COSHH, RISK ASSESSMENT AND CHEMICAL SAFETY

The following information and instructions supplement the Safety Policy for the School, and are key elements to ensure that the Safety Policy is implemented effectively.

Whilst dealing with and being around chemical (or biological) risks may be second nature to many working in a chemistry or biology department, within the School of Engineering, there are many people with different backgrounds and levels of experience. Thus whilst you may be confident in handling chemicals or biochemical, you need to be aware that other people working in your lab may be less familiar with the risks and ways of handling these things. In addition, if you find yourself undertaking (or being asked to undertake) chemical or biological procedures about which you do not feel confident, then, most importantly, you should ask your supervisor for the appropriate training, or contact one of the chemical or biological safety advisors listed in the main Safety document to arrange this training.

COSHH – Control of Substances Hazardous to Health

A COSHH Risk Assessment Form should be completed - see the following website:

http://www.gla.ac.uk/schools/engineering/informationforstaff/safety/risk%20assessmen/

It should be easily accessed by users in the laboratory as a printed copy; kept updated with regular reviews, and available for inspection by a member of the School's safety committee.

COSHH (2002) The Risk Assessment exercise for any activity is the key link to ensuring that we comply with legislation for safety at work. Written evidence, where appropriate, is the key factor in ensuring that there is a consistency of high standard across the department and that all staff and students are aware of, and respond correctly to potential hazards.

COSHH 2002 requires certain factors to be taken into consideration when compiling a risk assessment. These are: The hazardous properties of the substances (i.e. the intrinsic property of that substance to cause harm. This is different from the 'risk' which is the likelihood of that hazard causing harm in the context of its use, and by what means that harm will be expressed. The Risk assessment is to establish how the harm could be expressed, and what measures are needed to prevent it being expressed, hence the following questions)

- How it will be used
- The amount of the substance to be used
- Information on health effects provided by the supplier (e.g., the material safety data sheet)
- The level, type and duration of exposure (note particularly if the initial exposure is to a higher quantity of the substance prior to extracting a smaller quantity for use)
- Activities such as maintenance where there is the potential for a high level of exposure
- Any relevant occupational exposure standard
- The results of monitoring of exposures
- The risks presented by combinations of exposures to substances

Remember, however, that not all work needs to be assessed in such detail. Only that which poses a realistic foreseeable risk to people needs to be assessed. If the quantities of a substance are tiny (i.e. even from the first moment of collecting the chemical), the hazard small and therefore the risk negligible the assessment need only record the substances involved, that they will be used in accordance with the supplier's Material Safety Data Sheet and the conclusion that because the substances pose little or no risk, no further detailed risk assessment is warranted.

Chemical Safety – storage, handling and disposal

See also SEPS Health & Safety Notes at
http://www.gla.ac.uk/services/seps/az/chemicalsafety/

And
http://www.gla.ac.uk/services/seps/waste/#d.en.38775

Storage of Chemicals

- All containers of substances within School of Engineering laboratories must be clearly labelled to indicate the nature of the substance (no formulas). This includes the removal of all old labels, and replacing of damaged ones.
- No chemicals may be stored unlabelled at any time to avoid risk of error and ensure correct storage and disposal.
- Safety database sheets, where provided, should be made accessible to all users of that substance in the laboratory.
- Highly toxic substances and carcinogens should not be stored on open shelves. Schedule 1 poisons must be kept in a locked cupboard or drawer.
- Store chemicals below shoulder level. Safety bottle carriers (found in each lab) must be used for transport of liquids to and from the laboratory.

See Appendix for 'Unsafe Combinations of Chemicals in Storage'

Types of Specialised Storage Available:
Acid cabinets - These are made of acid-resistant materials and contain a tray to catch any leakage or spillage.
Flammable solvent cabinets - These are made of material with a minimum fire resistance of a 30 minute British Standard 476 (some are to 90 minute standard).
Ventilated cabinets - These are cabinets which are fitted with forced ventilation. They may be free-standing with their own extract system, or may be situated beneath a fume-cupboard and attached to its duct.

