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## **Procedures for Disposal of Chemical Waste**

This booklet is extracted from Chapter 16 of the HKUST Safety and Environmental Protection Manual.

## **Important Phone Numbers and Fax Number**

Reporting All Campus Emergencies, Security Control Centre 8999 or 6565

Enquiry of General Safety Matters 6512

Enquiry of Chemical Waste Disposal

Senior Engineer 6547

Assistant Health and Safety Officer 6456

Fax Number 2335 0074

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## I. Introduction to Chemical Waste Disposal/Treatment

With the implementation of the Waste Disposal (Chemical Waste) (General) Regulation, the disposal of chemical waste in Hong Kong is strictly controlled. To ensure compliance of the relevant regulations on disposal of chemical wastes and to promote environmental protection, HKUST has established a comprehensive chemical waste management program to manage chemical wastes produced on campus. This booklet provides summary of information about management of chemical wastes on campus which includes segregation and streaming of chemical wastes, chemical wastes disposal procedures, hazardous chemical lists, safety precaution required, service contact points and frequently used forms. It is divided into four parts under section V. Chemical Waste Management.

Section V.A.: Disposal of general chemical wastes

Section V.B.: Disposal of highly reactive chemical wastes

Section V.C.: Disposal of solid chemicals and solid wastes contaminated by chemicals

Section V.D.: Chemical waste minimization

Users are advised to read this booklet thoroughly prior to the handling of chemical waste. When in doubt, consult your supervisors or representative of the Health, Safety and Environment Office (HSEO) for disposal information which is not covered in this booklet.

## II. Scope of Chemical Wastes

A. Any unwanted substances that contain materials listed in Schedule I of the Waste Disposal (Chemical Waste) (General) Regulation (refer to Appendix A) are regarded as chemical wastes. Chemical wastes must be disposed of by Government's approved contractor whereas nonchemical wastes can be discharged directly into the drain or disposed of as municipal wastes. The following, as examples, are **NOT** considered as chemical wastes:

1. Solids and solutions (pH within 6-10) that do not contain substances listed in Appendix A.
2. Rinsing water and wiping tissue with low chemical contents.
3. Household chemicals used in laboratories (e.g. soap and detergent).
4. Acids and alkalis with concentration below those stipulated in Appendix A.
5. Liquids with low concentration (at 100 ppm or below) of chemicals. They are considered as waste water and can be treated by activated charcoal or ion-exchange resin before being discharged to drain. The used activated charcoal and ion-exchange resin are chemical wastes.

**B.** The procedures established in the booklet are **NOT** intended for use to handle the following items:

1. Radioactive materials
2. Explosive materials
3. Shock sensitive materials
4. Sealed metal articles or containers
5. Pressurized containers, e.g. gas cylinders
6. Asbestos bearing or contaminated substances
7. Substances contain or contaminated by biological agents, e.g. animal specimen, mould, etc.

Users are advised to contact HSEO for more information concerning disposal of the substances mentioned above.

### **III. General Information about Chemical Waste Management**

For information on request for chemical waste collection and chemical waste containers, exchange of usable chemicals, downloading of labels and frequently used forms, you are welcome to visit the HSEO website at <http://www.ab.ust.hk/hseo/> for details. Service request can be submitted to HSEO directly online or e-mail to [sepocwm@ust.hk](mailto:sepocwm@ust.hk).

### **IV. Safety Precautions in Handling Chemical Wastes**

The following links provide information about chemical waste safety:

Safety Reminder List for Chemical Waste Generator

<http://www.ab.ust.hk/hseo/Waste/safetyre.htm>

This list provides a systematic approach in checking the safety in chemical waste management.

Incompatible Chemicals List

<http://www.ab.ust.hk/hseo/Waste/incomp2.htm>

Incompatible chemical species are listed in this list.

Incompatible Chemical Waste Groups

<http://www.ab.ust.hk/hseo/Waste/incomp1.htm>

Chemical wastes are usually mixtures of chemicals. Common chemical waste mixtures are grouped in these tables and incompatible waste groups are listed.

Hazardous Waste Compatibility Chart (English version)

<http://www.ab.ust.hk/hseo/Waste/hwcompe.htm>

Incompatible chemicals are listed in this chart based on chemical groups or functional groups.

Hazardous Waste Compatibility Chart (Chinese version)

<http://www.ab.ust.hk/hseo/Waste/hwcompch.htm>

This is a Chinese version of the above hazardous waste compatibility chart. Incompatible chemicals are listed in this chart based on chemical groups or functional groups.

Checklist for Chemical Waste Management

<http://www.ab.ust.hk/hseo/pdf/wstchk.pdf>

This is a checklist for regulatory compliance and basic safety in storage of chemical waste.

## **V. Chemical Waste Management**

### **A. General Chemical Wastes**

#### **1. Waste Scope**

General chemical wastes include liquid, solid and sludge that can be grouped to the standardized chemical waste types listed below (section V.A.2.). Compatibility among chemicals in same chemical waste container is most importance. Mixing of incompatible chemicals could lead to disastrous consequences. Therefore, chemicals or mixtures which are highly reactive, water reactive or explosive must **NOT** be disposed of to the standard chemical waste containers.

#### **2. Chemical Waste Containers**

2.1. Standard chemical waste containers are provided by the Chemical Waste Treatment Centre. Both 20 liters and 200 liters sized containers are available. These containers are made of HDPE plastics, carbon steel or plastic with a metal casing (refer photos 1-4). To facilitate the processing of the chemical waste at the treatment plant, the Centre only accepts chemical waste contained in the containers provided by the Centre. Hence, HSEO only collects chemical waste contained in these standard containers.

2.2. A standard label is affixed on each chemical waste container which clearly shows the chemical waste type, warning sign, hazards and safety precautions (refer photo 5). For waste types which require filling out of chemical waste log sheet, a HSEO number is assigned to each container (same number appears on

the chemical waste log sheet of that container). This number can be found on the right-top corner of the container label (refer photo 6). Users should help to keep the labels in good conditions and ensure that these labels do not peel off from the containers.

- 2.3. Use narrow-mouth screw-cap containers to store liquid wastes. Open-top containers are used for sludges or gel wastes.
- 2.4. The Chemical Waste Treatment Centre currently provides 15 types of chemical waste containers. They are for collection of spent alkalis, chromium solutions, cyanides, fixers and developers, halo solvents, hydrofluoric acid, inorganic acids, lube oils, metal solutions, metal sludges, non-halo solvents, organic acids, organic gels, phenol sludges and rags with solvents/oils.

### **3. Chemical Waste Streaming**

- 3.1. Chemicals or mixtures which comply with section V.A.1. can be disposed of to the following chemical waste containers according to the guidelines below. Solids which can be dissolved in solvents or corresponding liquid wastes can also be discarded into respective containers. For example, copper sulphate crystal can be first dissolved in (aqueous) metal solution waste from the metal solution waste container, and then dispose back to the same container; or dissolve the solid with minimum amount of water before discarding into the metal solution waste container.

#### **a. SPENT ALKALI, LAB**

Sodium hydroxide, potassium hydroxide, and ammonia solution shall go to this container. Metal solutions (except chromium (VI)) can also be collected in this container.

#### **b. SPENT CHROMIUM SOLUTION**

Solutions that contain chromium (VI) shall be disposed of to this container. Chromium solutions of lower oxidation states can be disposed of to metal solution or alkali containers.

