Chapter 8: Chemical Hazards

Overview

Most of the chemicals used in schools do not pose serious dangers. However, there are some chemicals that require more careful handling and others that should be avoided altogether. It is important

- to know proper clean-up procedures, in case a spill does occur
- that teachers and students be familiar with the chemical and physical properties of chemicals they work with, particularly for regulated or hazardous substances
- to control risks by limiting chemical concentration and exposure (the higher the concentration of a chemical, the higher the toxic or corrosive hazard)

Toxic or corrosive properties are the most common hazards posed by chemicals in schools. A toxic substance is any substance that may cause damage by its chemical action when ingested, inhaled, absorbed, or injected into the body in relatively small amounts. Damage can occur when materials directly destroy tissue through corrosive action (e.g., NaOH reacts with moisture in the skin, interfering with chemical reactions of the body).

> ***Notes***
>
> Refer to Appendix G for a list of chemicals that pose excessive hazard risks and should not be present in Manitoba schools.

General Safety Measures

Whenever chemicals are used, **the onus is on the teacher** to assess risks, determine proper handling procedures, and convey this information to students before beginning the activity. It is important that the handling procedures for all chemicals aim to minimize exposure, especially to those chemicals that present greater hazards.

The following general guidelines can be followed to increase safety when working with chemicals:

- Always follow WHMIS regulations and practices.
- Always read and have available MSDSs for all chemicals.
- Purchase only required chemicals in minimum quantities.
- Choose the safest chemicals and labs where possible.
- Store chemicals properly.

- Keep stock bottles and solutions out of lab areas.
- Inform students of the risks involved in their lab activities.
- Never eat or drink in labs or storage areas.
- Minimize exposure to chemicals and always use proper protective equipment.
- Do not wear contact lenses.
- Only perform labs that have been tested beforehand.
- Make sure students follow protocols exactly as instructed.
- Be prepared for accidents.
- Dispose of waste materials properly.
- Follow proper clean-up procedures after each lab activity is finished, including washing hands.
- Secure chemicals in locking cabinets and storerooms.

Corrosive Chemicals (Liquid, Solid, or Gases)

The most familiar corrosive chemicals encountered in laboratories are acids and bases. Corrosive chemicals are substances that are injurious to body tissues (from a minor irritation to physical destruction of tissues) or corrosive to metals by direct contact.

On humans, this corrosive quality is often due to the reaction of the substance with water or moisture in the tissue. This is the case with strong acids and bases of 1M or greater concentration, non-metal halides, dehydrating agents, halogens, and oxidizing agents. The most serious corrosion hazards come with substances that are in a mist or gaseous state, since they can be readily absorbed through the skin or inhaled into the lungs. Tissues of the body are affected by direct chemical reaction, destruction of proteins, and disruption of cell membranes.

Dangers from corrosive materials can occur through

- direct contact with skin
- contact with eyes and mucous membranes
- inhalation of vapours or dust
- ingestion of liquids or solids

Corrosive materials also pose a hazard when dangerous gases are produced as a result of reaction with other materials (e.g., nitric acid will react with copper to produce nitrogen dioxide).

Types of Corrosives and Their Hazards

Liquid Corrosives

Liquid corrosives are typically encountered in school laboratories as acids (hydrochloric, sulphuric, nitric, and acetic) and water solutions of bases (sodium hydroxide, potassium hydroxide, and ammonium hydroxide).

Acids act on body proteins and produce a barrier that, although extremely painful, limits the activity of the acid.

Bases penetrate deeply with little or no pain since no protein barrier is produced. For that reason, bases can cause greater skin or eye damage than acids.

Examples of liquid corrosives encountered in schools:

Hydrochloric acid	It can liberate gases such as hydrogen and hydrogen cyanide. It reacts with formaldehyde to produce chloromethoxychloromethane, a potent carcinogen.
Nitric acid	It can oxidize cellulose material, creating a self-igniting condition. It is extremely exothermic and potentially explosive when mixed with organic materials.
Sulphuric acid	It is a powerful oxidizer that can dehydrate organic material rapidly with the production of heat.

Solid Corrosives

It is a mistake to think of corrosive solids as being relatively harmless because they can be removed more easily than liquids. Solid corrosives are often rapidly dissolved by the moisture in the skin and even more rapidly by moisture in the respiratory and alimentary systems. Solid corrosives also may not produce immediately painful reactions, causing delayed injury.

