Chemical Spills: Preparedness and Clean up

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Introduction:

In most cases a laboratory chemical spill involves small quantities and if handled properly represent nothing more than a minor inconvenience to the operations of a lab. However, if mishandled, even small spills of relatively low toxicity material can result in a major disruption. In a worst case scenario a chemical spill could result in injury or even death of a person and/or major damage to the lab not to mention a significant disruption to laboratory operations.

Clearly the prevention of chemical spills is the most important part of a chemical safety program. Laboratory spills can occur during a chemical’s storage, transportation or transfer as well as when in use in a lab.

Some tips on how to prevent spills are listed below.

* Containers should be stored by hazard class (refer to the Chemical Storage Program)
* Only possess sufficient chemical for your immediate needs and avoid storing large volumes of chemicals for long periods of time.
* Store glass bottles in cabinets when not in use
* Pick up glass solvent bottles with both hands and by the bottom, not by only by the loop at the neck.
* Use plastic solvent carriers whenever transporting chemical-containing bottles.
* Ensure waste containers are in good condition.
* Take chemical waste to the hazardous waste depots in your building once it’s generated.
* Replace dangerous materials/equipment with safer substitutes where feasible.
* Keep counters and floors clear of glass bottles.
* Use safety containers and carts (with a lip around the outside) when transporting chemicals.
* When transferring chemicals from one container to another pay attention to avoid over-filling.
* Keep floor and aisles in labs clear.
* Be prepared by having all of your equipment readily available before starting work.
* Use lab coats with elasticised cuffs, to avoid the cuff catching on containers.
* When working with small or poorly balanced containers, secure them in some fashion to avoid easily tipping the container (e.g., small cuvettes, tall narrow cylinders, round bottomed flasks)

However, despite everyone’s best effort a chemical spill is a very real possibility in any lab and laboratory personnel should be aware of spill clean-up procedures and be prepared to respond should a spill occur.

# 1.0 Spill Response Procedures

## 1.1 Spill Response Plan

To prepare for spills, you should: (1) learn about the hazards of the chemicals in your laboratory, (2) write response procedures to address those hazards, and (3) make sure that you have the equipment and training necessary to follow those procedures.

Spill response procedures should include elements such as

* a listing of appropriate protective clothing, safety equipment, and cleanup materials required for spill cleanup (gloves, respirators, etc.) and an explanation of their proper use;
* appropriate evacuation zones and procedures;
* availability of fire suppression equipment;
* disposal containers for spill cleanup materials; and
* the first aid procedures that might be required.

## 1.2 Emergency Equipment

Chemical spills can happen at any time and research laboratories are at a much higher risk of incidents in comparison to industrial plants. To ensure the safety of all the students and staff, there are several pieces of emergency equipment in each lab. Everyone in a lab should know how to use the eyewash, deluge shower, and fire extinguishers. For more information on the safety devices in your lab please take the “Lab Safety Orientation” module of the Science Safety Course on Blackboard. Please make yourself familiar with the emergency equipment in your lab so that in the event of an emergency, you can calmly and effectively use them.

### 1.2.1 Spill Kits

Each laboratory using hazardous chemical materials shall have easy access to a chemical spill kit that is prominently located, readily visible and identifiable. A spill kit may be shared between laboratories provided that all personnel are aware of its location and it is easily accessible at all times. Exact contents of a spill kit should be based on the hazardous properties of the materials present in the lab. Table 1 lists the recommended minimal requirements for spill kits.

Table 1 Spill Kit Contents

| Chemical Spill Kits Item | Characteristics and/or Recommended Quality |
| --- | --- |
| Universal Chemical Absorbent Pads  and/or  Universal Chemical Absorbent Powder  (silica free) | High absorption capacity  Chemically inert  Good for all chemicals   * Acids, including hydrofluoric acid * Bases * Flammable liquids * Formaldehyde * Organic peroxides |
| Plastic Scoop | Polypropylene |
| Large Polyethylene Bags | Strong composition  Leak proof  To be used as pail liners |
| Gloves | Nitrile/Silver shield combination preferred  At least 2 pairs |
| Chemical Goggles | Splash resistant  At least 2 pairs |
| 20 L Plastic Pail with Lid | Labelled as “SPILL KIT”  To contain spill equipment  When emptied to be used as disposal container for contaminated absorbents  Leak proof |
| Plastic Dust Pan and Broom | Polypropylene bristles |

Other items you may want to add to your chemical spill kit, depending on the hazards present in the lab are:

disposable Tyvek® suits;

synthetic rubber aprons;

duct tape;

pH paper;

hazardous waste tags; and

specific neutralization mixtures.