#### **c. SPENT CYANIDE SOLUTION, LAB**

Cyanides or mixtures containing cyanides **MUST** be disposed of to this container. The pH of liquid inside this container **MUST** be kept strongly alkaline to prevent the evolution of a lethal gas-hydrogen cyanide.

#### **d. SPENT FIXER AND DEVELOPER**

This container is for fixing and developing agents used in film and photo processing.



**e. SPENT HALO SOLVENT, LAB**

Organic solvents and compounds with halogens (F, Cl, Br, & I) (e.g. trichloromethane, trichloroethylene, and dichloromethane) shall be collected in this container.

**f. SPENT HYDROFLUORIC ACID**

This container is for hydrofluoric acid. If the amount of hydrofluoric acid is small (the final concentration of hydrofluoric acid is less than 5% in the filled up waste content), it can be disposed of in inorganic acids container.

**g. SPENT INORGANIC ACID**

This container is for hydrochloric acid, nitric acid, sulphuric acid and perchloric acid. **Organic acids must be EXCLUDED.** Large amount of organic acids shall go to organic acid container; for small amount, they can be disposed of to halogenated or non-halogenated solvent container depending on halogen content. For safety, concentrated acids **MUST** be diluted (less than 25%) before poured into this container.

**h. SPENT LUBE OIL**

Pump oil, lubricating oil, liquid paraffins, mineral oil, hydraulic oil, etc., shall go to this container.

**i. SPENT METAL SLUDGE**

Sludges contain toxic metallic powders or ions can be disposed of to this container. The sludges should be dewatered as much as possible and the separated liquid should be disposed of to metal solution container if the metal ion concentration is high.

**j. SPENT METAL SOLUTION, LAB**

Aqueous solutions containing metallic ions or precipitates (except chromium (VI)) shall be disposed of in this container. Waste containing chromium (VI) shall be collected in "SPENT CHROMIUM SOLUTION" container. Diluted acid and alkali can also be disposed of in this container.

**k. SPENT NON-HALO SOLVENT, LAB**

This container is for organic solvents and compounds without halogens (e.g. acetone, hexane, and petroleum ethers).

## **I. SPENT ORGANIC ACID**

Collect organic acids in this container. Small amount of organic acids can be disposed of in non-halogenated or halogenated solvents container according to halogen content. Organic acids **MUST NOT** be discarded to inorganic acid container.

## **m. SPENT ORGANIC GEL, LAB**

This container is for toxic gel, such as polyacrylamide gel, or gels contaminated with toxic chemicals (e.g. ethidium bromide). Non-toxic gels, such as agarose, not contaminated by toxic chemicals can be discarded as municipal waste. Gel with biological agents (e.g. agar plate with microbials) **MUST NOT** be disposed of to this container.

## **n. SPENT OXIDIZER, ACIDIC, LAB**

Oxidizer (e.g. permanganate, persulfate and perchlorate) in solution with pH < 7 shall be disposed of to this container.

## **o. SPENT OXIDIZER, ALKALI, LAB**

Oxidizer (e.g. hypochlorite) in solution with pH > 7 shall be disposed of to this container.

## **p. SPENT SOIL WITH PHENOL**

Soil contaminated with high concentration of phenol shall be disposed of to this container.

3.2. Waste mixtures are streamed according to the major components in the wastes **EXCEPT**:

- a.** Waste containing cyanide shall always go to the cyanide waste container.
- b.** Organic mixtures contain halogenated compounds shall be put into halogenated solvents container even if the halogenated compounds are the minor components.

Table 1: Examples of Chemical Waste Container Selection

Chemical Waste Mixture	Chemical Waste Container
	If more than one choice, they are listed in descending preference.
Ethanol/acidified ethanol	Non-halogenated solvent or halogenated solvent
Acetic acid - large amount - small amount (< 2 L)	- Organic acid - Non-halogenated solvent
Trichloroacetic acid - solution - small amount of solid  - large amount of solid	- Halogenated solvent - Dissolve in minimum quantity of an appropriate solvent (e.g. water), then to halogenated solvent - Dissolve in minimum quantity of solvent, then to organic acid
Chromium solution - Cr (VI) - Cr with oxidation state <VI	- Chromium solution - Metal solution, alkali, inorganic acid or chromium solution
Chloroform (minor component) + methanol + hexane + acetone	Halogenated solvent
Mixture with cyanide as minor component	Cyanide
Metal solutions/precipitates	Metal solution, alkali or inorganic acid
Hydrofluoric acid - final concentration < 5 % - final concentration > 5 %	- Inorganic acid or hydrofluoric acid - Hydrofluoric acid
Acidified potassium permanganate solution	Acidic oxidizer

#### 4. Safety Precautions

- 4.1. Always wear appropriate personal protective equipment (e.g. goggles, gloves and laboratory coat) when handling chemical waste.
- 4.2. For waste that evolves vapour, the transferring of waste to chemical waste container should be done inside a fume cupboard.
- 4.3. Make sure a waste to be poured into a chemical waste container is compatible with the waste already inside the container. Perform a compatibility test (refer section V.A.5.) before mixing different batches of chemical wastes.
- 4.4. To prevent evolution of vapour, always cap chemical waste container properly.

- 4.5. Highly reactive and water reactive compounds shall **NOT** be poured into standard chemical waste containers. Pre-treatment shall be conducted before they can be disposed to these containers. They can also be handled by procedures in section V.B. Examples of explosives and water reactive substances are listed in Appendixes C and D respectively and the lists shall not be considered as exhaustive.
- 4.6. Tightly fit metallic cases are provided for halo and non-halo solvent standard containers (refer photo 1). Do not take out the inner plastic containers from their metallic cases. The metallic cases provide better mechanical protection for the containers and also act as spill trays if the plastic containers are damaged.
- 4.7. For all other liquid standard containers, always put the containers inside spill trays. Standard spill trays (refer photo 7) can be purchased from the Centre of Laboratory Supplies (CLS) (ext. 6875 or 6876).
- 4.8. To prevent overflow, always check the liquid level in a waste container before adding new waste. The container shall only be filled up to 70 to 80 % of its full capacity for collection by HSEO.
- 4.9. Use a funnel to transfer large volume of liquid waste into a chemical waste container for spill prevention.
- 4.10. The following mixtures have caused mishaps at campus. Users shall observe precautions recommended when handling these waste types.

**a. Explosive**

Concentrated nitric acid and some organics  
Concentrated sulfuric acid and solid potassium permanganate

Such mixtures **MUST** be treated immediately. Do **NOT** dispose of them to chemical waste container.

**b. Highly Reactive Reagent**

Concentrated sulfuric acid and nitric acid  
Fuming/concentrated sulfuric acid  
Fuming/concentrated nitric acid

These mixtures/chemicals can deteriorate the standard inorganic acid container. Dilute at least five times before disposing of them to inorganic acids container.

### c. Gas Producing

Nitric acid and organics  
Mixture containing hydrogen peroxide  
Inorganic acid and bicarbonate/carbonate

Gas producing mixtures inside a sealed container can develop pressure up to an explosive level. Reaction must be completed or mixture treated before disposing of them to chemical waste containers.