Note: Fume Cupboards should be kept clear for operational work and not be used for storage, as unnecessary materials disrupt the air-flow making the fume cupboard less efficient.

Handling of Chemicals

Familiarize yourself thoroughly with the steps required for assessing the risks of laboratory activities. For activities that already have a completed COSHH form, do not assume that all the risks are covered - review any changes you make in a process and take time to check the nature of the substance with which you are working in relation to what you are doing with it. Make sure that you sign against COSHH Risk Assessments for work you are involved with.

Contact lens wearers are advised that it is preferable to wear spectacles when working with chemicals because volatile solvents could be trapped between the lens and eye. MVLS policy states that safety glasses must be worn by contact lens wearers at all times where a risk of this nature may arise.

Containers or vials of volatile or hazardous substances must be opened only in fume cupboards.

The School of Engineering policy states that laboratory coats should be worn at all times in laboratories, and additional protective clothing should be considered where appropriate as part of a Risk Assessment of an activity.

Disposal of Chemicals

Disposal of water-miscible substances: Small quantities of water-miscible solvent may be flushed down the sink provided there is a sufficient accompanying flow of water to produce a high dilution. For non-water immiscible chemicals, each laboratory should have two containers clearly labelled 'flammable' and 'non-flammable'. Each container must carry a label which details the individual substances which it contains.

Acrylamide stained gels
Special arrangements are in place for disposal of gels stained with this mutagenic compound. Gels must be only disposed into plastic drums labelled 'Ethidium Gels' and carrying a Biohazard sign. These drums must be removed when full by a licensed disposal route.

Disposal of surplus chemicals, solvents and waste chemical produced:
To dispose of unwanted or surplus chemicals and waste chemical produced by your lab, please contact Bill Monaghan.

The URL below give a useful link to understanding chemical risk phrases and symbols and http://www.hse.gov.uk/chip/phrases.htm

Use of Carcinogens and other Controlled Drugs

Toxic substances (including carcinogens) should be kept in a separate locked cupboard as should Controlled Drugs governed by the Medicines Act, 1968.
There is confusion about what regulations are applicable when using carcinogens. However, in the United Kingdom the use of "carcinogens" is governed by COSHH and its associated Approved Codes of Practice, the CHIP regulations and EH40/2005 Work Place Exposure Limits.

Exposure Limits

EH40 Occupational Exposure Limits Supplement 2005. HSE. ISBN 0717620832 - available via the Health and Safety Executive web pages. The COSHH Carcinogen Approved Code of Practice only applies to substances bearing the risk phrases R45 "May cause cancer" and R49 "May cause cancer by inhalation." It does not apply to substances labelled "suspected carcinogen" or appearing in lists produced by other countries. Note that all COSHH records should be kept intact as part of the laboratory's (and University's) safety records.

- All the reagents should be contained in a metal tray and all implements in contact require to be treated as carcinogen and decontaminated or sent to toxic waste. These should be carefully kept aside on a metal tray and stored for inactivation immediately at the end of the experiments.
- One stage at which a carcinogen is most potent is when it is being solubilised or added to a chemical reaction. These modifications should be carried out in a class I or class II cabinet.

Storage of Carcinogens
Storage facilities for chemical carcinogens should always be locked, and a record kept of each chemical deposited.

Recording Data
By law, a register of all carcinogen users should be held and records maintained for 20 years. On purchasing any chemicals with the Risk Phrase "R45" and "R49", the Safety Co-ordinator should be informed of the name of the substance, where it was purchased from, the quantity and date of purchase.

Inactivation and disposal of carcinogens

- Where possible use prepared commercial solutions of ethidium bromide (ETBr) and acrylamide gels. The low levels of ETBr present in gel buffers can be flushed down the sink. Particular care should be taken when viewing DNA gels by transilluminator. Buffer splashes should be dried by wiping with a tissue and alcohol solution and the tissue discarded into the yellow plastic bags provided for the disposal of solid carcinogen waste.
- Outdated carcinogens or ones no longer is use should be arranged for disposal.