When using acid or base neutralization mixtures, one should be prepared for heat generation and sputtering of the liquid.

Table 2 lists examples of specific neutralization mixtures for Spill Response.

|  |  |
| --- | --- |
| Neutralizer Type | Examples |
| Acid Neutralizers | Sodium bicarbonate  Neutrasorb (colour change once neutralized)  Spill-X-A  Calcium carbonate (for hydrofluoric acid spills) |
| Caustic Neutralizers | Citric acid powder  Neutracit-2 (colour change once neutralized)  Spill-X-C |
| Solvent Neutralizers  (reduce vapours and increase flashpoint) | Activated charcoal  Solusorb  Spill-X-S  Spilfyter vapour suppressor kit |

### 1.2.2 Mercury Spill Kits

If mercury or mercury compounds are present in the laboratory (including mercury in thermometers), the lab supervisor must ensure a mercury spill kit is available.

Table 3 lists the recommended contents for a mercury spill kit.

| Contents | Characteristics or Recommended Quality |
| --- | --- |
| Sulphur powder or commercially available mercury amalgamation powder | Effectively amalgamates mercury and suppresses vapours |
| Mercury vapour suppression spray | Prevents additional mercury vapourization by coating mercury |
| Mercury decontamination liquid, wipes or sponges | For surface decontamination |
| Aspirator such as a Pasteur pipet and bulb or eye dropper | For sucking up small beads of mercury on a surface. |
| Disposal container with lid | Preferably plastic |
| Mercury indicator powder (optional) | Indicates the presence of mercury. Good for suspected contamination issues for use after clean up. |

It is recommended that an inventory list be included on/in spill kits to allow for easy inspection. Inspections should be performed regularly and documented, e.g. on an inspection tag. Inspections should include verifying contents and ensuring that supplies are unexpired and in good condition.

Science Facilities maintains chemical spill containment and clean up supplies in Science Complex rm. SC 132, DNA Loading Dock A and LHS Loading Dock D. These are additional resources which can be used to supplement the in-lab spill kits, but are not a replacement for laboratory kits. Mercury spill supplies and are also available at these locations.

## 1.3 Training

It is the responsibility of the laboratory supervisor to ensure that lab personnel are trained in appropriate chemical spill response specific to the chemicals contained within their laboratory. Training should be documented. Lab personnel are responsible for ensuring that they are aware of the spill clean-up procedures for any chemical(s) prior to their use.

## 1.4 Hazard Identification and Risk Assessment

When a spill occurs it is crucial that laboratory personnel are aware of the hazards of the material they are working with in advance of work commencing. All laboratory personnel should have reviewed the SDS for the chemicals in use and be aware of the risks involved in the particular lab procedure to be used with the chemical.

When a spill occurs there are three steps which would be taken to determine the severity of a spill.

A) Evaluate the spill’s risk. Does it have human health effects, property damage or a risk of environmental damage.. READ THE SDS for the material involved.

B) Evaluate the quantity. If a spill is with material considered non-hazardous then the primary concern is with the ability to control and clean up the spill. If the spilled material is hazardous, the threshold for whether this is a minor or incidental spill versus a major spill is dependent on the physical properties and hazards of the material, the availability of the correct Personal Protective Equipment (PPE), the training and experience of laboratory personnel and the layout of the spill location.

C) Evaluate Potential Impacts. The third step in determining whether a spill is minor or major is to look at the broader impacts of the spill. Is a spill is in an areas where the risks may be magnified (large number of people in area or the physical situation makes clean up difficult)? Can hazardous vapours or dusts be spread to a larger area (through ventilation for example). Can a spill in a sink spread through the plumbing system to other areas? Is there the presence of incompatible material nearby. If the spill is of a flammable material are their ignition sources or other combustible material nearby. The presence of any of these factors might increase the severity of a spill.