## 5. Compatibility Test Procedures

- 5.1. Reactions among chemicals in chemical waste mixtures can be extremely complicated. The compatibility test only provides a quick check on the compatibility of the concerned wastes. As some dangerous substances may take times to produce, passing this test shall not be considered as a definite conclusion about the compatibility of the mixed wastes. Chemical waste producers shall make their own judgement or consult their supervisors or HSEO if in doubt.
- 5.2. Wear eye protection, gloves and lab coat and conduct the test inside a fume cupboard.
- 5.3. Homogenize the waste inside the target chemical waste container and withdraw about 50 ml from the container into a beaker.
- 5.4. Measure the temperature of the sample.
- 5.5. **Slowly** mix a portion of the chemical waste which is waiting for disposal (new waste) to the sample. The volume to be added should be close to the volumetric ratio between the new waste and the content in the waste container. For example, if the volumes of waste inside the target waste container and the new waste are 10 L and 2 L respectively, then add 10 ml of the new waste to the sample.
- 5.6. If rigorous reaction is observed upon mixing, stop the addition **immediately**.
- 5.7. After addition, measure the temperature of the mixture. If bubbling, gassing or temperature rises by 10°C or more during or within 5 minutes after mixing, the wastes are considered incompatible. Carry out pre-treatment before disposing of the waste into standard containers or consider Labpack Waste Scheme (section V.B.). Consult your supervisor or HSEO for alternate disposal methods if necessary. Store this new waste separately in another container and label the waste with detailed information on

chemical composition, date of generation, and contact information (email and telephone number) of the waste producer.

- 5.8. Mixing of wastes which produce colour change/precipitation but not accompanied by bubbling, gassing or significant temperature rise is not considered as incompatible. If no adverse reaction occurs within 5 minutes, the new waste can be added to the corresponding chemical waste container.

## 6. Chemical Waste Log Sheet

- 6.1. Disposal of most chemical wastes to standard chemical waste containers requires filling in of chemical waste log sheets (refer Appendix E). Chemical waste log sheet is not required for chemical waste containers for fixers and developers, lube oils, organic gels, metal sludges, or soil with phenol. Chemical waste log sheets are delivered together with chemical waste containers to users by HSEO if necessary. They bear unique HSEO numbers which match with number labels on the chemical waste containers (photo 6).
- 6.2. A duly completed chemical waste log sheet is essential due to the following reasons:
  - a. To comply with the chemical waste handling procedures (section V.A.4.3.) issued by the Chemical Waste Treatment Centre. It states that "every waste entering into a chemical waste container must be properly logged. The filled log sheet must accompany the container at the time of collection by Centre. The Centre will **refuse collection** of containers that do not carry a legible log sheet. "
  - b. To comply with the "Code of Practice on the packing, labelling and storage of chemical wastes" issued by the Environmental Protection Department of Hong Kong.
  - c. To provide clues for the compatibility of chemical wastes in the container.
  - d. To provide information for the Chemical Waste Treatment Centre on the composition of waste.
- 6.3. Fill in all the columns neatly by a pen with dark water-proof ink. Do **NOT** use pencil, fountain pen, and felt pen with water-based ink.
- 6.4. Write down the names and concentrations of the reactants/products/wastes in full and in block letters. Abbreviation and short form are **NOT** acceptable. Molecular formulae of the chemicals are helpful.

- 6.5. Write down the volume or weight of the waste being poured into the container. Since the Chemical Waste Treatment Centre does not collect chemical waste container without a duly completed and legible chemical waste log sheet, in the same manner, HSEO does not collect chemical waste container without a proper log sheet.
- 6.6. Whenever waste is added to a container, immediately enter the information of the new waste to the chemical waste log sheet of that container.

## **7. Operational Procedures**

- 7.1. The request for chemical waste collection and chemical waste container delivery can be submitted to HSEO at the following link:

[https://www.ab.ust.hk/cgi-bin/kx\\_cgi.sh/WService=broker\\_kw\\_p/prg/kw\\_chem\\_waste.r](https://www.ab.ust.hk/cgi-bin/kx_cgi.sh/WService=broker_kw_p/prg/kw_chem_waste.r)

or by following this path:

HSEO website > Hazardous Waste (left menu) > Request for Chemical Waste Collection

- 7.2. Fill in the “Request for Chemical Waste Collection and Chemical Waste Container Form” and submit electronically.
- 7.3. When the container is three quarters full, submit a “Request for Chemical Waste Collection Form” to HSEO for arranging chemical waste collection.
- 7.4. HSEO collects and delivers chemical waste containers every Tuesday afternoon. If Tuesday is not a working day, the service will be deferred to the next working day. All requests submitted online on or before Monday will be handled on the next working day.
- 7.5. To facilitate chemical waste collection and waste container delivery to unattended location, please contact HSEO staff for necessary arrangement by indicating in the remarks in the request form or calling ext. 6546.

## **B. Highly Reactive Chemical Wastes**

### **1. Introduction**

"Labpack" is another chemical waste disposal service provided by the Chemical Waste Treatment Centre. Highly reactive chemicals which cannot be discarded into the standard waste containers mentioned in

section V.A. even after pre-treatment are usually disposed of through this approach. Labpack wastes are collected in their original containers, grouped and packed in small drums for transportation to the disposal site by Chemist. Prior disposal approval must be obtained from the Environmental Protection Department for Labpack Waste collection.

## **2. Waste Scope**

The following items are collected through this scheme:

- 2.1. Highly reactive chemicals.
- 2.2. Water reactive chemicals.
- 2.3. Wastes that cannot pass the compatibility test (refer to section V.A.5.).
- 2.4. Unwanted chemicals or expired chemicals with prior approval by the Chemical Waste Treatment Centre on individual basis.

## **3. Handling of Labpack Waste**

- 3.1. Keep Labpack wastes in their original containers as much as possible. Since Labpack wastes are collected only once every several years, seal the container in a plastic bag or other compatible material if the original container is damaged or not in good condition, such as leakage. Keep the label intact or label the packing properly.
- 3.2. For very special wastes, such as complex mixtures, the waste producers are required to fill in "Labpack Waste Identity Sheet" (refer Appendix F). Submit this form to HSEO together with the waste upon collection.

## **4. Disposal Procedures**

- 4.1. Fill in a "Labpack (Unwanted/Expired Chemical) Form" (Appendix G) for the disposal of
  - a. unwanted raw chemicals, or
  - b. expired chemicals.
- 4.2. Fill in a "Labpack (Incompatible Waste) Form" (Appendix H) for waste that
  - a. fails the compatibility test, or
  - b. waste mixtures contain water reactive and/or highly reactive chemicals.



4.3. Return the completed form

- a. to a HSEO's representative designated for your department/ office/center, or
- b. by email to [sepocwm@ust.hk](mailto:sepocwm@ust.hk).

4.4. Information collected will send to the Chemical Waste Treatment Centre. Each disposal request will be assessed by the Environmental Protection Department before approval is granted. Chemical waste that can be safely disposed of by using the appropriate waste containers listed in section V.A.3. shall not be disposed of through the Labpack service.

4.5. After the request is approved by the Environmental Protection Department, HSEO will collect the waste from your lab/workshop for disposal.

### C. Solid Chemicals or Solid Wastes Contaminated by Chemicals

1. Chemical wastes shall be segregated from non-hazardous substances to minimize the amount of chemical waste. For example, a teaspoon of toxic solid chemical mixed with a bucket of sand will make the mixture become a chemical waste. Request for chemical waste collection service by filling in a form at HSEO website with this link :

[https://www.ab.ust.hk/cgi-bin/kx CGI.SH/WService=broker\\_kw\\_p/prg/kw\\_chem\\_waste.r](https://www.ab.ust.hk/cgi-bin/kx CGI.SH/WService=broker_kw_p/prg/kw_chem_waste.r)

or by following this path:

HSEO website > Hazardous Waste (left menu) > Request for Chemical Waste Collection

2. The disposal procedures for common solid wastes are as follows:

#### 2.1. Hazardous Solid Chemicals

They can be disposed of to the standard chemical waste containers as mentioned in section V.A.. Refer to V.A.3. for details. For non-toxic chemicals like sodium carbonate, potassium chloride, iron chip, agarose, etc., they can be packed in sealed containers and disposed of as municipal waste.

