

GUIDELINES ON THE DISPOSAL OF CHEMICAL WASTES FROM LABORATORIES



Periodic Table of the Elements

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SECOND EDITION
MAY 2015



Department of Environment
Ministry of Natural Resources and Environment

FOREWORD

The proper storage and disposal of chemical wastes generated in a laboratory is an important element for laboratory management and for ensuring the safety of those involved in that workplace environment. In Malaysia, there is some concern over the management of chemical wastes produced in laboratories during their daily operations as well as wastes produced as a result of chemicals that have expired or have been discarded or abandoned. This is mainly due to the long-term impact of improper disposal into the environment could sometimes be far-reaching and costly.



In Malaysia, the control of wastes is governed by the Environmental Quality Act 1974. The Environmental Quality (Scheduled Wastes) Regulations 2005 requires all wastes to be handled properly and as far as possible, be rendered innocuous prior to disposal and be treated at prescribed premises or on-site treatment facilities only. Currently, there are 77 categories of scheduled wastes, there are also other hazardous wastes such as the wastes generated in the laboratories that can pose dangers to human health or the environment that raise concern.

The overall goal of the Department of Environment is to ensure that the prevention of pollution be the best management practice. The present Guidelines on the Disposal of Chemical Wastes from Laboratories has therefore been developed with prevention in mind and as a handy tool for laboratory personnel's use. It is envisaged that it would assist them in the proper techniques of handling chemical laboratory wastes and its subsequent disposal in such manner that will not degrade the environment nor endanger health and safety. In the course of the preparation of these guidelines good inputs were provided by many agencies and institutions of higher learning. This sharing of their experiences and knowledge in the handling of chemical wastes from their own laboratories has provided useful information on the proper and practical aspects that are required and would ensure that hazardous chemical wastes are disposed off safely.


DATO' HALIMAH HASSAN

Director General of Environmental Quality, Malaysia
May 2015

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1.0

INTRODUCTION

- 1.1 Management of chemical wastes from laboratories is a growing concern in Malaysia. Chemical wastes generated from laboratories in daily operations can cause adverse effects to the occupational and public health as well as the environment when improperly segregated or disposed off. Serious accidents could occur if laboratory operators become complacent in handling such wastes.

- 1.2 In Malaysia, the Laboratory Chemical Wastes management is governed by the Environmental Quality Act, 1974 and the regulations, orders and guidelines made under the provisions of this Act. Laboratory Chemical Wastes are classified as scheduled wastes in the First Schedule of Environmental Quality (Scheduled Wastes) Regulations, 2005 under the following codes.
 - a) SW 409 - Disposed containers, bags or equipment contaminated with chemicals, pesticides, mineral oil or scheduled wastes
 - b) SW 410 - Rags, plastics, papers or filters contaminated with scheduled wastes
 - c) SW 429 - Chemicals that are discarded or off-specification
 - d) SW 430 - Obsolete laboratory chemicals

*These wastes shall be disposed and/or treated at prescribed premises licensed by the Department of Environment only.

- 1.3 It is imperative that there should be an emphasis on the proper management of all types of chemical waste generated in laboratories and as far as practicable such wastes be rendered innocuous prior to disposal.

2.0 SCOPE

- 2.1 The scope of these guidelines covers the implementation of proper management practices in handling, storage and disposal of chemical wastes generated from the laboratories.
- 2.2 These guidelines contain recommendations on procedures for handling and disposal of chemical wastes from laboratories in such a manner that will not constitute a risk to human health, safety or the environment, which includes the following aspects:
- a) management;
 - b) types of laboratory chemical wastes
 - c) characterisation;
 - d) minimisation;
 - e) safety procedure in handling;
 - f) storage and labelling procedures;
 - g) emergency procedures; and
 - h) treatment and disposal.

3.0 TERMS AND DEFINITIONS

3.1 Incompatible Chemicals

Chemicals which when they come into contact with each other, could react by releasing poisonous or flammable gases, exploding or spontaneously igniting. These chemicals therefore should not be stored near each other to avoid such reaction.



3.2 Scheduled Wastes (SW)

Any waste falling within categories of waste listed in the First Schedule of Environmental Quality (Scheduled Wastes) Regulation 2005.

3.2.1 Laboratory Chemical Wastes (LCW)

Any obsolete, abandoned, discarded, expired and off-specification laboratory chemicals in the form of liquid, solid, or gaseous material including samples resulting from laboratory operations that are no longer in use and intended for disposal.

3.3 Laboratory Operator

A person who operates a chemical laboratory and he or she holds a management position.

(Appointed by the management of the respective schools)

3.4 Laboratory Personnel

Personnel who works in a laboratory and handles chemicals or chemical wastes.

