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2. Introduction

Laboratory waste is considered hazardous when it contains properties that are harmful to human health and to the wider environment. The Hazardous Waste Regulations 2005 provide a definition of Hazardous Waste and specify the control measures necessary for proper waste management.

Under the Environmental Protection Duty of Care Regulations 1991, the Environmental Protection Act 1990 (EPA) imposes a cradle-to-grave shared responsibility on producers and other holders of waste for ensuring that controlled waste is always adequately described, and disposed of safely.

Hazardous laboratory waste arising within the University can be subdivided into radiochemical waste, biological waste and chemical waste. This guidance deals with the disposal of laboratory chemical waste only. The disposal of non hazardous chemical waste, and all radiochemical and biological waste is covered in 'The Hazardous Waste Management System', and two other policy and guidance documents entitled 'Working with ionising radiation' and 'Biological safety and genetic

modification' respectively. However, it is possible that biological waste or radiochemical waste might also have to be considered as a hazardous chemical waste. The School/Service Radiation Protection Supervisor and Biological Officer along with the Health and Safety Office should be consulted if the originator is uncertain of the correct method of disposal.

3. Responsibilities

Sustainability:

- Appointing and managing a licensed Waste Disposal Contractor.
- Co-ordinating the collection of laboratory waste from source. Any unit which has chemical waste for disposal must send a 'Chemical Waste Disposal Request Form' to the Sustainability Office who will then make suitable arrangements for collection.
- Carrying out Duty of Care checks.
- Managing chemical waste documentation.
- Notification and registration to the relevant authorities.
- Provide advice on the classification of hazardous waste.

Schools and Services:

- Must ensure they have a system in place for COSHH assessment of hazardous substances and that assessments identify the correct means of disposal.
- Provide suitable packaging and ensure chemical waste is appropriately labelled for collection.
- Must send fully completed 'Chemical Waste Disposal Request' forms to Sustainability to book a collection.
- Provide a suitable and secure waste chemical storage area
- Ensure they have a designated Responsible Person to manage and monitor the waste storage area.

4. Hazardous waste identification.

Schools/Services should purchase only the amount of a chemical or product that they expect to use within the foreseeable future so that there is a minimum of excess for

subsequent disposal.

Suppliers are legally required to provide material safety data sheets (MSDS); these provide information relating to the hazards posed by a substance and outline the recommended handling, disposal and storage measures.

A COSHH assessment must be completed prior to using any hazardous substance. The assessment must record details of the disposal route and any special handling, storage and packaging requirements.

Table 1 outlines the hazardous properties set out by the revised Waste Framework Directive (2008/98/EC) and may be used to identify which wastes are considered hazardous.

Hazardous waste classification also includes materials such as oils, lead, Ni-Cd and Li batteries, pesticides, wood treatments, paints and aerosols – this list is not exhaustive.

Any material that may be contaminated with a hazardous substance becomes a hazardous waste itself and should be disposed of as such.

Further detailed guidance on hazardous waste classification and threshold limits for the different hazard classifications may be found in the Environment Agency Technical Guidance WM2 (<http://publications.environment-agency.gov.uk>).

Table 1.

Classification	Hazard Description	Hazardous Waste Properties
H1	Explosive	Substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.
H2	Oxidising	Substances and preparations, which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.
H3-A	Highly Flammable	<ul style="list-style-type: none"> • Liquid substances and preparations having a flashpoint below 21°C (including extremely flammable liquids) • Substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without application of energy, or • Solid substances which may readily catch fire after brief contact with a source of ignition, or • Gaseous substances and preparations which are flammable in air at normal pressure, or • Substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.
H3-B	Flammable	Liquid substance and preparations having a flash point equal to or greater than 21°C and less than or equal to 55°C
H4	Irritant	Non-corrosive substances and preparations which through immediate, prolonged or repeated contact with skin or mucous membrane can cause inflammation.
H5	Harmful	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.
H6	Toxic	Substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death.
H7	Carcinogenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin may induce cancer or increase its incidence.
H8	Corrosive	Substances and preparations which may destroy living tissue on contact.
H9	Infectious	Substances and preparations containing viable micro-organisms or their toxins which are known or reliable believed to cause disease in man or other living organisms.
H10	Toxic for Reproduction	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce non-hereditary congenital malformations or increase their incidence.
H11	Mutagenic	Substances and preparations which, if they are inhaled or ingested, or if they penetrate the skin may induce hereditary genetic defects or increase their incidence.
H12	Toxic	Waste which releases toxic or very toxic gases in contact with water, air or an acid.
H13	Sensitising	Substances and preparations which, if they are inhaled or if they penetrate the skin are capable of eliciting a reaction of hypersensitisation such that on further exposure to the substance or preparation, characteristic adverse effects are produced.
H14	Ecotoxic	Waste which presents or may present immediate or delayed risks for one or more sectors of the environment.
H15		Waste capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics above.