## 1.5 Spill Classification

Major spills – Major spills are those spills which involve chemicals or quantities of materials in excess of those outlined in Table 4, or involve highly toxic material and may require further assistance for clean-up.

| Material | Quantity |
| --- | --- |
| Air and Water reactive materials | Any Quantity |
| Flammable liquids | Greater than 4 L |
| Combustible liquids | Greater than 4 L |
| Non-flammable organic liquids | Greater than 4 L |
| Concentrated liquid acids | Greater than 1 L |
| Concentrated solid acids | Greater than 1 Kg |
| Concentrated liquid bases | Greater than 1 L |
| Concentrated solid bases | Greater than 1 Kg |
| Mercury | Greater than 30 mL |
| Liquid oxidizers | Greater than 1 L |
| Solid oxidizers | Greater than 500 g |
| High toxic, highly malodourous liquid materials such as phenol, mercaptoethanol, hydrofluoric acid) | Greater than 1 mL |
| Low Hazard material | At the discretion of lab personnel |
| Compressed gas leaks | If the leak cannot be stopped by closing the main valve on the cylinder |
| Radioactive materials | See the Radiation Safety Program spill response procedures. |
| Biohazardous materials | See the Biosafety Program spill response procedures |

The above table provides guidelines for quantities only. Other considerations for classifying a spill as major include whether or not respiratory protection is required and whether any personnel injuries have been sustained. Laboratory personnel should never attempt to clean-up a spill if they have not been trained in the proper chemical spill response or are unsure of the proper procedures. All major spills are to be reported to Security, RMO and Science Facilities by calling Campus Security 705 748-1333

Minor or Incidental Spills – These are spills not meeting the requirements of a Major spill that can be responded to by properly trained and equipped laboratory personnel.

# 2.0 Spill Response

## 2.1 Roles and Responsibilities

In the event of any spill of a hazardous material it is important that everyone understands what their roles and responsibilities are. In all cases the most important thing is everyone’s safety. The onus of responding to a spill lies with the individual whose action led to the spill. Chances are that the individual who has been working with the material will likely know more about the material than anyone else. If, however the individual is not comfortable in handling the spill they should contact Campus Security who will co-ordinate contacting the EHS officer and Science Facilities. The EHS officer will ultimately decide if the spill can be handled internally or will require a third party contractor be called in to help. In either case the personnel involved in the spill must remain available to assist in the clean up process and/or provide information to the responding personnel. When contacting Campus Security be sure to inform them of your name, your building, room number of the spill, and where you are physically located so they can make contact with you. Do not leave the general area of the spill unless you are in physical danger. If you must leave the area, contact Campus Security to let them know where you are.

## 2.2 Roles

**Researcher or lab personnel**

* Protect yourself and others
* Inform personnel present and in the vicinity of the spill
* Inform your supervisor
* Contact Campus Security 705 748-1333
* Clean up the spill (if you are trained and comfortable to do so).

**Campus Security**

If called to attend a hazardous materials spill campus security should

* Control the zone/area
* Contact the EHSO and Science Facilities
* Remain on site to ensure security if necessary
* Provide access to emergency services if necessary
* Not responsible for cleaning up the spill

**EHSO and Science Facilities**

* Assess spill and determine whether the spill can be handled internally or if additional resources are required.
* Determine if the area is safe for continued use or if further evacuation is required
* If necessary take control of the area (Incident Commander)
* Provide the researcher or lab personnel with advice on the best way to clean up the spill.
* Not responsible for cleaning up the spill, but will assist others.

## 2.3 Major Spill Response:

In the event of a Major chemical spill the immediate steps to be taken include

1. Evacuate the lab and close the doors.

2. Restrict access to the area, and notify others in the area of the spill.

3. Call Campus Security at 705 748-1333 and Security will coordinate spill clean-up responses with the RMO and Science Facilities.

4. If safe to do so:

* + Attend to injured or contaminated personnel.
  + If a flammable material is involved, turn off ignition sources (i.e. shut off power to area, turn off Bunsen burners, etc.)
  + Restrict or contain the flow of the spilled liquids.
* Activate emergency alarm if there is an immediate risk to the safety of other people in the building.
* Remain in the general vicinity. Be available to provide technical information to emergency responders e.g. chemical identity, SDS, identity of other equipment and hazardous materials in the lab.
* Wait for university personnel in the general area.

