

Among the injuries that may occur are:

a) Fainted

Fainting is the condition of a person who is in a state of unconsciousness. The person who faints will regain consciousness when the blood flows back to the head. The signs of a person who is about to faint are:

i)pale

ii)the pulse becomes weak, fast and not the same pulse.

iii)dizziness and weakness.

iv)breathing becomes weak and slow.

The treatment for people who faint is:

i) provide a comfortable space for the victim by asking the public not to surround the victim.

ii)lay down the victim.

iii)loosen the victim's clothing on the neck, chest and waist.

iv)ask a friend to contact the incident officer or staff in the laboratory.

b) wounds

A wound is an injury that causes blood to flow out of the body. Wounds will also allow for internal contamination such as being exposed to dirt and being infected with bacteria. Actions to be taken in the event of an injury (wound) are:

i) remove dirt on the wound carefully.

ii) go to a comfortable area.

iii) wash and wrap neatly the injured part.

iv) seek further treatment if the injury is in a serious condition.

Types of wounds

a) Incised wound - wounds caused by sharp -edged objects or weapons. The condition of the wound is clean or one line. For example, wounds caused by slices of knives, swords, bamboo shoots, razors and so on.

b) Lacerated wound- a torn wound that is usually caused by weapons or tools that are not sharp, such as road accidents, scratches or animal bites or the like.

c) Contusion - a wound that injures the internal tissues in which the blood that comes out collects in the tissues. This type of wound is usually caused by a heavy object that is not sharp edged. For example, being hit by a hammer, being punched, being squeezed into heavy objects.

d) Punctured wound - a wound or injury caused by an object or weapon with a sharp tip. These wounds are small but usually deep and produce a lot of blood. For example, stabbing knives, needles, nails, thorns and so on.

Types of bleeding

a) Bleeding from the arteries - the blood that comes out is squirted because it follows the heartbeat. The blood that comes out is bright red. This is because it contains high oxygen.

b) Bleeding from venous channels - blood comes out continuously and continuously. In addition, the color of his blood is dark red. This is because the blood contains a high content of carbon dioxide gas.

c) Bleeding from the capillaries- the blood drops out and the blood stops quickly. The color of the blood is bright red because it contains oxygen.

Signs and symptoms of wounds and bleeding are as follows:

i. The victim complained of pain at the injured site.
ii. Pale.
iii. Headache.
iv. Nausea and possible vomiting.
v. Restless and sweating profusely.
vi. The pulse is fast and not strong in volume.
vii. Shortness of breath and rapid and shortness of breath.
viii. Body skin is sweaty and cold.
ix. Loss of strength or ability.
x. There was shock and fainting.

General treatment of wounds and bleeding

a) Take the victim or patient to a safe place and proper air circulation.
b) Calm the victim if he is still conscious.
c) Determine the level of consciousness of the victim, whether he is conscious or otherwise. Make sure the victim's airway is in good condition. Give Cardiopulmonary Resuscitation (CPR) assistance if needed.
d) Loosen the victim's clothes, especially at the neck and waist.
e) Stop bleeding if there is a wound that produces a lot of blood.
f) How to stop bleeding can be done in 2 ways:
i) Stop bleeding immediately:
- apply pressure to the bleeding area for 10 minutes.
ii) Indirectly:
- presses on the blood vessels.
- time are recorded. Loosen the soak for every 20 minutes for one minute.
- after the blood stops- wash the wound and make a suitable bandage.
- do not give any food or drink when the patient is unconscious or just conscious
from shock.
-get medical treatment as soon as possible.

Bleeding / special wounds

i) Bleeding from the nose

- Squeeze the base of the soft bone with the victim's bone for 10 minutes.
- Bend the victim's head slightly so that blood does not enter the stomach or respiratory tract.
- Calm the victim and direct the victim to breathe through the mouth.
- Give cold compresses to the victim's nose and forehead to reduce pain or stop bleeding.
- Do not discard blood clots as this can cause re-bleeding.
- Seek immediate medical attention.

  - Bleeding from the gums.
  - Calm the victim and place him in a comfortable position.
  - Place a gauze or cotton cloth on the bleeding spot and the direction of the victim to bite the cotton cloth dive for 15 minutes.
  - Give a cold compress on the cheeks so that the blood vessels become constricted and reduce pain.

- Do not spit incessantly. o Do not gargle too much.
- Do not throw blood clots on the wound.
- Seek immediate medical attention.

ii) Bleeding from the ears.