4.0 LABORATORY CHEMICAL WASTES MANAGEMENT COMMITTEE

4.1 The flow-chart diagram in **Appendix I** outlines the types of chemical wastes generally generated in laboratories and the recommended procedures for their disposal.

4.2 Laboratory Chemical Wastes Management (LCWM) Committee led by a senior officer of a laboratory should be set up. The committee should comprise of laboratory operators and laboratory personnel's.

- 4.3 The committee should be responsible for:
- a) endorsing the procedure for the LCWM Committee;
 - b) assigning a competent laboratory personnel who will be responsible for managing waste disposal;
 - c) monitoring record of the amount of wastes generated; and
 - d) ensuring the wastes where applicable, are treated, recycled, recovered or disposed off in a safe and environmentally sound manner.
 - e) ensuring proper trainings are provided to the laboratory personnel;
 - f) ensuring the personnel's are equipped with proper Personal Protection Equipment (PPE).

5.0 TYPES OF LABORATORY CHEMICAL WASTES

5.1 Chemicals that are abandoned, discarded, intended to be discarded or disposed into the atmosphere, placed on any soil or surface of any land or inland waters need to be disposed off in a proper manner to reduce their effect on health and the environment.

5.1.1 Types of LCW according to Environmental Quality (Scheduled Wastes) Regulation 2005

Code	Description
SW 409	Disposed containers, bags or equipment contaminated with chemicals, pesticides, mineral oil or scheduled wastes (Description)
SW 410	Rags, plastics, papers or filters contaminated with scheduled wastes
SW 429	Chemicals that are discarded or off-specification
SW 430	Obsolete laboratory chemicals

Table 1: Types of LCW



5.2 Types of laboratory chemical wastes (Table 1) for treatment and disposal at the integrated scheduled wastes treatment and disposal facility at Kualiti Alam Sdn Bhd (KA) can be classified according to the following groups:

GROUP	WASTE TYPE
A	MINERAL OIL WASTE Waste containing lubricating oil, hydraulic oil etc.
B	ORGANIC CHEMICAL WASTE CONTAINING HALOGENS AND / OR SULPHUR > 1% Freon, PVC wastes, chloroform, solvents, capacitors and transformers containing PCB etc.
C	WASTE SOLVENTS CONTAINING HALOGENS AND / OR SULPHUR < 1% Acetone, alcohol (eg. Ethanol, methanol), benzene, turpentine, xylene etc. Waste should be pumpable, containing < 50% water 18MJ / kg calorific value
H	ORGANIC CHEMICAL WASTE CONTAINING HALOGENS AND / OR SULPHUR < 1% Glue, latex, paint, phenol, printing ink, synthetic oil, epoxy etc.

K	WASTE CONTAINING MERCURY Mercury, vapour lamps, COD-fluids, mercury batteries etc.
T	PESTICIDE WASTE Insecticides, fungus and weed killers, rat poison, etc.
X	INORGANIC WASTE Acid, alkaline, sodium hypochlorite, inorganic salts, metal hydroxide sludge, chromate and cyanide waste etc.
Z	MISCELLANEOUS Medicine waste, lab-packs, asbestos waste, mineral sludge, isocyanate (MDI, TDI), batteries, etc.

Source: Kualiti Alam Sdn Bhd

Table 2: Types of laboratory chemical wastes

6.0 CHARACTERISTICS OF LABORATORY CHEMICAL WASTES

6.1 Laboratory chemical wastes should be characterised as follows:

- a) corrosive substances;
- b) explosive substances;
- c) inflammable liquids;
- d) inflammable solids;
- e) organic peroxides;
- f) oxidizing substances;
- g) solid: spontaneously combustible;
- h) solid: dangerous when wet;
- i) toxic substances; and
- j) mixture of miscellaneous dangerous substances.



7.0

MINIMISATION OF LABORATORY CHEMICAL WASTES

- 7.1 As far as possible Laboratory Chemical Wastes should be minimised in order to reduce the amount generated and their toxicity through the following approaches:
- Practice the concept of source reduction by ordering the smallest quantity of chemical materials required.
 - Keep an inventory of chemicals on hand.
 - Systematic waste segregation according to their properties.
 - Change practices so that less waste is generated.
 - Select processes that inherently produce less waste.
 - Reduce the volume of waste that will undergo disposal (e.g.:decantation, centrifugation)
 - Substitute chemicals with those of non-hazardous or less toxic.
- 7.2 Some laboratory wastes could be treated on-site to a certain extent for the purpose of waste minimisation and reduction which may result in cost saving for their disposal at treatment facilities.
- 7.3 The following laboratory procedures such as neutralisation, chemical reduction, adsorption, evaporation, filtration and separation are some of the activities that could assist in reducing the generation of Laboratory Chemical Wastes.
- Neutralisation is a process used to adjust the pH of a substance to between pH 5.5 and pH 9.0 in order to render it less hazardous for disposal. Supernatant from neutralisation process which meets the standard of effluent discharge stipulated in the Environmental Quality (Industrial Effluent) Regulation 2009 can be discharged into the water course.