5. Hazardous chemical waste disposal procedures.

All hazardous chemical waste should be disposed of via the University's approved chemical waste contractor. Waste collections should be booked through Sustainability by completing a Chemical Waste Disposal Form which is available via the following link:

http://www.bristol.ac.uk/environment/waste/chemical_%20waste

The completed form should be emailed to Sustainability-estates@bristol.ac.uk with 'Chemical Waste Disposal' in the subject field. The following information is requested

- General description of the waste.
- Hazard classification as outlined in Table 1 (e.g. H1, H2 etc).
- Volume/amount to be disposed of.
- Type of packaging used.

Waste must be segregated according to chemical compatibility (see 6.) and should be packaged in suitable, secure and chemically compatible containers. It must be correctly labelled as to the contents, hazards, originator of the waste and the date. Waste should be stored in a secure, fit for purpose area until collection is arranged.

6. Waste segregation

Chemical waste must be segregated according to compatibility and hazard classification. The objective is to keep substances with similar properties together as far as possible in order to avoid hazardous reactions should spillage or breakage occur, and to make the disposal easier. Schools must ensure they segregate the following chemical groups:

- Oxidising agents from reducing agents and combustibles
- Reducing agents from readily reducible substances
- Pyrophoric compounds from flammables
- Organic peroxides from heat and light
- Aqueous solutions from water reactive materials.

Chemicals within compatible groups are safe to store together but different groups should not be packaged and stored together. The following link provides useful guidance regarding chemical compatibility considerations:

<http://www.merckmillipore.co.uk/showBrochure/201006.268.ProNet.pdf>

6.1 Inorganic compounds

These should be separated into liquids and solids with acids, bases and reagent solutions being kept in separate sub-groups:

- Metals, Hydrides
- Halides, sulphates, sulphites, thiosulphites, phosphates, halogens
- Amides, nitrates (except ammonium nitrate), nitrites, azides
- Hydroxides, oxides, silicates, carbonates, carbon
- Sulphides, selenides, phosphides, carbides, nitrides
- Chlorates, perchlorates, perchloric acid, Chlorites, Hypochlorites, peroxides, hydrogen peroxide.
- Arsenates, cyanides, cyanates
- Borates, chromates, manganates, permanganates
- Nitric acid, inorganic acids
- Sulphur, phosphorus, arsenic, phosphorus pentoxide.

6.2 Organic compounds

These should be segregated into liquids and solids and kept within the following compatible storage groups:

- Organic acids, anhydrides, peracids.
- Alcohols, glycols, amines. Amides, imines, imides
- Hydrocarbons, esters, aldehydes
- Ethers, ketones, ketenes, halogenated hydrocarbons, ethylene oxide.
- Epoxy compounds, isocyanates
- Peroxides, hydroperoxides, azides
- Sulphides, polysulphides, sulphoxides, nitrites
- Phenols, cresols

6.3 Contaminated solid waste

Paper, plastics, and other solid waste that may be contaminated with hazardous substances should be securely packed in a suitable container (e.g. heavy duty plastic bag, cardboard box), labelled with its contents and the hazards. Any contaminated sharps, e.g. needles, glass; etc should be placed in a suitable UN approved "sharps" box. Further information regarding the contaminant should be passed to Sustainability on the Waste Disposal Form.