- Lay the victim down by lowering the bleeding ear for the victim who is unconscious due to the possibility of bleeding or rupture of the skull.
- Do not stuff cotton into bleeding ears.
- Wrap bleeding ears with a clean cloth.
- Seek immediate medical attention.

iii) Bleeding bruises

- Calm the victim.
- Apply cold compresses to the bruised area to reduce pain and swelling
- Do not massage the bruised area

iv)Internal Bleeding

Signs and symptoms:

- The victim's face is pale
- The victim is weak and disabled.
- Anxiety
- Cold body
- Dizziness and vomiting
- Fast and weak breathing
- Fast but weak pulse.

Treatment:

- Calm the victim.
- Lay the victim at leg height.
- Loosen tight clothing.
- Do not give any food and drink.
- Check pulse and respiratory movements from time to time.
- If the victim is in shock, try to recover.
- Seek medical attention immediately.

c) Burns and scalds

i) Burns - injuries caused by hot dry materials. For example fire, lightning, hot iron, sunlight, acid, alkali and so on.

ii) Burns - injuries caused by hot, damp or wet objects. For example steam, steam, hot water, hot oil, hot tar and others.

Signs and symptoms:

i. Strong pain.
ii. The skin becomes swollen, red, and hot.
iii. Water bubbles occur on the skin.
iv. The skin is flaky and blackish, especially if burned by acids or alkalis.
v. The exposed tissue is red and watery.
vi. There are signs of general symptoms of shock.

General Treatment of Burns and Scorches

a) Move the victim to a safe and ventilated place.
b) Drain or soak the injured limb for some time for the purpose of cooling or reducing the concentration of acid or alkali affected. c) Calm the victim.
d) Loosen clothing and remove objects worn by the victim. For example rings, earrings, bracelets and so on. This is because the injured area will be swollen and it will be difficult to remove the equipment.
e) If the patient is in a state of shock, recover the victim's shock first.
f) Do not date foreign objects attached to the injured area. For example attached clothes.
g) Wash the injured area carefully. Wrap or cover to prevent infection.
h) Do not apply cream or oil on the injured area.
i) Do not burst the bubble as it facilitates infection.
j) If the patient is in a stable condition - drink plenty of water to replace the lost fluid loss.
k) Seek immediate medical attention.

Burned by Acid or Alkali

a) Remove clothing that has been exposed to the material immediately.
b) Drain or soak the injured limb with plenty of water.
c) If exposed to acid, can use sodium bicarbonate solution to neutralize the acid.
d) In case of contact with alkaline substances, use acidic substances to neutralize the acid. Do not use acidic or alkaline substances in contact with eyes. Eye injuries can use only plain running water.
e) After washing, wrap or cover the injured area with a clean cloth.
f) Seek medical attention.

Clothing Burn Treatment

a) Cover the victim with a wet cloth, wet sheet or wet sack so that the fire can be extinguished.

b) The direction of the victim rolling on the grass to put out the fire on the clothes.

c) Pouring water towards the victim can extinguish the fire.

e) Wash the burns thoroughly.

f) Cover the injured area and seek medical attention.

Burn or Sore Throat Treatment.

a)Give the victim as many cold or iced drinks as possible.

b)Give a cold compress to the neck.

c)Seek medical attention.

10.7 Safety Signs

In the event of a fire, laboratory users should exit using the emergency door. Emergency lights (Figure 10.7.1) and directional signs to the emergency door, (Figure 10.7.2) are support equipment to provide light to all safety routes, all directions of exit gates and can help residents, firefighters to find a way out/in safer in the building during an emergency or during a fire.

Figure 10.7.1: Emergency Light

Figure 10.7.2: Directional Sign

References

[1] Garis Panduan Keselamatan dan Kesihatan Pekerjaan USM

[2] Panduan Keselamatan Makmal, JKKP, Makmal Berpusat, Universiti Malaysia Terengganu

[3] Panduan Keselamatan Makmal Perubatan Universiti Kebangsaan Malaysia, Klinik Kesihatan, Pusat Pembangunan Kesihatan Keluarga, Jabatan Kesihatan Awam, Kementerian Kesihatan Malaysia (2009)

[4] Akta Keselamatan dan Kesihatan Pekerjaan (1994)
- Peraturan-Peraturan Keselamatan dan Kesihatan Pekerjaan (Pengelasan, Pembungkusan dan Pelabelan Bahan Kimia Berbahaya) (1997)
- Peraturan-Peraturan Keselamatan dan Kesihatan Pekerjaan (Penggunaan dan Standard Pendedahan Bahan Kimia Berbahaya Kepada Kesihatan) (2000)

[5] Akta Kualiti Alam Sekeliling (1974)

[6] Peraturan-Peraturan Kualiti Alam Sekeliling (Buangan Terjadual) (2005)

[7] Akta Kilang dan Jentera (1967)

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