#### 2.2. Spent Chromatographic Column Packing

Chromatographic solid supports such as alumina, silica gel, resin and Sephadex can be disposed as municipal waste after the eluent

or solvents have been evaporated. Transfer them to rigid containers (e.g. a wide-mouth plastic reagent bottle), add water to keep them moist, seal the container and then discard as municipal waste.

### **2.3. Solid Contaminated with Highly Toxic Chemicals**

Plastic lab-ware (e.g. vial, test tube, pipet tips, bottle, etc.) and personal protective equipment (e.g. gloves) which are combustible and contaminated with very toxic chemicals, such as potent toxins and carcinogens, shall be sealed in thick plastic bags or boxes. Call HSEO to make collection arrangement on individual basis.

### **2.4. Solid Contaminated with Harmful Chemicals**

Disposal lab-ware (e.g. pipet tips, test tubes, vials, etc.) and personal protective equipment (e.g. gloves) which are contaminated with harmful chemicals shall be rinsed with water or detergent solution, drained, wrapped in plastic bags or keep in rigid containers, and then disposed of as municipal waste.

### **2.5. Tissue Paper and Towel Soaked with Solvents**

Small amount of this waste type can be discarded as municipal waste after the solvents have evaporated in fume cupboard. For large amount of this waste, keep them in **closed** plastic bags inside a fire-safe bin. They will be collected under the waste type of "Rags with solvents/oils". Pay special attention to the potential fire hazard associated with this waste. Submit a collection request to HSEO when the waste is more than 5 kg.

### **2.6. Rags, Towel, Cloth and Tissues Soaked with Oils**

Only rags, towel, cloth and tissues that are saturated (not contaminated or partially soaked) with oils (including lubricant oil, hydraulic oil, mineral oil, pump oil, kerosene, etc.) are considered as chemical waste. Collect them in plastic bag and always close the bag to avoid evolution of vapours to minimize fire risk and control odour. Submit a collection request to HSEO under the waste type "Rags with solvents/oils" when the waste is more than 10 kg.

Large volume waste producers can request for 200 litres container from the HSEO website by this link:

[https://www.ab.ust.hk/cgi-bin/kx CGI.sh/WService=broker\\_kw\\_p/prg/kw\\_chem\\_waste.r](https://www.ab.ust.hk/cgi-bin/kx CGI.sh/WService=broker_kw_p/prg/kw_chem_waste.r)

## 2.7. Elemental Mercury

In Hong Kong, currently there is no proper treatment or disposal method available for treating mercury. However, to minimize potential impacts to the environment, mercury wastes are collected and stored until they can be treated or disposed of by an environmentally preferable approach in future. To help the long term storage of mercury, user shall minimise the volume of the mercury waste generated as much as possible. For example, pour the mercury inside a sphygmomanometer to a rigid and sealable container of SIMILAR size and then discard the non-contaminated metallic case, tubing, and cuff as municipal waste. For waste collection, submit a request to HSEO. Select “Others” under the “Waste Type” column and write down “mercury waste” and its approximate weight in the blank.

Unless high purity is required, contaminated mercury can be purified by simple process such as filtering or dilute acid washing. Treated mercury can be reused in apparatus such as manometer.

Waste generated in elemental mercury spill cleanup shall be minimized as much as possible. Do not use excessive amount of tissue/towel in spill control. Non-porous objects, such as beakers, bottles or trays, adhered with mercury droplets can be decontaminated by rinsing with water inside a spill tray. Then the tray is shaken gently to agglomerate the droplets. Only collect the mercury drops rather than dispose of all non-porous objects in contact with mercury. Seal spill cleanup waste in double plastic bags. Write down “mercury spill cleanup waste” in your collection request.

## 2.8. Batteries

For **large size** exhausted rechargeable batteries which are generated due to campus activities (e.g. batteries for battery room, forklift truck, uninterrupted power supply, etc.), they are collected by HSEO.

Prepare the battery according to the following steps established by the Environmental Protection Department before submitting a collection request to HSEO:

- a. Fully discharge the battery by a dummy or an electrical device.
- b. Drain the liquid (e.g. dilute sulphuric acid in case of lead acid battery) to an inorganic acid chemical waste container. Follow section V.A.7. to request for a container. Take special precaution when discharging the acids from the battery.

- c. Connect the terminals of the battery with a conductive wire. Make sure the battery is completely discharged before short circuiting. If not, large amount of heat generated in the conducting wire can result in fire.
- d. Submit a collection request on HSEO website:

[https://www.ab.ust.hk/cgi-bin/kx\\_cgi.sh/WService=broker\\_kw\\_p/prg/kw\\_chem\\_waste.r](https://www.ab.ust.hk/cgi-bin/kx_cgi.sh/WService=broker_kw_p/prg/kw_chem_waste.r)

Select “Others” under “Waste Type” column. Provide information on the battery type, number of pieces, and approximate weight of whole batch in the blank.

For small amount of large size batteries, it will be collected on the next chemical waste collection day. HSEO will contact you for further arrangement if large amount of battery will be collected.

For **small size rechargeable** batteries (e.g. nickel metal hydride, nickel cadmium and lithium ion) of small electronic appliances, these batteries can be disposed of to the rechargeable battery collection box at the waste recycling point at The Hong Kong Jockey Club Atrium (near the escalators leading to the Chia-Wei Woo Academic Concourse). To prevent fire hazard due to short circuit of battery terminals, the output terminals of batteries shall be covered by tape before putting them in the collection box.

## 2.9. Empty Chemical Containers and Reagent Bottles

Residual chemicals inside these containers shall be cleared as much as possible. Wash the containers, drain to dryness and call CLS at ext. 6884 or 6887 for collection.

## 2.10. Large Amount of Hazardous Solid Wastes

They can be disposed of by co-disposal at landfill through a licensed chemical waste collector. Contact HSEO for details.

## D. Chemical Waste Minimization

1. Chemical waste can be minimized through thorough planning of chemical needed, proper estimation of chemical consumption rate, and exchange unwanted chemicals with others. Purchase chemical in appropriate package, especially for chemicals with short shelf life or peroxide forming chemicals. For same chemical with more than one bottle, always put the bottle with shorter expiry date in front.

## **2. Chemical Exchange Program**

2.1. HKUST Chemical Exchange Program (CEP) is a waste minimization scheme with the objective TO REDUCE:

- a. chemical waste generation,
- b. risk and manpower in handling and treating chemical wastes, and
- c. expenditure associated with chemical purchase and chemical waste management.

2.2. Through CEP, an unwanted chemical (i.e. a hazardous waste) can be donated to colleagues of HKUST and chemical users of other local tertiary institutions. Chemicals listed in the CEP are typically surplus chemicals of high quality with their original factory seals intact. Users are encouraged to utilize the CEP to release unwanted chemicals rather than disposing them as chemical wastes.

Please visit [http://www.ab.ust.hk/hseo/chemical\\_ex](http://www.ab.ust.hk/hseo/chemical_ex) for further information.