7. Packaging.

The aim is to pack substances of similar properties together in such a way that the consignment becomes simple to label with respect to the CLP Regulations EC1272/2008 and the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (CDG) and so permit transportation on the public highways. Waste chemicals must be packed for final disposal so that:

- Liquids are separated from solids
- Organic compounds are separated from inorganic compounds
- Separate from cross reactive chemicals e.g. acids/alkalis
- Individual containers are separated from others by inert packing material similar to vermiculite or polystyrene chips
- In secured containers, i.e. tops properly tightened, bungs and glass stoppers sealed in place
- In containers clearly, permanently and correctly labelled.
- Where volumes are above the limited quantities thresholds defined in the CDG regulations, waste should be packaged in type-approved packaging as certified to UN standards by the U.K. Department for Transport. Details are available on their website:

<http://www.dft.gov.uk/vca/dangerousgoods/dangerous-goods-offi.asp>

Original packing materials should be retained and reused where possible. All containers should be clearly labelled describing the contents, the originator and the date, in such a way that the label does not become defaced or separated during

transport. Old labels must be removed or completely obliterated. Unknowns should be labelled showing the department of origin and the date.

8. Storage

In accordance with Good Laboratory Practice, waste chemicals should be stored in safe, clean, dry conditions and as directed in the supplier's instructions. Avoid storing chemicals on bench tops or in fume cupboards. Do not expose stored chemicals to heat or direct sunlight. Waste chemicals should be separated into compatible groups, as they would be if still in use.

Within the laboratory, waste flammable liquids should be stored temporarily in an appropriate storage cabinet or safety cans. Their volume must be included in the target total volume of not more than 50 l (or two working days' supply), which may be kept in laboratories. This waste must be labelled accordingly, and should not contain halogenated solvents in any more than trace quantities (<1% by volume). A separate container should be provided for any solvent mixture containing >1% by volume halogenates, and this should be labelled as 'Chlorinated Solvent Waste'.

Bulked waste solvents should be stored in a separate, suitable waste storage area; each container should not exceed 10L containers to comply with Manual Handling Operations Regulations 1992. Disposal should be arranged as outlined in appendix one.

Every effort should be made to ensure that labels do not become detached or defaced as this could lead to a dangerous situation, additionally it is extremely expensive to dispose of unknown substances and this may cause a charge to be made to the originating School. The responsibility for identifying 'unknown' materials, where reasonably practicable, remains with the School.

Faculties/ Schools/Service should provide a suitable area for the storage of waste chemicals that are awaiting collection by the approved Chemical Waste Contractor. These stores should be secure, dry and well ventilated. Fire detection requirements should be identified by risk assessment. Appropriate hazard warning signs should be clearly displayed and emergency spill kits easily accessible. Where large volumes of liquids/solvents are likely to be kept (>50 litres), drums should be stored on bunded

pallets or trays to aid containment of any large spills or leaks. Containment should be designed to accommodate at least 110% of the stored volumes. A responsible person should be identified to manage the area and a risk assessment of each waste storage area should be carried out. If appreciable volumes of flammable or explosive substances are stored, the area should be classified according to the Dangerous substances and explosive atmospheres 2002 (DSEAR) regulations. Waste stores should be included in the schools regular laboratory Health and Safety inspections.

Appendix One.

This section is not exhaustive but represents some commonly found chemicals or items containing chemicals under the Hazardous Waste Regulations.