Flammable Solvents

Solvent supplies in laboratories should be kept to a minimum, preferably not more than will be needed during the working day. Solvents must be returned to flame-proof cupboards when not in use. Ether is especially dangerous because of its flammability.
Not all concentrations of a flammable vapour in air are flammable. For each vapour, there is a concentration below which and above which propagation of a flame will not occur. These are known as the lower and upper explosive limits, and vary widely for different substances, e.g.:-
Hydrogen 4% - 74%
Carbon Monoxide 12.5% - 74%
Carbon Disulphide 1% - 50% (the autoignition temp is 90°C -
about the same temp as a cup of hot tea!)
Benzene 1.% - 8%
“Many common solvents have a flammable range of about 1% to 10% and so would appear to be safer than those substances with a wide flammable range. This is only partially true, however, as most of these solvents give concentrations of vapour in the flammable range at room temperature.

The most useful parameter of flammability is the "flashpoint". This is the lowest temperature at which a vapour-air mixture will ignite, if an ignition source is introduced. Some solvents such as diethyl ether and carbon disulphide are so flammable that they have flashpoints below 0 degree celsius, e.g., at -45 °C enough diethyl ether will evaporate to be ignitable. (This is the reason why it is so dangerous to store flammable solvents in a domestic, i.e., non-spark proof, refrigerator). Most of the common organic solvents have flashpoints at or below room temperature and are thus a significant fire hazard.

The autoignition temperature is the lowest temperature at which a substance (solid, liquid or gas) will self-ignite and sustain combustion in the absence of a spark or flame. For solids, this value is greatly influenced by the size, shape and rate of heating."

Waste Solvents should be disposed of via the same route as waste chemicals.

Toxic Hazard Classification of Chemicals

All materials can be classified into one of four toxic hazard categories:-
Very High (V) High (H) Medium (M) Low (L)
and are defined by the following criteria:-
In the following definitions the letter R denotes an EC Risk Phrase; LC = lethal concentrations; LD = lethal dose. Information about the material properties used in the classifications below, is in general given in the material safety data sheets (MSDS) provided by the supplier.

<u>Very High Hazard (V)</u>
A material which meets any of the following criteria:

- Exposure Standards <0.1 ppm for vapour or <0.1 mg/m3 for dusts

- Is very toxic by acute exposure:
- LC50 rat 0.5 mg/L/4hr or less: R26 VERY TOXIC BY INHALATION
- Dermal LD50 rat or rabbit £ 50 mg/kg: R27 VERY TOXIC IN CONTACT WITH SKIN
- Oral LD50 rat 25 mg/kg or less: R28 VERY TOXIC IF SWALLOWED
- Subacute toxicity with oral no effect level <0.1 mg/kg/day or equivalent dosage by other routes.
- Potent carcinogen: R45 MAY CAUSE CANCER, R49 MAY CAUSE CANCER BY INHALATION
- Respiratory sanitizer: R42 MAY CAUSE SENSITISATION BY INHALATION
- Substances of unknown toxicity which after inspection of the structure or of other data are likely to be classified at V by analogy.

<u>High Hazard (H)</u>

- Exposure Standards >0.1 ppm & <10 ppm for vapour or >0.1 mg/m3 and <1 mg/m3 for dusts.
- Is toxic by acute exposure:
- LC50 rat 0.5 - 2 mg/L/4hr: R23 TOXIC BY INHALATION
- Dermal LD50 rat or rabbit 50 - 400 mg/kg: R24 TOXIC IN CONTACT WITH SKIN
- Oral LD50 rat 25 - 200 mg/kg: R25 TOXIC IF SWALLOWED
- Subacute toxicity with oral no effect level <1 mg/kg/day or equivalent dosage by other routes.
- Corrosive: R34 CAUSES BURNS, R35 CAUSES SEVERE BURNS
- Extreme skin or eye irritants: R41 RISK OF SERIOUS DAMAGE TO EYES.
- Proven animal carcinogen or materials with suspected carcinogen activity but unknown potency: R45 MAY CAUSE CANCER, R49 MAY CAUSE CANCER BY INHALATION, R40 POSSIBLE RISK OF IRREVERSIBLE EFFECTS
- Substances of unknown toxicity which, after inspection of the structure or of other data are likely to be classified as H by analogy.