## **VI. Conclusion**

Chemical waste is hazardous. Improper handling of chemical waste can result in serious consequences such as explosion, fire, personal injury and may cause damage to the environment. Chemical waste producers are reminded to exercise due care and follow local regulations and University's requirements when handling chemical waste.

## Appendix A

### **Substances and Chemicals Listed in Schedule I of the Waste Disposal (Chemical Waste)(General) Regulation**

#### **Part A**

Any substance to which the Antibiotics Ordinance (Cap. 137) applies

Asbestos

Dangerous drugs (as defined in the Dangerous Drugs Ordinance (Cap. 134))

Dangerous goods, category 2, NES

Dangerous goods, category 6, NES

Dangerous goods, category 9, NES

Dibenzofurans

Dioxins

Pesticides (as defined in the register referred to in section 4(b) of the Pesticides Ordinance (Cap. 133))

Poisons (Part I) (as defined in the Pharmacy and Poisons Ordinance (Cap. 138))

Polychlorinated biphenyls

#### **Part B**

Antimony and its compounds

Arsenic compounds

Barium compounds

Beryllium and its compounds

Boron compounds

Cadmium and its compounds

Chromium and its compounds, NES

Chromium bearing solid tannery waste

Cobalt and its compounds

Copper compounds

Cyanides

Dangerous goods, category 3, NES

Dangerous goods, category 4, NES

Dangerous goods, category 5, NES

Dangerous goods, category 7, NES

Dangerous goods, category 8, NES

Dangerous goods, category 10, NES

Halogenated organic solvents and compounds

Lead and its compounds

Manganese and its compounds

Mercury and its compounds

Mineral oils employed for engine lubrication

Mineral oils, NES

Nickel and its compounds