- b) Chemical reduction refers to a process where various organic chemicals and heavy metals are reduced by chemical means to minimise toxic substances, e.g. hexavalent chromium is reduced to less toxic trivalent chromium.
- c) Adsorption binds soluble and gaseous substances to a surface of adsorbents such as activated carbon without altering them chemically.
- d) Evaporation is allowed when inorganic waste mixed with water is treated.
- e) Filtration is primarily used to remove undissolved heavy metals present in suspended solids.
- f) Separation includes those processes that separate solids from liquids and separate liquids of different densities. Supernatant from slurry which meets the standard of effluent discharge stipulated in the Environmental Quality (Industrial Effluent) Regulations 2009 can be discharged into the water course.

8.0 SAFETY IN HANDLING OF LABORATORY CHEMICAL WASTES

- 8.1 LCW containing hazardous and toxic chemicals can pose a serious threat to health through various route of exposure; inhalation of vapour or dust, absorption through the skin from contaminated clothing, spillage on benches, floors or apparatus and ingestion from contaminated hands or food or smoking.
- 8.2 Personnel should be made aware of the potential hazard of the waste, the limitations of the protective equipment and the safety procedures for handling waste.
- 8.3 The Personnel Protection Equipment (PPE) should be in accordance with the Occupational Safety and Health (Use and Standards of Exposure of Chemical Hazardous to Health) Regulations 2000.



It should include the following:

- a) rubber, PVC or polythene gloves, preferably disposable;
- b) laboratory coats;
- c) laboratory safety glasses or goggles or if there is a danger of liquids splashing, a full-face shield; and
- d) an approved respirator with a suitable particulate/vapour cartridge or an approved disposable face mask.

Example of appropriate PPE can be referred in **Appendix IV**.

- 8.4 PPE should be stored adjacent to the work area and should not be taken to other areas of the laboratory.
- 8.5 Avoid the usage of expired PPE.
- 8.6 PPE should be removed and stored before leaving the laboratory.


9.0 STORAGE AND LABELLING OF LABORATORY CHEMICAL WASTES

- 9.1 LCW should be stored in containers which are durable and able to prevent spillage or leakage of the contents into the environment. These containers should be able to withstand the chemical attacks likely to be caused by their contents and must be leak-proof and gas tight.
- 9.2 Incompatible wastes should be stored in separate containers (Refer to **Appendix II** and **Appendix III**).
- 9.3 Areas for storage of the waste containers should be separated from the working area of the laboratory and maintained to ensure that there is no spillage or leakage.

- 9.4 The containers should be located in a well-ventilated place and kept tightly closed at all times to stop volatile materials escaping.
- 9.5 Containers of LCW should be clearly labelled for identification and warning purposes in accordance with labelling requirements for scheduled wastes.
- 9.6 The labels may be a stick-on type, a metal plate type or a stencilled or printed type on the container. However, the labels should not fade off with time.
- 9.7 All hazards must be clearly identified on the labels. In the case of wastes capable of presenting two or more hazards, all hazards must be clearly identified and the wastes labelled accordingly.
- 9.8 Storage of LCW should not be more than 180 days. Any application to extend the storage period should obtain written approval from DOE State Office.

10.0 EMERGENCY PROCEDURES

- 10.1 Any personnel or significant laboratory contamination with hazardous waste shall be reported immediately to the LCWM Committee. Such reporting must be made mandatory.
- 10.2 The incident or injury shall be investigated fully and laboratory safety procedures reviewed in the light of the report.
- 10.3 Accidental skin contact with toxic waste materials should be treated immediately by rinsing the affected parts in cold running water for at least five minutes using safety shower or other available source of water, followed by thorough washing with warm soapy water. If necessary, the persons should shower and change their clothes and shoes.

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- 10.4 In the case of an eye splash, the eye should be irrigated immediately with cold running water for fifteen minutes. It may be necessary to force water into the eye to ensure that it is thoroughly irrigated. Medical advice should be sought.
 - 10.5 All persons in the laboratory should be evacuated immediately if there is a significant spill of a toxic waste or if a fire or explosion occurs.
 - 10.6 In the case of a spillage, only properly equipped and trained persons should be assigned to clean up. Suitable protective clothing should be worn and proper equipment should be used.
 - 10.7 Immediately wash away contaminant using safety shower or other available source of water. Allow water to run over the affected body area for at least 15 minutes. Do not use neutralising chemicals, creams or lotion.