The following are some examples of solid corrosives encountered in schools:

- alkali metal carbonates (e.g., K_2CO_3)
- alkali metal hydroxides (e.g., NaOH)
- alkali metal sulphides (e.g., Na_2S)
- alkaline earth hydroxides (e.g., $Ca(OH)_2$)
- elemental alkali metals (e.g., Na, K, Li)
- chromium salts
- iodine
- trisodium phosphate

Gaseous Corrosives

Perhaps the most dangerous form of corrosives, these gases enter the body via absorption through the skin and by inhalation. The corrosive gases are grouped by solubility and effect upon the respiratory system.

The harmful effect of a corrosive gas is not directly related to concentration and exposure duration. They can produce severe, immediate damage and even death without causing systemic injuries. When evaluating possible effects, it is necessary to consider the concentration, solubility, and duration of exposure.

Corrosive substances may react with another material to give off corrosive, toxic, and flammable gases, and may react to produce other hazardous substances.

Common corrosive gases include the following:

- ammonia
- formaldehyde
- hydrogen chloride
- halogens
  - They will support combustion, and may ignite powdered metals on contact. They also react violently with organic substances.
  - Chlorine and bromine gas should not be used as reagents in school labs.

Specific Precautionary Measures with Corrosive Chemicals

In addition to the General Safety Measures (on page 93), it is important to

- use the following protective equipment:

See Safety Equipment and Supplies (on page 47).

  - lab coat or acid-proof apron
  - safety goggles/face shield
  - gauntlet-type acid-resistant gloves
  - outside of a fume hood, a safety screen
- use a fume hood
- have adequate exhaust ventilation where corrosive substances are stored
- have plenty of water available for flushing, including eyewash
- have plenty of sodium bicarbonate available for neutralizing liquid corrosive spills
- store corrosive chemicals properly
  See Storage Facilities for Chemicals (on page 113).

Principles of Corrosive Chemical First Aid

- Alert the teacher or nearby colleague.
- Call 911 (emergency services).
- Neutralizers and solvents (alcohol, etc.) should not be used by the first aider.
- In the event of contact with eyes:
  - **Immediately** flush the eyes with water and continue to flush for 15 minutes using tempered (not cold) water. Eyelids may have to be forced open so that the eyes may be flushed. Get medical attention if necessary. The first few seconds after contact are critical. Immediate flushing of the eyes may prevent permanent damage.
  - If the student is wearing contact lenses, remove them after flushing if they have not been washed out already. Continue flushing.
- In the event of contact with skin:
  - Strong chemicals burn the skin rapidly. Begin flushing the area with water **immediately**. Remove carefully and discard clothing (including socks and shoes), watches, and jewellery. Continue to flood the area while clothing is being removed.
- The precautionary warning on the product label should be consulted for full first-aid information. Provide the label information and MSDS to the attending physician.

Toxic Hazards

A toxic substance has the potential of injury by direct chemical action with body systems. Almost any substance is toxic when taken in excess of tolerable limits. Toxic substances include corrosive as well as poisonous materials.

The potential for contact with toxic materials exists in activities in science. Chemistry experiments are the most obvious situations with potential hazard. However, a person may be exposed to toxic substances from unsuspected sources. Toxic materials may be involved incidentally as part of a laboratory or demonstration procedure. Careful consideration is to be given to all materials used and produced in an activity (e.g., the dust of heavy metal minerals may be inhaled during the breaking of rock samples).

Inadequate clean-up may lead to exposure to toxic materials after a lab procedure is finished. Substances left on benches or in beakers and bottles may expose others to these toxic materials. Students may ingest toxic materials they have been in contact with if they do not wash thoroughly before eating or smoking. Foods and beverages readily absorb many vapours and should never be brought into a lab. Chewing of gum should not be allowed.

Toxic materials damage the body by interfering with the function of cells in body tissue. Damage can occur when

- toxic materials interfere with chemical reactions of the body (e.g., CO_2 replaces O_2 in hemoglobin)
- disruption of the biological processes occurs (e.g., NO_2 causes pulmonary edema and allergic responses)

Toxic effects can be local or systemic as well as acute or chronic. Local effects are confined to the area of the body that has come in contact with toxic materials. Systemic effects occur throughout the body after absorption into the bloodstream. Acute effects are immediate, while chronic effects may take many years before they become evident.