## 2.4 Minor or Incidental Spill Response:

* Attend to injured or contaminated personnel.
* If a flammable material is involved, turn off nearby ignition sources.
* Restrict the area and notify others in the lab of the spill.
* Select and wear all appropriate PPE. It is essential to properly protect yourself.
* Promptly attend to the spill according to Table 9. If unsure of the proper clean-up procedure, contact your supervisor for guidance. The RMO and Science Facilities are also available to provide guidance. Once the spill is cleaned up or under control, contact Campus Security to report the incident.

Table 5. Response Procedures for Minor or Incidental Chemical Spills

| Material Spilled | Response Procedures |
| --- | --- |
| Liquid Acids | * If available, neutralize with sodium bicarbonate or commercially available acid neutralizer. Add Neutralizer starting from the outside of the spill and moving inward in ever decreasing circle. * Using a utensil of some sort, mix thoroughly to ensure neutralization. Litmus test strips can be used to test completeness of neutralization. Add more neutralizer as required. * Proceed as per general liquid spill clean-up |
| Liquid Caustics (Bases) | * If available, neutralize with citric acid or commercially available caustic neutralizer. Add neutralizer starting from the outside of spill and moving inward in ever decreasing circle * Using a utensil of some sort, mix thoroughly to ensure neutralization. Litums test strips can be used to test completeness of neutralization. Add more neutralizer as required. * Proceed as per general liquid spill clean-up |
| Solvents | * If available, supress vapours with activated charcoal or commercially available vapour suppressor. * Cover with absorbent material (spill blankets or other liquid absorbent material * Proceed as general liquid spill clean-up. |
| General liquids | * Encircle with universal chemical absorbent pads, socks or powder * Cover the spill with universal chemical absorbent pads or powder * Allow the liquid to be absorbed * Once absorbed, transfer to garbage bags or pails using scoop and/or dust pan if necessary * Label bag appropriateld with hazardous waste information and dispose through the chemical waste program * Wear the appropriate Personal Protective Equipment (Gloves, protective eyewear, lab coats etc…) |
| Mercury | * Contain the spill. * If available, spray mercury suppression spray into immediate air space above the spill. * While wearing gloves, push the beads together using a small tool. * Using an aspirator such as a Pasteur pipet and bulb, “suck up” as much of the material as possible and place in disposal container. * Cover spill area with amalgamation powder. * Allow the amalgamation powder and remaining mercury to solidify (form the almalgam). * Using a dust pan and broom or scoop, transfer the amalgam into disposal container * **NEVER** USE A VACCUM CLEANER TO CLEAN A MERCURY SPILL |

# 3.0 Spill Recovery

Once the spill has been contained, is under control and the initial clean up is complete it will be necessary to dispose of the clean up material and PPE.

All waste generated as a result of a spill and the clean up of a spill will need to be disposed of as chemical waste. All waste containers, bags and material will need to be labelled with information as per the Chemical Waste program procedures and should include the chemical name, chemical used in the clean up and the approximate volume.

If security has not been contacted yet, (for example if it is a minor spill and lab personnel were able to perform the clean up), then Campus Security should be contacted and an incident report filed. The same requirement to contact the lab supervisor applies as well. You may be contacted by Risk Management or Science Facilities personnel as well after the incident. It is highly recommended that shortly after the incident, personnel involved write a report of the incident, what caused the spill and the actions taken by the personnel involved. If an injury has occurred contacting Campus Security is mandatory.

Recovery from a major spill may be much more involved and depending on the circumstances, take some time. Lab users may need to be prepared to suspend their work in the lab until additional testing and or repairs are complete. In all cases, the safety of personnel in the lab and building will take priority over all other needs.

# 4.0 Conclusion

The information above is presented as general guidelines to be used by Laboratory Supervisors and Lab personnel in developing their own Spill Response procedures. An excellent document to review is the American Chemical Society’s “Guide for Chemical Spill Response Planning in Laboratories”. Always read the SDS for information on Chemical Spill Clean Up specific to that chemical.

# 5.0 References:

Trent University Safe Chemical Use Program

Trent University Chemical Waste Program

American Chemical Society, Guide for Chemical Spill Response Planning in Laboratories

University of Toronto Chemical Spill Guidelines

University of Ottawa Chemical Spill Guidelines