11.0 TREATMENT AND DISPOSAL OF LABORATORY CHEMICAL WASTES

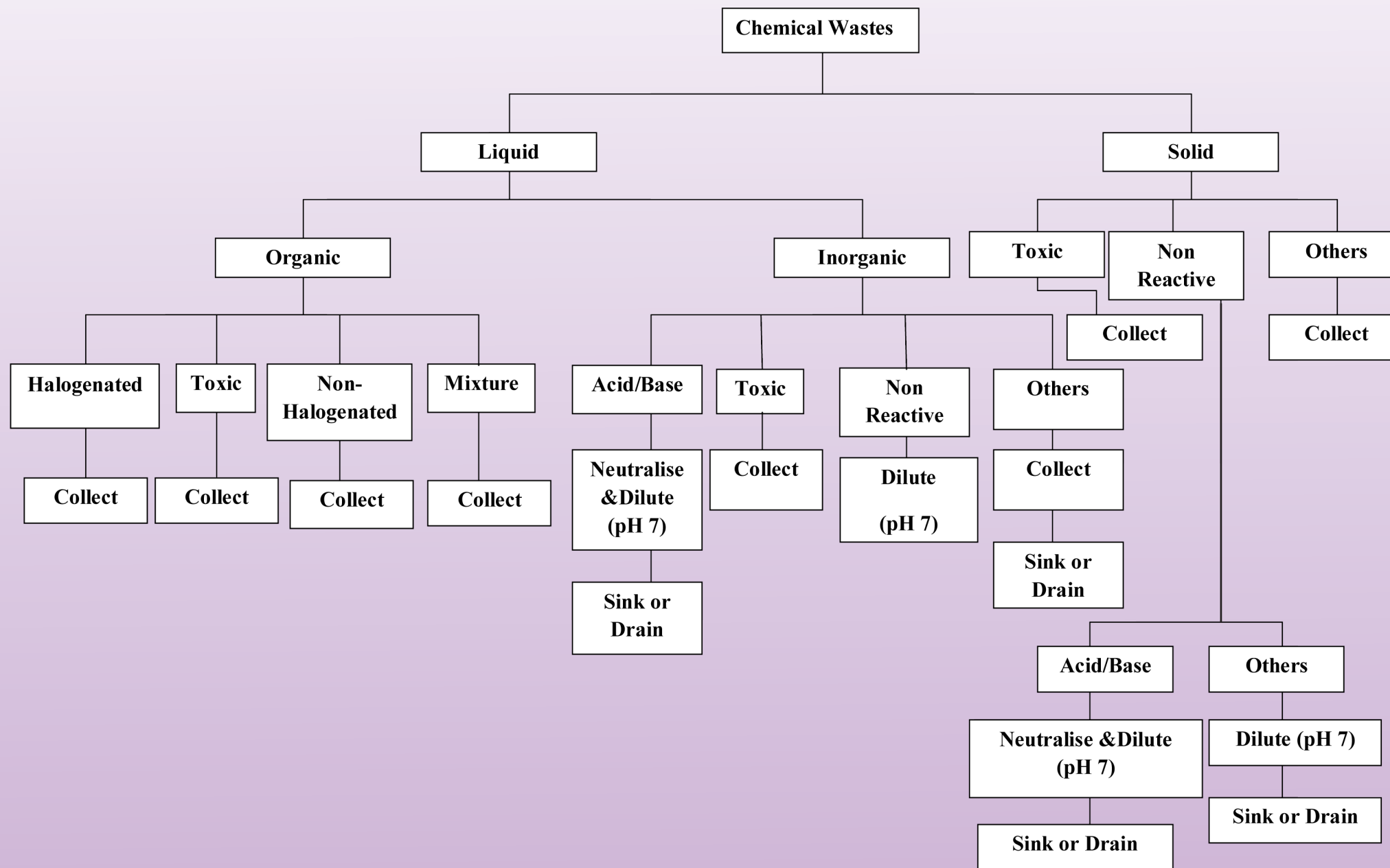
- 11.1 The disposal of any waste should be endorsed by an internal LCWM Committee.
- 11.2 Toxic or hazardous wastes should not be disposed of down the sink, drain or into the atmosphere.
- 11.3 Acidic or alkaline wastes should be neutralised before it is disposed down the sink or the drain or disposed into a pit.