Dangers from toxic materials can occur through

- direct contact with skin
- contact with eyes and mucous membranes
- inhalation of vapours or dust
- ingestion of liquids or solids
- direct entry to the bloodstream through punctures or open wounds

Symptoms

Poisoning may be suspected when any of the following are evident:

- strange odour on the breath
- unconsciousness, confusion, or sudden illness
- discolouration of lips and mouth
- pain or burning sensation in the throat
- drugs or poisonous chemicals in bottles or packages found open in the presence of students

Special Caution: Many toxic vapours and liquids can have little or no odour, even in dangerous concentrations.

Toxic materials or controlled products are rated in Manitoba by an Occupational Exposure Limit (OEL), as defined in section 36 of the *Workplace Health Hazard Regulation* at <http://web2.gov.mb.ca/laws/regs/pdf/w210-217.06.pdf>. This is a regulation under the *Workplace Safety and Health Act*.

Specific Precautionary Measures with Toxic Chemicals

In addition to the General Safety Measures (on page 93), it is important to

- treat a substance as toxic unless definitely known otherwise
- close chemical containers (Vapours, dust, and liquids can easily escape during normal handling.)
- use fume hoods when heating toxic materials (Smoke and vapour may be released in much greater quantity when material is hot.)
- use fume hoods when transferring powders
- avoid crushing and grinding solids, which may release dusts into the air
- use toxic materials in areas with adequate ventilation (Toxic vapours can rapidly accumulate to dangerous levels in a room.)
- not lean over an open container containing a toxic material (Toxic vapours can be in high concentration immediately above an open bottle, even in well ventilated rooms.)
- cover all exposed areas with chemical-resistant clothing, including
  - protective gloves
  - aprons
  - lab coats
  - face shields

Principles of Toxic Chemicals First Aid

- Alert the teacher or nearby colleague. Speed is essential.
- Call 911 – emergency services.
- In the case of contact with skin or eyes, wash affected area immediately and continue to do so for at least 15 minutes.
- If a material has been inhaled or swallowed or if a victim is unconscious, in convulsions, or in pain, contact trained assistance immediately.

Insidious Hazards

Insidious chemical hazards could be easily overlooked or ignored, even during routine safety inspections, because their effects are not immediately obvious and are inconspicuous (can't be seen, tasted, smelled, or felt). They may cause, however, local or systemic, acute or chronic effects, depending upon the nature of the substance and duration of exposure.

Sources of Insidious Hazards

Insidious hazards include

- residues in the sink drain
  - If aqueous solutions are disposed of by flushing down the drain, this can lead to the build-up of toxic (e.g., mercury) or other hazardous materials that may be released into the laboratory air upon contact with a catalyst (e.g., nickel, metal).
- leaking gas cylinders
- leaking gas lines and jets
- ignition sources
- chemicals that slowly react to form toxic products or build pressure
- faulty pressure control equipment for compressed gases
- neglected containers of dried solutions and residues of chemical products from past demonstrations and activities
- improperly stored (see Chapter 9) or labelled (see Chapter 5) chemicals

Specific Precautionary Measures for Insidious Hazards

In addition to the General Safety Measures (on page 93), consider the following measures:

- Prepare a list of potential insidious hazards that should be updated regularly.
- Give specific attention to possible sources of insidious hazards during the safety inspection process.
- Avoid stock build-up of toxic, flammable, or corrosive materials.
- Have efficient and appropriate clean-up agents for spills.
- Collect waste materials in separate containers and do not mix them.

Mercury

Mercury is one of the most common insidious hazards. It evaporates and readily absorbs through the skin and respiratory system, which can have serious and cumulative effects on the gastrointestinal and central nervous systems. Mercury is also capable of forming explosive compounds, such as mercury fulminate.

The risks of using mercury and its compounds exceed its educational utility. Therefore, its use is not recommended in Manitoba schools. Mercury

thermometers should be avoided because of potential breaks and spills. To avoid mercury spills, you should

- use organic-filled (like alcohol) or electronic thermometers rather than mercury thermometers
- use care in handling instruments containing mercury

Nevertheless, if mercury is spilled, it must be cleaned up and stored before disposal by a hazardous waste removal company. Proper handling of spills and subsequent storage should be as follows:

- Students should not be allowed to clean up spills.
- Use a commercial spill kit that includes the control of mercury vapours (aspirator, mercury absorbent, and vapour absorbent).
- Use gloves to clean and handle the spill kit.
- Clean up immediately and thoroughly when a spill occurs.
- Store mercury in a plastic bottle under a layer of water or oil.
- Keep the container sealed in a cool, well ventilated area.
- Avoid opening the container and allowing vapours to escape.
- Wear gloves when handling the container.