If the resultant hazard classification is Very High or High, try to reduce the hazard by eliminating a material or by using a substitute.

<u>Medium Hazard (M)</u>

A material which meets any of the following criteria but does not fall into class V or H

- Exposure Standards <500 ppm for vapour or <10 mg/m3 for dusts.
- Is harmful following acute exposure:
- LC50 rat 2.0 - 20 mg/L/4hr: R20 HARMFUL BY INHALATION
- Dermal LD50 rat or rabbit 400 - 2000 mg/kg: R21 HARMFUL IN CONTACT WITH SKIN
- Oral LD50 rat 200 - 2000 mg/kg: R22 HARMFUL IF SWALLOWED.
- Subacute toxicity with oral no effect level of 1-50 mg/kg/day or equivalent dosage by other routes.
- Skin or eye irritants: R36 IRRITATING TO EYES.
- Skin Sensitizers: R43 MAY CAUSE SKIN SENSITISATION BY SKIN CONTACT.
- Low potency carcinogens.

<u>Low Hazard (L)</u>

A material which meets any of the following criteria but does not fall into class V, H or M

- Exposure Standards >500 ppm for vapour or >10 mg/m3 for dusts.
- Substances which are non-harmful following acute exposure:
- LC50 rat >20 mg/L/4hr
- Dermal LD50 rat or rabbit >2000 mg/kg
- Oral LD50 rat >2000 mg/kg.

- Subacute toxicity with oral no effect level of >50 mg/kg/day or equivalent dosage by other routes.
- Non-irritant material.
- Non-genotoxic and non-carcinogenic materials.
- Materials which are not skin sensitisers.

Note - Chemicals known or suspected of being absorbed through the skin will have the notation SKIN in their hazard data. The absence of this notation does not guarantee that the material will not be absorbed through the skin.

Hazard Classification – Very toxic, Toxic, Harmful

Under the “Classification, Packaging and Labelling of Dangerous Substances” Regulations there are certain definitions which are also used in the COSHH Regulations. The following definitions of “very toxic”, “toxic” and “harmful” apply.

Toxic Levels

Category	LD50 absorbed orally rat, mg/kg	LD50 absorbed percutaneously in rat or rabbit, mg/kg	LC50 absorbed by inhalation in rat mg/litre (4 hrs)
Very Toxic	25	50	0.5
Toxic	25 to 200	50 to 400	0.5 to 2
Harmful	200 to 2000	400 to 2000	2 to 20

LD50 and LC50 (Lethal Dose 50% and Lethal Concentrations 50%) are terms used to describe animal toxicological experiments. The LD50 of a substance is the dose which causes death in 50% of test animals. LD50 is the term used if the substance was administered orally or percutaneously, LC50 the concentration in air if it was administered by inhalation.
If facts show that for the purposes of classification it is inappropriate or inadvisable to use LD50 or LC50 values as a principal basis because the substance produces other effects, then the substance should be classified according to the magnitude of these other effects.

Dealing with Spillages

Spilling a liquid or any dangerous substance can be a trigger for a number of different serious incidents. It is important when working with any hazardous substances that you have read (or completed) a risk assessment in relation to the substances you are working with, and that you have all the materials to hand to respond appropriately.
The following minimum guidelines apply:-

- Be aware of, and alert, potentially affected individuals around you.
- Where appropriate, protective clothing, eg, suitable gloves and eye-shields, should be worn during the cleaning up procedure. Lab coats should be fully fastened.
- Water and ice should be mopped up immediately as spills constitute a slip hazard.
- Always contain spillages immediately by appropriate means, ensuring at the same time, that your bench set-up can be left unattended for the duration.
- The preferred method of treating spills is to contain the liquid by the use of absorption granules.
- Double-bag all the waste in plastic bags, label with chemical name and "Destroy without opening" tapes, and notify the Laboratory Responsible to arrange the most appropriate method of disposal.
- For spillage of powder, damp down the spillage immediately with water 70% methanol. Then add absorption granules and treat as above.
- Residual strong acids can be neutralised with an excess of solid sodium carbonate.