Item		Hazardous Threshold (if applicable)	Action	Disposal Method	Notes
Rechargeable Batteries	Nickel-Cadmium	Undamaged, discharged.	https://www.bris.ac.uk/environment/waste/recycling	Via University Battery Recycling Box.	
	Nickel-Cadmium	Damaged or leaking.	Cover terminals with insulating tape. Seal in strong plastic bag.	Chemical Waste via Sustainability	
	Lead-Acid		https://www.bris.ac.uk/environment/waste/recycling	Via University Battery Recycling Box.	
Ethidium Bromide	Powder/ Crystals		Contain in yellow bins. Label as EWC 18013/180202	Chemical Waste via Sustainability	
	Solutions	≥ 0.1%	Contain in yellow bins. Label as EWC 18013/180202	Chemical Waste via Sustainability	Do not dispose via sink.
	Solutions	< 0.1%	Decontaminate using activated carbon filters or De-staining bags.	Decontaminated solution may be disposed of via drain.	
	Gels	<0.1%	Contain in sealed yellow clinical waste sacks. Label as EWC 18013/180202	Clinical Waste via Sustainability	
Formaldehyde / Formalin	Solutions	≥ 3%		Chemical Waste via Sustainability	
	Solutions	< 3%	Contact Sustainability to determine whether volumes are appropriate for disposal to drain. A disposal log should be maintained (dates & volumes).	Possible via drain with permission from Sustainability and Local Water Authority.	
Gas Cylinders			Contact supplier to arrange collection. If this is not possible book for collection through Sustainability.	Chemical Waste	
	www.bcgq.co.uk/preview/cylinder_disposal.php				

Histology Stains	Products assigned Hazard Statement H400 to H413	>1% <1%		Chemical Waste via Sustainability Dilute to Drain (x40).	
Mercury Thermometer			1. Ventilate area for 24 hours. 2. Ensure gloves, lab-coat/coverall and safety glasses are worn. 3. Using cardboard &/or masking tape, transfer beads of mercury to a glass container. 4. Double bag and label the container and contaminated items. DO NOT vacuum or sweep the area.	Chemical Waste via Sustainability	Follow Health Protection Agency advice www.hpa.org.uk
Nanomaterial			Minimise exposure as low as is reasonably practicable. Waste nanomaterials and contaminated items should be double contained in sealable yellow incineration bins and label clearly.	Chemical Waste incineration via Sustainability	Do not allow to enter drains or any non-hazardous waste stream. www.safenano.org/UKNanosafetyPartnership.aspx
Oils	Lubricating/ Vacuum pump oil etc		May be transferred to central University Chemical Waste store and bulk contained into 200L drums. Containers used for transfer must be ≤ 10L.	Chemical Waste Disposal via Sustainability	Do not allow to enter drains.
	Transformer oils		Confirm the presence of PCB's with manufacturer. Store separately from other oils.	Chemical Waste via Sustainability	Do not allow to enter drains.
Silica powders and chromatography column solid waste			Place in sealable yellow incineration bins and label clearly. Contact the school local waste representative to arrange collection.	Chemical Waste incineration via Sustainability	
Used Sample vials			Place in sealable yellow incineration bins and label clearly with the contents. Contact the school local waste representative to arrange collection.	Chemical Waste incineration via Sustainability	
Solvents.	Non Chlorinated		Segregate from chlorinated solvents. May be bulked into 10L containers. Where solvent contains an	Chemical Waste via Sustainability	Do not allow to enter drains

			appreciable amount of another chemical it should be disposed of separately.		
	Chlorinated		Segregate from non-chlorinated solvents. May be bulked into 10L containers. Where solvent contains an appreciable amount of another chemical it should be disposed of separately.	Chemical Waste via Sustainability	Do not allow to enter drains
Unknown			Establish any information relating to history of the item and include this on the disposal form. Double contain and seal the item. Label with department of origin, date and clearly state the item is unknown.	Chemical Waste via Sustainability	
Discharge to Sewer	pH Chromium Nickel Copper Zinc Lead Molybdenum Silver Tin	Between 6 and 10. 3 mg l ⁻¹ 2 mg l ⁻¹ 3 mg l ⁻¹ 5 mg l ⁻¹ 3 mg l ⁻¹ 2 mg l ⁻¹ 2 mg l ⁻¹ 2mg l ⁻¹	Dilute with copious amounts water		The discharge <u>must not contain</u> : Volatile petroleum products. Chlorinated hydrocarbons Flammable substances Water immiscible substances. UK environmental Red List Compounds.