- 11.4 Waste chemicals should be disposed off quickly to avoid accumulation of large stocks.
- 11.5 Chemicals immiscible with water must not be discarded into sinks or drains. Flammable solvents must similarly not be discarded.
- 11.6 All waste solvents should be collected in the appropriate waste containers and clearly labelled. The wastes containers should not be filled to the brim. Always leave some air space.
- 11.7 Where solvent mixtures are collected, the name of each solvent component should be specified. Avoid mixing waste solvents.
- 11.8 Incompatible chemicals should not be mixed (refer to **Appendix II** and **Appendix III**). For example waste chloroform should never be mixed with ether solvents because it may react dangerous with impure acetone.
- 11.9 Waste mercury should be collected by means of a suction pump and placed in glass bottle, sealed and handle separately for disposal.
- 11.10 A proposed method for packing the containers that is practiced by the Department of Chemistry, Malaysia is:
 - i. Separate the types of wastes before packing. Pack them separately into different drums. Care must be taken not to mix them up.
 - ii. Line or cushion the bottom of a 200L steel drum (into which bottles containing wastes can be packed) with a polystyrene sheet and saw-dust.
 - iii. Place the bottles containing the waste into the drum, making sure that the contents and volume of each bottle are recorded correctly.
 - iv. There must be cushioning between the bottles and also between the bottles and the walls of the drum to prevent breakage. Each bottle should sit stable.



- v. Fill up all gaps and crevices with saw-dust.
 - vi. Cover the bottles with saw-dust.
 - vii. Place another polystyrene sheet and again pack the bottles as in steps (iii) to (vii).
 - viii. Each time record the number of bottles, waste and quantity packed. Finally total them up and keep a list for contents of each drum.
 - ix. The 200L drum can take at least sixteen 4L bottles when packed and stacked in this way.
 - x. Label each drum according to DOE requirements and use the correct sticker as instructed.
 - xi. Store the drum under shade in a well-ventilated place.
 - xii. Warning signs should be used around where the drums are kept.
- 11.11 Laboratory Chemical Wastes should be transported by a licensed transporter to the licensed facilities for the treatment and disposal in accordance with the Environmental Quality (Scheduled Wastes) Regulations 2005.
- 11.12 A waste generator premises are required to use 'e-SWIS' web application to include information in accordance with the Sixth Schedule (Regulation 12) Environmental Quality (Scheduled Wastes) Regulations 2005 for every outward movement of scheduled wastes from waste generator's premises www.doe.gov.my.
- 11.13 A waste generator shall keep accurate and up to date inventory in accordance with the Fifth Schedule (Regulation 11) Environmental Quality (Scheduled Wastes) Regulations 2005 of the categories and quantities of scheduled wastes being generated, treated and disposed as in Appendix VI. Besides, waste generators also need to ensure that record keeping of the chemicals is compliance with (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013 under Occupational Safety and Health Act 1994.

FLOW CHART FOR DISPOSAL OF LABORATORY CHEMICAL WASTES





SCHEDULED WASTES OF POTENTIAL INCOMPATIBILITY

The mixing of a waste in Group A with a waste in Group B may have the following potential consequences:

Group 1-A

Alkaline caustic liquids
Alkaline cleaner
Alkaline corrosive liquid
Caustic wastewater
Lime sludge and other corrosive
Alkalies

Group 1-B

Acid sludge
Chemical cleaners
Electrolyte, acid
Etching acid, liquid or solvent
Pickling liquor and other
corrosive acid
Spent acid
Spent mixed acid

Potential consequences: Heat generation, violent reaction

Group 2-A

Asbestos
Beryllium
Unrinsed pesticide containers
Pesticides

Group 2-B

Solvents
Explosives
Petroleum
Oil and other flammable
wastes

Potential consequences: Release of toxic substances in case of fire or explosion

Group 3-A

Aluminium
Beryllium
Calcium
Lithium
Magnesium
Potassium
Sodium
Zinc powder and other reactive
Metals and metal hydrides

Group 3-B

Any waste in Group 1-A or
1-B



Potential consequences: Fire or explosion; generation of flammable hydrogen gas

Group 4-A

Alcohols

Group 4-B

Any concentrated waste in
Group 1-A or 1-B
Calcium
Lithium
Metal hydrides
Potassium
Sodium
Water reactive wastes

Potential consequences: Fire, explosion or heat generation; generation of flammable toxic gases

Group 5-A

Alcohols
Aldehydes
Halogenated hydrocarbons
Nitrated hydrocarbons and other
reactive organic compounds and
solvents
Unsaturated hydrocarbons