Non-halogenated organic solvents and compounds

Organo lead compounds

Organo mercury compounds  
Organo tin compounds  
Paints  
Pesticides (as defined in the register referred to in section 4(a) of the Pesticides Ordinance (Cap. 133))  
Pharmaceutical products and medicines, NES  
Phosphorus compounds excluding phosphates  
Selenium compounds  
Silver compounds  
Sulphides  
Thallium and its compounds  
Tin compounds  
Vanadium compounds  
Zinc compounds

### **Acids, Alkalis and Corrosive Compounds**

Acetic acid above 10% acetic acid by weight  
Acids or acidic solutions, NES with acidity equivalent to above 5% nitric acid by weight  
Ammonia solution above 10% ammonia by weight  
Bases or alkaline solutions, NES with alkalinity equivalent to above 1% sodium hydroxide by weight  
Chromic acid above 1% chromic acid by weight  
Fluoboric acid above 5% fluoboric acid by weight  
Formic acid above 10% formic acid by weight  
Hydrochloric acid above 5% hydrochloric acid by weight  
Hydrofluoric acid above 0.1% hydrofluoric acid by weight  
Hydrogen peroxide solution above 8% hydrogen peroxide by weight  
Nitric acid above 5% nitric acid by weight  
Perchloric acid above 5% perchloric acid by weight  
Phosphoric acid above 5% phosphoric acid by weight  
Potassium hydroxide solution above 1% potassium hydroxide by weight  
Potassium hypochlorite solution above 5% active chlorine  
Sodium hydroxide solution above 1% sodium hydroxide by weight  
Sodium hypochlorite solution above 5% active chlorine  
Sulphuric acid above 5% sulphuric acid by weight

NES - Not elsewhere specified

**Chart 1: Hazardous Waste Streaming Flowchart**

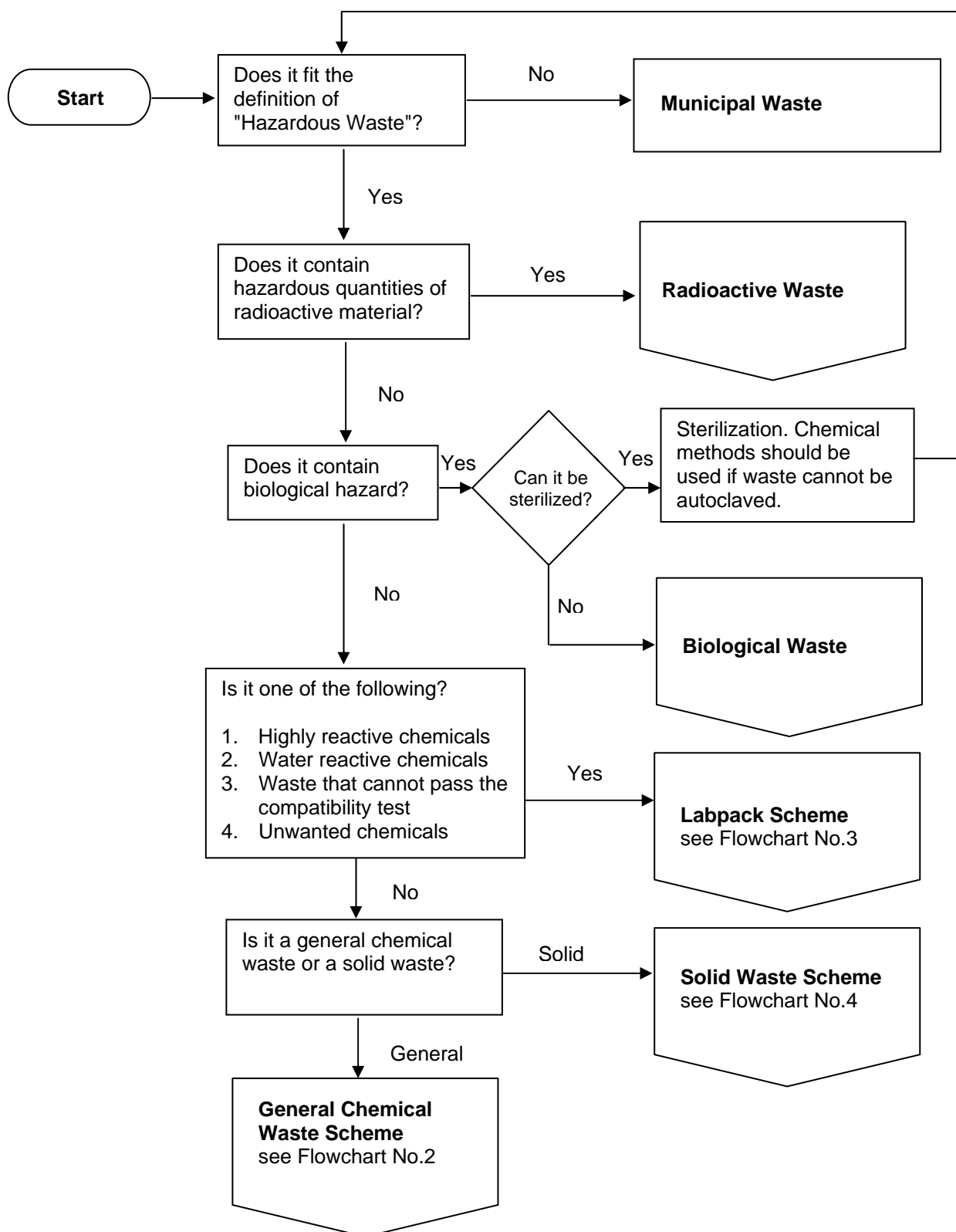
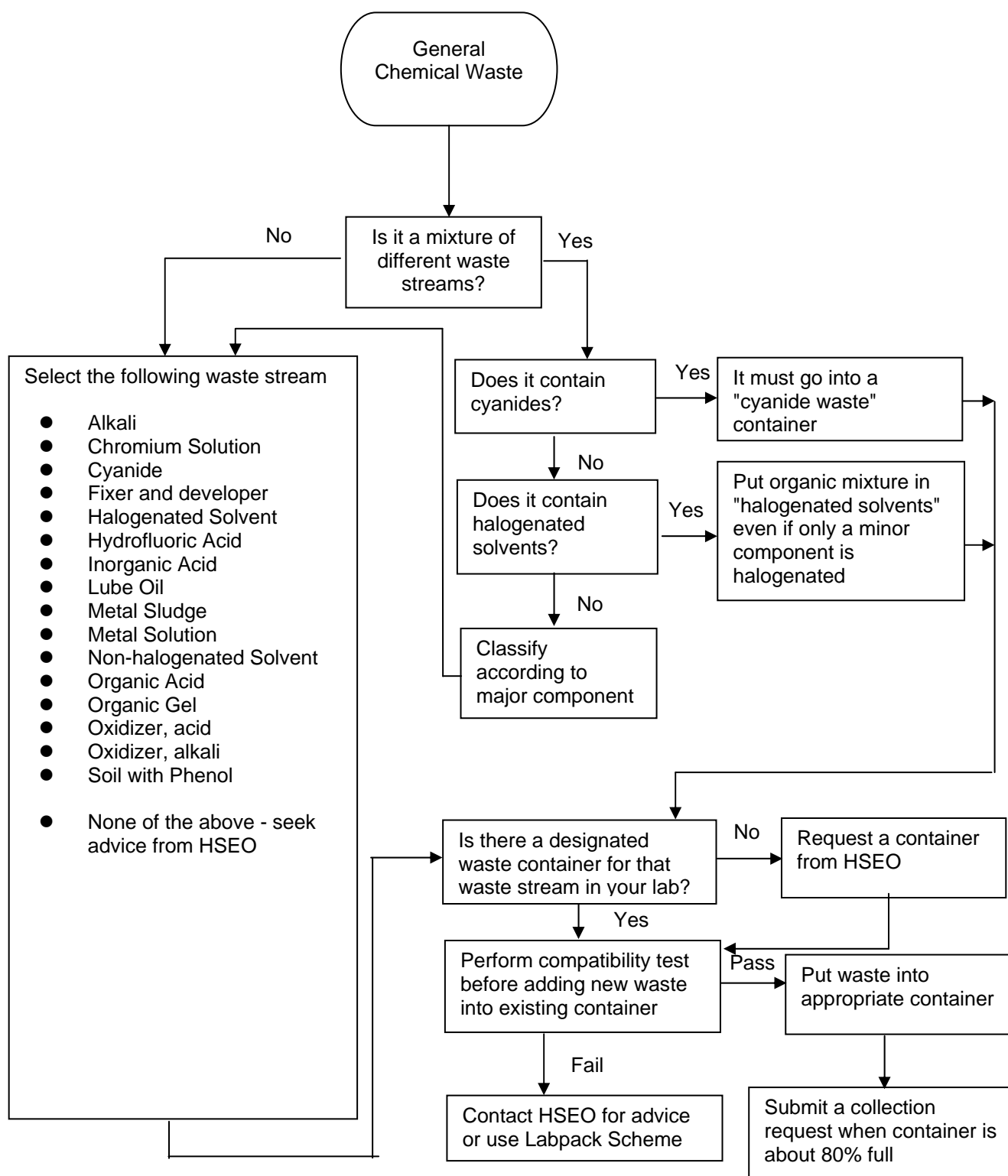