- Residual caustic alkali solutions can be neutralised with ammonium chloride and plenty of water.
- Specialist advice for dealing with carcinogenic material is provided in the section on Carcinogens.
- Review the events that led to the spillage (eg, lack of clear bench space or layout of equipment) and take remedial action as appropriate.
- For all hazardous spillages, complete an Accident and Dangerous Occurrence form.

See also:
Spillages of Dangerous Chemicals, University of Glasgow Safety and Environmental Protection Services (SEPS)
First Aid for Chemicals, University of Glasgow Safety and Environmental Protection Service (SEPS)

Dealing with Sharps

Hypodermic Needles and Syringes

Under no circumstances should needles be resheathed with the needle cover prior to disposal in a cinbin. The needle cover is there to provide sterility to the needle. Resheathing increases the likelihood of a needlestick injury because the needle can easily penetrate the cover.

Scapel blades and lancets

Scapel blades and lancets must always be disposed of in CinBins. Full CinBins, clearly marked with project code, should be disposed of via a licensed contractor

Broken Glass

Broken glass should never be disposed into Cinbins, but safely boxed and put out with general waste, provided there is no additional chemical or biological hazard, a dustpan and brush should be used for this purpose (a piece of blu-tak or wad of wet tissue roll can be useful for collecting awkward slivers of glass which do not brush up easily). If a chemical is involved, proceed as for chemical spillages, then sweep up the glass.

Pasteur pipettes which are not contaminated with hazardous material can be disposed of in the broken glass container.

Biologically contaminated glass and plasticware should always be rinsed in a Chloros type bath, before disposal in a biohazard bin.

Sharp objects or broken glass which are contaminated with radioactivity should be placed in a plastic CinBin labeled with radioactive warning tape and with the name/number of the lab from which it comes. When full, the Cinbin containing radioactive sharps should be sent to the University Radiation Protection Service for disposal.
See also:
The Avoidance of 'Needlestick' and Similar Sharp Induced Injuries, Health and Safety Note 98/017, SEPS, University of Glasgow

Unsafe Combination of Chemicals in Storage

X = Unsafe Combination

	Inorganic Acids	Organic Acids	Caustic Alkalis	Amines and Alkanolamines	Halogenated Compounds	Alcohols,Glycols and Glycol Ethers	Aldehydes	Ketones	Saturated Hydrocarbons	Aromatic Hydrocarbons	Alkenes	Petroleum oils	Esters	Monomers and Polymerisable Esters	Phenols	Ethoxides	Cyanohydrins	Nitriles	Ammonia	Halogens	Ethers	Elemental phosphorous
Organic Acids	x																					
Caustic Alkalis	X	X																				
Amines and Alkanolamines	X	X																				
Halogenated Compounds	X		X	X																		
Alcohols,Glycols and Glycol Ethers	X																					
Aldehydes	X	X	X	X		X																
Ketones	X		X	X			X															
Saturated Hydrocarbons																						
Aromatic Hydrocarbons	X																					
Alkenes	X				X																	
Petroleum oils																						
Esters	X		X	X																		
Monomers and Polymerisable Esters	X	X	X	X	X	X																
Phenols			X	X			X							X								
Ethoxides	X	X	X	X		X	X							X	X							
Cyanohydrins	X	X	X	X	X		X									X						
Nitriles	X	X	X	X												X						
Ammonia	X	X					X	X					X	X	X	X	X					
Halogens			X			X	X	X	X	X	X	X	X	X	X				X			
Ethers	X													X						X		
Elemental phosphorous	X	X	X																	X		
Molten Sulphur									X	X	X	X				X						X
Acid Anhydrides	X		X	X		X	X							X		X	X	X	X			