Group 5-B

Concentrated Group 1-A or
1-B wastes
Group 3-A wastes

Potential consequences: Fire, explosion or violent reaction

Group 6-A

Spent cyanide and sulphide
solution

Group 6-B

Group 1-B wastes

Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulphide gas

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Group 7-A



Chlorates and other strong oxidizers
Chlorites
Chromic acid
Hypochlorites
Nitrates
Nitric acid
Perchlorates
Permanganates
Peroxides

Group 7-B




Organic acids
Group 2-B wastes
Group 3-B wastes
Group 5-A wastes and other
flammable and combustible
wastes

Potential consequences: Fire, explosion or violent reaction

EXAMPLES OF PERSONAL PROTECTION EQUIPMENT (PPE)

Equipments	Descriptions
<p data-bbox="297 426 518 459">Fire extinguisher</p> 	<p data-bbox="680 426 1184 575">This tool should be ensured to be in good condition and not expired. It should be placed in a conspicuous place and labelled properly.</p>
<p data-bbox="323 815 489 848">First-aid kits</p> 	<p data-bbox="680 815 1184 890">First-aid kit should be located at the place that is easily accessible.</p> <p data-bbox="680 933 1184 1008">It should at least contain the following items :</p> <ol style="list-style-type: none"> <li data-bbox="680 1012 1036 1045">i. Triangular bandages <li data-bbox="680 1049 1005 1081">ii. Sterile gauze pads <li data-bbox="680 1085 975 1118">iii. Elastic bandage <li data-bbox="680 1122 1174 1197">iv. Pairs of gloves (disposable/non sterile) <li data-bbox="680 1201 1170 1234">v. Stainless steel bandage scissors <li data-bbox="680 1238 955 1271">vi. Adhesive tape <li data-bbox="680 1275 1009 1307">vii. Alcohol prep pads <li data-bbox="680 1311 991 1344">viii. Antiseptic liquid <li data-bbox="680 1348 964 1381">ix. Wound Plaster <li data-bbox="680 1385 1184 1460">x. Safety pins for triangular bandages <li data-bbox="680 1464 895 1497">xi. Tweezers <li data-bbox="680 1501 935 1534">xii. Cotton buds <li data-bbox="680 1537 1103 1570">xiii. Inventory of box contents

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<p>Safety boots</p> 	<p>Safety boots must be appropriate to the needs of the physical properties of chemical.</p>
<p>Laboratory coat</p> 	<p>Laboratory coat must be appropriate to the needs of the physical properties of chemical.</p>
<p>Sawdusts</p>  <p>Saw dusts should be placed in appropriate containers</p>	<p>This material should be provided in quantities appropriate to the type of chemicals in the laboratory. This is to control spillage in the event of chemical spills.</p>

*

Rubber gloves



Rubber gloves must be appropriate to the needs of the physical properties of chemical.

Safety mask



Safety mask must be appropriate to the need of the physical properties of chemical.

Safety goggles



Safety goggles must be appropriate to the needs of the physical properties of chemical.

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Shovels



Shovel is used to collect chemical wastes during a chemical spillage and have to ensure is provided in the laboratory.

EXAMPLES OF GOOD LABORATORY PRACTICE



Figure 1: Personal Protective Equipment (PPE) properly stored

Source: Department of Chemistry Malaysia

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Figure 2: Emergency shower



Figure 3: Emergency fire blanket

Source: Department of Chemistry Malaysia and Laboratory of Nexus International School



Figure 4: Proper storage for fire extinguisher and first aid kit

Source: Department of Chemistry Malaysia

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Figure 5: Fume hood



Figure 6: Temporary chemical waste storage area

Source: Department of Chemistry Malaysia



Figure 7: Chemical storage area

Source: Department of Chemistry Malaysia, Laboratory of Kualiti Alam Sdn. Bhd and Laboratory of Nexus International School