Chart 2: Chemical Waste Disposal Flowchart



**Chart 3: Labpack Waste Scheme Flowchart**

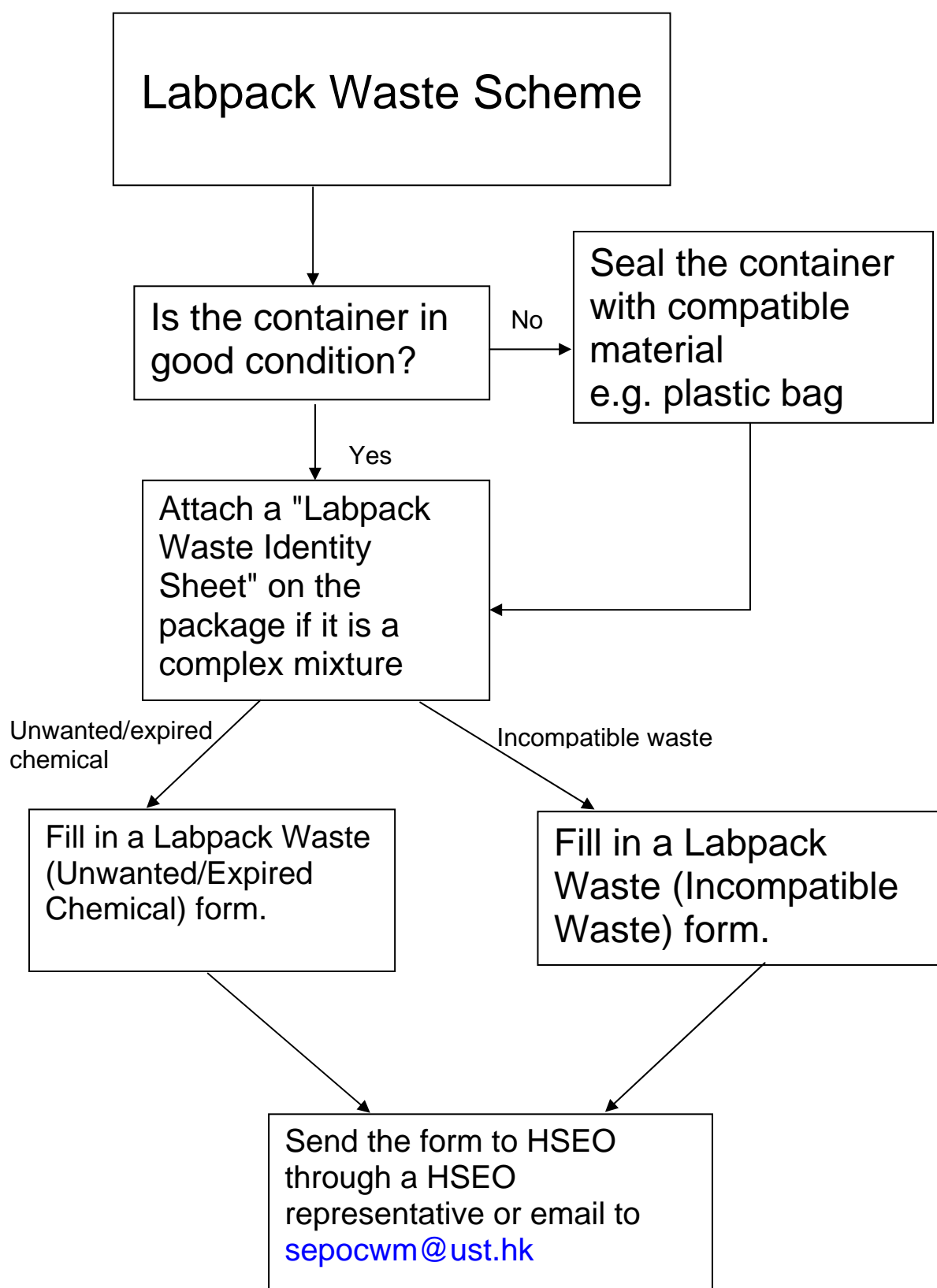
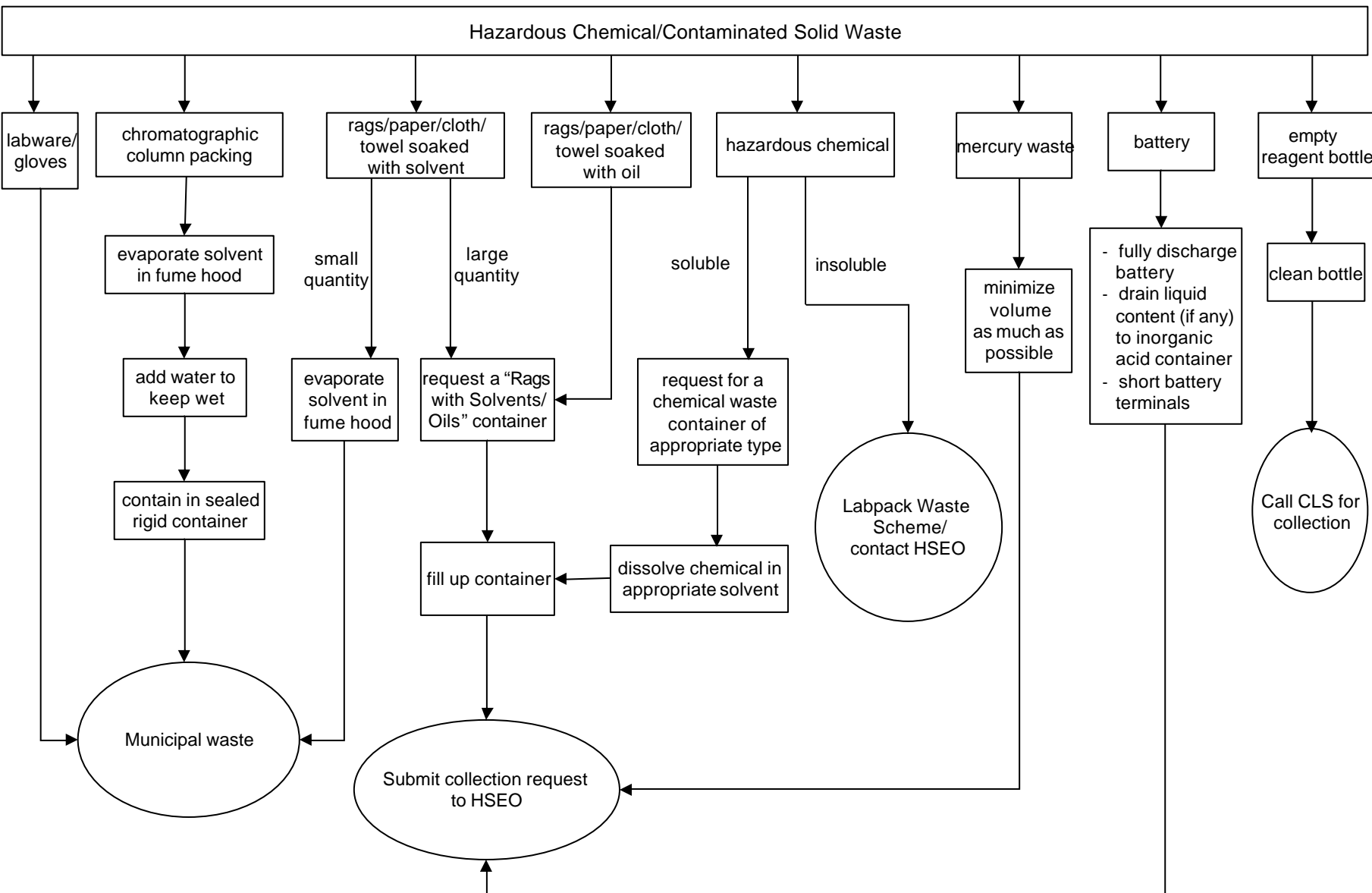


Chart 4: Handling Paths of Solid Wastes



## Appendix C

### **Examples of Explosives**

Acetyl azide	Acetyl nitrate
Ammonium azide	Ammonium chlorate
Ammonium hexanitrocobaltate	Ammonium nitrate
Ammonium nitrite	Ammonium periodate
Ammonium permanganate	Ammonium picrate
Ammonium tetraperoxychromate	Azidocarbonyl guanidine
Barium azide	Benzene diazonium chloride
Benzotriazole	Benzoyl peroxide
Bismuth nitride	Boron triazide
Bromine azide	Butanetriol trinitrate
t-Butyl hypochlorite	Cadmium azide
Cadmium hexamine chlorate	Cadmium hexamine perchlorate
Cadmium nitrate	Cadmium nitride
Cadmium trihydrazine chlorate	Calcium nitrate
Cesium azide	Chlorine azide
Chlorine dioxide	Chlorine fluoroxide
Chlorine trioxide	Chloroacetylene
Choropicrin	Copper acetylide
Cyanuric triazide	Diazidoethane
Diazodinitrophenol	Diethylene glycol dinitrate
Dipentaerithritol hexanitrate	Dipicryl amine
Disulfur dinitride	Ethyl nitrate
Ethyl nitrite	Fluorine azide
Glycol dinitrate	Glycol monolactate trinitrate
Gold fulminate	Guanyl nitrosaminoguanilydene hydrazine
HMX	Hydrazine azide
Hydrazoic acid	Lead azide
Lead dinitroresorcinate	Lead mononitroresorcinate
Lead styphnate	Mannitol hexanitrate
Mercuric oxycyanide	Mercury fulminate
Nitrocarbonitrate	Nitrocellulose
Nitroglycerin	Nitrosoguanidine
Nitrostarch	Pentaerythritol tetranitrate
Picamide	Picric acid
Polyvinyl nitrate	Potassium dinitrobenzfuroxan
Potassium nitrate	RDX
Silver acetylide	Silver azide
Silver nitride	Silver styphnate
Silver tetrazine	Smokeless powder
Sodium picamate	Tetranitro methane
Tetraselenium tetranitride	Tetrasulfur tetranitride
Tstrazene	Thallium nitride
Trilead dinitride	Trimercury dinitride
trinitrobenzene	Trinitrobenzoic acid
trinitronaphthalene	Trinitroresorcinol
trinitrotoluene	Urea nitrate
Vinyl azide	Zinc peroxide

## Examples of Water Reactive Substances

Acetic anhydride	Acetyl bromide
Acetyl chloride	Alkyl aluminum chloride
Allyl trichlorosilane	Aluminum aminoborohydride
Aluminum borohydride	Aluminum bromide
Aluminum chloride	Aluminum fluoride
Aluminum hypophosphide	Aluminum phosphide
Aluminum tetrahydroborate	Amyl trichlorosilane
Anisoyl chloride	Antimony tribromide
Antimony trichloride	Antimony trifluoride
Antimony triiodide	Antimony trivinyl
Arsenic tribromide	Arsenic trichloride
Arsenic triiodide	Barium
Barium carbide	Barium oxide
Barium sulfide	Benzene phosphorus dichloride
Benzoyl chloride	Benzyl silane
Beryllium tetrahydroborate	Beryllium hydride
Borane	Bismuth pentafluoride
Boron dibromide	Boron bromide
Boron tribromide	Boron phosphide
Boron triiodide	Boron trichloride
Bromine pentafluoride	Bromine monofluoride
Bromo diethylaluminum	Bromine trifluoride
n-butyl trichlorosilane	n-Butyl lithium
Cadmium amide	Cadmium acetylide
Calcium carbide	Calcium
Calcium oxide	Calcium hydride
Cesium amide	Calcium phosphide
Cesium phosphide	Cesium hydride
Chlorine monofluoride	Chlorine dioxide
Chlorine trifluoride	Chlorine pentafluoride
Chlorodiisobutyl aluminum	Chloroacetyl chloride
Chromyl chloride	Chlorophenyl isocyanate
Cyclohexenyl trichlorosilane	Copper acetylide
Decaborane	Cyclohexyl trichlorosilane
Diethyl aluminum chloride	Diborane
Diethyl zinc	Diethyl dichlorosilane
Dimethyl dichlorosilane	Diisopropyl beryllium
Disulfury chloride	Dimethylmethane diisocyanate
Ethyl dichloroarsine	Dodecyl trichlorosilane
Ethyl trichlorosilane	Ethyl dichlorosilane
Fluorine monoxide	Fluorine
Gold acetylide	Fluorosulfonic acid
Hexyl trichlorosilane	Hexadecyl trichlorosilane
Iodine monochloride	Hydrobromic acid
Lithium aluminum hydride	Lithium
Lithium ferrosilicon	Lithium amide
	Lithium hydride

## Appendix D

Lithium peroxide  
Methyl aluminum sesquibromide  
Methyl dichlorosilane  
Methyl isocyanate  
Methyl magnesium bromide  
Methyl magnesium iodide  
Nonyl trichlorosilane  
Octyl trichlorosilane  
Phosphonium iodide  
Phosphorus oxychloride  
Phosphorus trisulfide  
Phosphorus oxybromide  
Phosphorus pentachloride  
Phosphorus tribromide  
Polyphenyl polymethyl isocyanate  
Potassium hydride  
Potassium peroxide  
Pyrosulfuryl chloride  
Silver acetylide  
Sodium aluminum hydride  
Sodium hydride  
Sodium oxide  
Sodium-potassium alloy  
Sulfonyl fluoride  
Sulfur chloride  
Sulfur trioxide  
Thiocarbonyl chloride  
Thiophosphoryl chloride  
Toluene diisocyanate  
Triethyl aluminum  
Trimethyl aluminum  
Tri-n-butyl borane  
Trichloroborane  
Triethyl stibine  
Trimethyl stibine  
Trisilyl arsine  
Vanadium trichloride  
Zinc acetylide  
Zinc peroxide

Lithium silicon  
Methyl aluminum sesquichloride  
Methylene diisocyanate  
Methyl trichlorosilane  
Methyl magnesium chloride  
Nickel antimonide  
Octadecyl trichlorosilane  
Phenyl trichlorosilane  
Phosphoric anhydride  
Phosphorus pentasulfide  
Phosphorus (amorphous red)  
Phosphorus sesquisulfide  
Phosphorus trichloride  
Potassium  
Potassium oxide  
Propyl trichloride  
Silicon tetrachloride  
Sodium  
Sodium amide  
Sodium methylate  
Sodium peroxide  
Stannic chloride  
Sulfuric acid (>70%)  
Sulfur pentafluoride  
Sulfuryl chloride  
Thionyl chloride  
Titanium tetrachloride  
Trichlorosilane  
Triisobutyl aluminum  
Tri-n-butyl aluminum  
Tricotyl aluminum  
Triethyl arsine  
Trimethyl arsine  
Tripropyl stibine  
Trivinyl stibine  
Vinyl trichlorosilane  
Zinc phosphide

**The Hong Kong University of Science and Technology**

**Chemical Waste Log Sheet**

C.W.P.Reg. No.: 9311-831-T2006-01 HSEO NO.: \_\_\_\_\_

Waste Type: \_\_\_\_\_ CWTF-ID: \_\_\_\_\_

Department: \_\_\_\_\_ Room No.: \_\_\_\_\_ Contact Person: \_\_\_\_\_ Ext. \_\_\_\_\_

Date (DD/MM/YY)	Name of Reactant/ Product/ Waste (Full Name in Block Letter)	Quantity	Producer's Name	Phone No.

Appendix F

**The Hong Kong University of Science and Technology**  
**Labpack Waste Identity Sheet**

Composition of Chemical Waste	QTY/Conc.

Hazards:

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Safety Precautions:

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Location of waste: \_\_\_\_\_ Date of production: \_\_\_\_\_

Name of waste producer: \_\_\_\_\_ Post: \_\_\_\_\_

E-mail: \_\_\_\_\_ Room \_\_\_\_\_ Tel: \_\_\_\_\_

Name of supervisor: \_\_\_\_\_ Post: \_\_\_\_\_

E-mail: \_\_\_\_\_ Room \_\_\_\_\_ Tel: \_\_\_\_\_



# The Hong Kong University of Science and Technology

## Labpack (Unwanted/Expired Chemical) Form

Name of waste producer: \_\_\_\_\_ Tel: \_\_\_\_\_ E-mail: \_\_\_\_\_

Name of supervisor (if any): \_\_\_\_\_ Tel: \_\_\_\_\_ E-mail: \_\_\_\_\_

Waste location: \_\_\_\_\_

Date: \_\_\_\_\_

Item No.	Chemical Name	Chemical Formula	Physical State (S/M/L)	Container Size (ml)	Container Type (G/P/M)	Type of Lid (G/P/M)	Quantity (# of Containers)	Chemical Weight/ Volume (Kg/Litre)	Remarks

Note : Form WPS1 for Unwanted/Expired Raw Chemicals;

S = Solid      M = Sludge      L = Liquid;

Form WPS2 for Wastes Produced from Lab Testing

G = Glass      P = Plastic      M = Metallic

## The Hong Kong University of Science and Technology

## Labpack (Incompatible Waste) Form

Name of waste producer: \_\_\_\_\_ Tel: \_\_\_\_\_ E-mail: \_\_\_\_\_

Name of supervisor (if any): \_\_\_\_\_ Tel: \_\_\_\_\_ E-mail: \_\_\_\_\_

Waste location: \_\_\_\_\_

Date: \_\_\_\_\_

Item No.	Waste Name	Name of Reaction	Reagents Used	Physical State (S/M/L)	Container Size (ml)	Container Type (G/P/M)	Type of Lid (G/P/M)	Quantity (# of Containers)	Chemical Wt/ Vol. (Kg/Litre)	Remarks

Note : Form WPS1 for Unwanted/Expired Raw Chemicals;

S = Solid      M = Sludge      L = Liquid;

Form WPS2 for Wastes Produced from Lab Testing

G = Glass      P = Plastic      M = Metallic

Photos 3- 4



Photo 3 Standard Chemical Waste Container for Lube Oil



Photo 4 Standard Chemical Waste Container for Organic Gel,  
Metal Sludge, and Soil with Phenol



Photo 5 Standard Label on Standard Chemical Waste Container



Photo 6 HSEO Number on Chemical Waste Container



Photo 1 Standard Chemical Waste Container for Halo and Non-halo Solvent



Photo 2 Standard Chemical Waste Container for Alkali, Chromium Solution, Cyanide, Hydrofluoric Acid, Fixer and Developer, Inorganic Acid, and Metal Solution

Photo 7



Photo 7 Standard Spill Tray for Chemical Waste Container