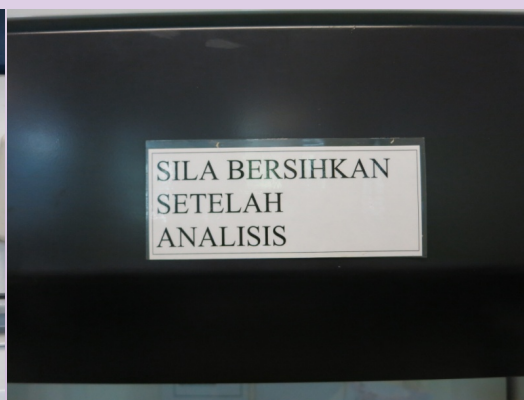
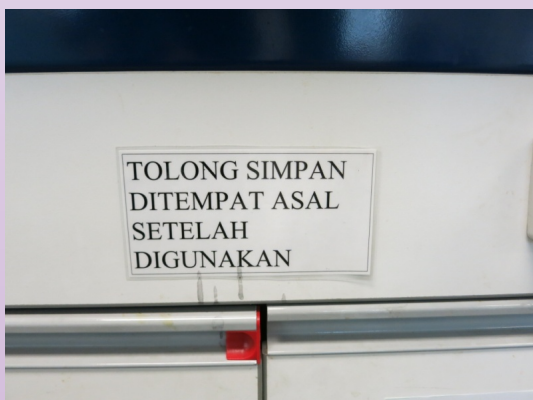
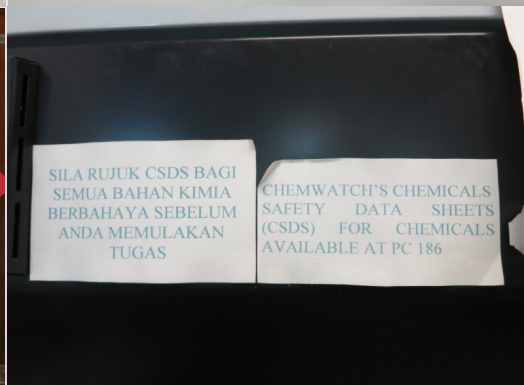
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Figure 8: Laboratory apparatus storage area

Source: Department of Chemistry Malaysia and Laboratory of Nexus International School

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CHEMICAL WASTES FROM LABORATORIES



Figures 9: Laboratory Safety Signage

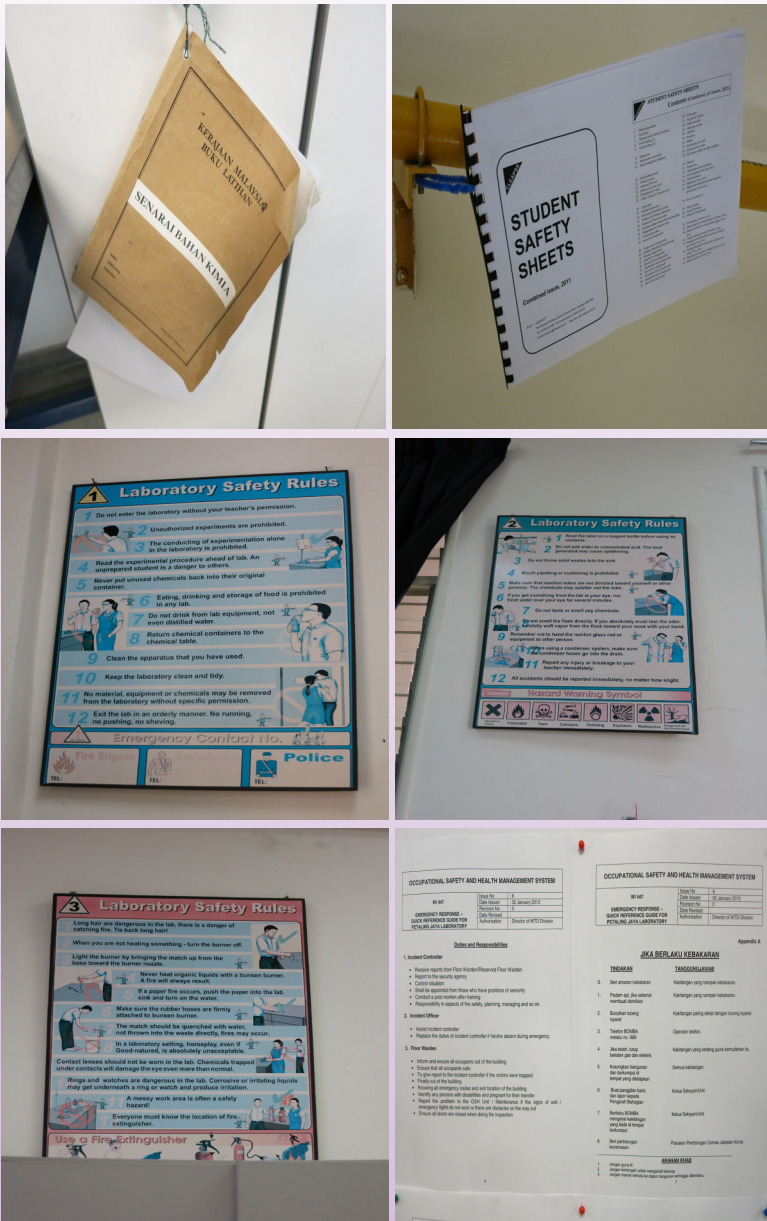
Source: Department of Chemistry Malaysia and Laboratory of Nexus International School



Figures 10: Chemical waste storage area

Source: Department of Chemistry Malaysia and Laboratory of Nexus International School

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Figures 11: Emergency Response Plan (ERP) and chemical information record

Source: Laboratory of Kualiti Alam Sdn. Bhd and Laboratory of Nexus International School

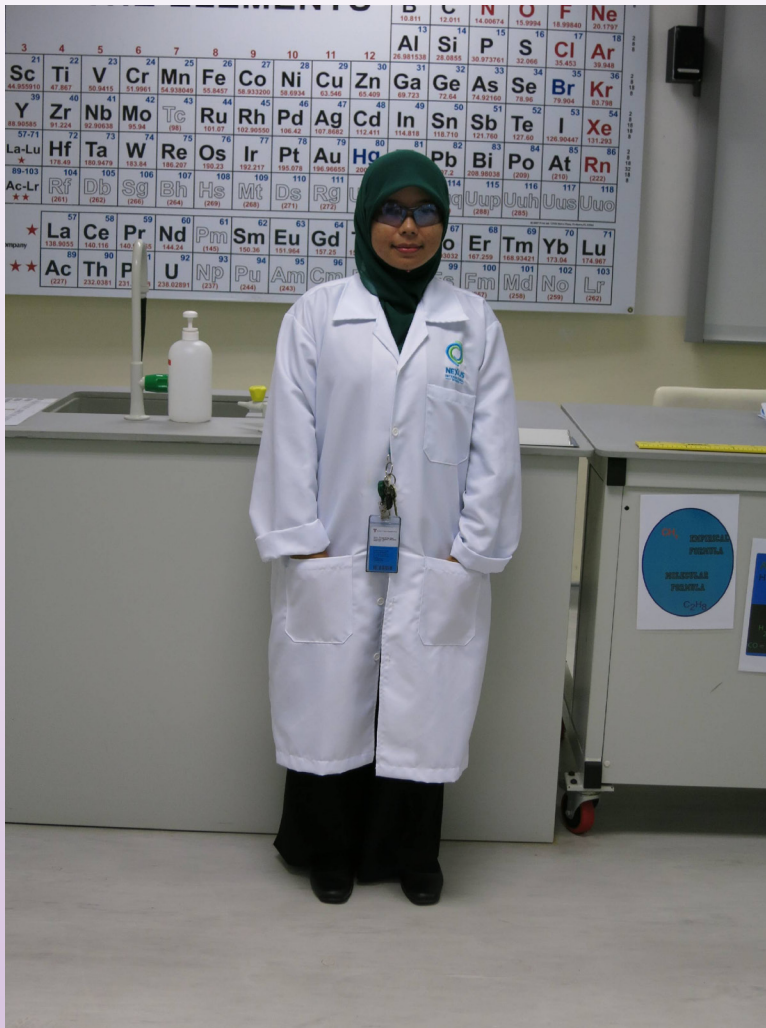


Figure 12: Proper laboratory attire

FIFTH SCHEDULE

**(Regulation 11)
ENVIRONMENTAL QUALITY ACT 1974**

**ENVIRONMENTAL QUALITY (SCHEDULED WASTES)
REGULATION 2005**

INVENTORY OF SCHEDULED WASTES AS AT:

*	* Waste aDate Category Code	* Name of Waste	* Quantity Generated (Metric Tonnes)	*Waste Handling		
				Method ^b	Quantity in Metric Tonnes	Place ^c

Note:

- * Inventory of the current generation of scheduled wastes
- a Date when the scheduled wastes are first generated
- b Stored , processed, recovered for materials or product from such scheduled wastes, incinerated, exchanged or other methods (specify)
- c Give name and address of the facility

I hereby declare that all information given in this form is to the best of my knowledge and belief true and correct in all respect.

Name of Reporting Officer:

Designation:

Signature: Date:

I.C. Number:



REFERENCES

1. Guidelines on the Disposal of Chemical Wastes from Laboratories First Edition, 2000
2. Malaysia Standard MS 2476:2012, SIRIM
3. Garis Panduan Perlesenan Pembawa yang Ditetapkan bagi Pergerakan, Pemindahan, Penempatan atau Peletakan Buangan Terjadual
4. Environmental Quality (Scheduled Wastes) Regulations 2005

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Puan Zuraini Binti Ahmad Tajuddin

Puan Fenny Wong Nyuk Yin

Encik Abdul Mazli Hafiz Bin Abdul Malik

Encik Faizal Bin Alias

Puan Ijan Khushaida Binti Mohd Jan

Puan Ezahtul Shahreen Binti Abdul Rahman

Puan Ili Daliela Binti Md Razali

Puan Nur Haily Binti Ramli

Encik Mohd Zulkifly Bin Yusoff

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Nexus International School, Putrajaya

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