Unless mercury spills are promptly and thoroughly cleaned up and the area decontaminated, dangerous exposure to vapours will continue. In the past, the common practice for clean-up was to aspirate or sweep up any visible drops. Mercury droplets from 10 to 1000 micrometres in diameter also stick to vertical surfaces and penetrate into porous flooring. In some cases, relatively large amounts of mercury may be left undiscovered after spills. Prompt and thorough clean-up of mercury spills is essential or **cumulative exposure to mercury vapours can cause irreparable harm to those working in the area.**

School board policies should be followed in the case of a spill (from thermometer breakage, for example). If a spill occurs near students, they should move away from the area and inform their teacher immediately.

Carcinogens

A carcinogen is a chemical, physical, or biological substance that is capable of causing cancer. The damaging effects are subtle and imperceptible in the short term; thus, carcinogenic substances are another insidious hazard that may be present in the laboratory and chemical storage area. A substance is considered to be carcinogenic if it has been evaluated and rated as a human carcinogen, an animal carcinogen, or a potential carcinogen by the American Conference of Government Industrial Hygienists or the International Agency of Research on Cancer. These substances will also be categorized under **WHMIS** as Class D2. Health Canada has tabled a list of substances assessed for carcinogenicity on its website at <www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/carcinogenesis-carcinogenese_e.html>.

The website also has links to agencies to enable searches of the most current information. Carcinogenic properties of chemicals with excessive risks are also indicated in Appendix G.

Actual manifestation of cancer or tumors for most carcinogenic chemicals requires prolonged and often relatively constant exposure. Proper storage of such chemicals in airtight containers reduces this hazard by limiting exposure only to periods of chemical usage. However, the more frequent the use, the greater the exposure, particularly for powdered forms of these chemicals, which can be absorbed through the skin and lungs.

Fewer chemicals have carcinogenic properties compared to other risks, and those that do should be avoided, if possible. Whether to stock and use chemicals with carcinogenic properties will depend on curricular requirements, adequacy of facilities, and the ability to safely handle these chemicals with the frequency required. Serious consideration should be given to using alternative chemicals wherever possible.

Other Hazardous Materials

Cryogenic Substances (Liquefied/Solidified Gases)

Cryogenic substances are gases that are maintained in liquid or solid form at extremely low temperatures. The most common cryogens that are readily available to schools are solid carbon dioxide (dry ice) and liquid forms of hydrogen, oxygen, methane, and nitrogen. Cryogens pose several serious hazards. These include the following:

- **Explosive Pressure**: Cryogenic gas generates enormous pressure when it vaporizes within the container and when it is released through the valve. In the case of methane gas, for example, the expansion is 630 times that of the equivalent liquid volume.
- **Fire**: Flammable cryogenic substances present the same flammability hazard as their gaseous forms.
- **Embrittlement** of structural materials and human tissues: Most materials experience some degree of embrittlement at temperatures below –50°C. Contact with cryogenic liquids, their gases, or the surfaces of their containers can lead to frostbite or more extensive freezing of tissue that can be very destructive. Living tissue can become completely frozen and so brittle that it will shatter on impact.
- **Asphyxiation:** Except for liquid oxygen, expansion of cryogens may displace a sufficient volume of air to cause asphyxiation. This is particularly true of dry ice, which sublimes into carbon dioxide gas and readily displaces normal air.

Teachers might use cryogenic compounds to create special effects in a demonstration only. Students shouldn't be allowed to manipulate cryogenic substances. There is no outcome directly linked to the use of such substances in the Manitoba curricula. Follow regulations from your local school board in handling cryogens.

Anyone choosing to use cryogens should have a thorough knowledge of the characteristics of the substance at the temperatures and pressures being used, and the appropriate safety precautions for handling. They should also know how to recognize and eliminate leaks, and the requirements for short- and long-term storage.

Specific Precautionary Measures for Cryogens

In addition to General Safety Measures (on page 93), follow these measures:

- Use cryogens only in a properly ventilated space to avoid a build-up. Adequate ventilation is particularly important to prevent asphyxiation with the use of dry ice.
- Store containers of cryogenics in a cool, well ventilated space, in an upright secured position, and vent containers properly to avoid explosion.
  - Prolonged storage in a poorly ventilated area will cause metal valves to undergo chemical corrosion. If this occurs, store in a separate cool, dry room away from direct sunlight and sources of sparks or flame.
- Ensure warning signs and the name of the cryogen are all posted in locations where the substance is stored or used.
- Ensure vessels are appropriately labelled and filled only with the liquids that they were designed to hold.
- Perform operations slowly to minimize boiling and splashing.
- If liquid nitrogen is heavily contaminated with oxygen, handle it with precautions suitable for liquid oxygen.
  - The appearance of a blue tint in liquid nitrogen is a direct indication of oxygen contamination.
- Take appropriate precautions when releasing cryogenic gases.
  - If oxygen is used, remember that it does not burn but it does enhance burning of flammable materials; thus, open flames or sources of sparks should be removed from the area.
- Ensure that all eyes are protected by goggles and all skin is covered by
  - a face shield, pants, and boots
  - a laboratory coat or apron without pockets or cuffs
  - loose-fitting gloves that can be easily removed
- Remove watches, rings, bracelets, and other jewellery.
- Have another person nearby for emergency assistance.

Compressed Gases

Cylinders of compressed gases should be handled and stored in a similar fashion to cryogenic substances. Containers used to store gases should meet the National Fire Protection Association (NFPA) standard, prescribed for both Canada and the United States.

Figure 18 ***Compressed Gases***

Flammable Substances

Generally, substances that are highly flammable—particularly those that are also highly volatile—should not be used by students. If minute amounts are provided for student use, make sure the area is well ventilated and far from open flames or sparks. Identify and eliminate any unwanted ignition sources that may exist, such as sparks that come with unplugging electrical cords and static electricity. Teacher demonstrations using flammable substances can be done under similar conditions or under the fume hood. Again, cabinets and containers used to store gases should meet the National Fire Protection Association (NFPA) standard, which is relevant both in Canada and the United States.

Reactive Chemicals

Frequent accidents occur in laboratories simply because the effects of a particular chemical combination have not been anticipated. This is not uncommon even among highly experienced chemists.

The mishandling of reactive chemicals is a well-known problem in science laboratories. Many explosions, fires, burns, and other bodily injuries have been caused by improper and careless handling of reactive chemicals. Misuse does not necessarily refer to problems occurring while the reactive chemicals are being used. It can also result from improper storage, record keeping, and labelling.

Types of Reactive Chemicals

Reactive chemicals can refer to substances that enter into violent reactions to spontaneously generate large quantities of heat, light, gas, or toxicants. Reactive chemicals can be classified as follows:

- **Explosive Substances** are concentrated forms of unstable substances that have the potential to explode. They pose too great a risk to warrant use, and they should not be kept in schools. Some explosive substances in lower concentrations, such as hydrogen peroxide, are relatively safe. For more information on explosive substances, refer to this group in the Reactive Chemicals table below.
- **Acid-sensitive chemicals** react with acids to release heat, hydrogen, explosive gases, and toxicants.
- **Water-sensitive chemicals** react with water to release heat and/or flammable or explosive gases.
- **Oxidation-reduction** reactions can occur in any phase, but they tend to generate heat and are often explosive.
- **Pyrophoric substances** burn when exposed to air.

Check the *Chemicals That Pose Excessive Risk* information table in Appendix G (on page G1) of this document. For a more comprehensive treatment of the hazards associated with chemical species, consult the online *Chemical Hazard Information Table* available at <www.edu.gov.mb.ca/k12/cur/science/index.html> and click on "Science Safety Resources."

- Storage
- Reactivity
- Disposal procedures
- Safety issues

Notes

It must be noted that the appearance of a controlled substance on this list does NOT necessarily mean that the substance should be used in Manitoba science classes.

The following table provides some of the information available in the controlled substance list.

Reactive Chemicals			
Reactive Nature of Chemical	Examples	Specific Hazards	Precautionary Measures
Explosive*	■ Fulminates* ■ Nitroglycerin* ■ Peroxides (benzoyl, sodium)* ■ Picric acid* ■ Azides* ■ Perchlorates (Na, K)* ■ Hydrazines* ■ Dioxane* ■ Ether (excluding petroleum ether)*	■ Substances that decompose with such speed that they cause a rapid expansion of air, sometimes accompanied by burning gases and flying objects ■ Easily detonated ■ Can explode from shock, friction, or heat ■ Unstable ■ Can form peroxides	Protect from shock, high temperature, sudden temperature changes, and other reactive substances
Acid Sensitive	■ Alkali metals ■ Alkaline hydroxides ■ Carbonates ■ Carbides* ■ Nitrides Metals ■ Sulphides ■ Cyanides*	Substances that react with acids to release heat, hydrogen, and/or other explosive gas and toxicants	■ Isolate from reactive substances ■ Wear and use adequate protection
Water Sensitive	■ Strong acids and bases ■ Acid anhydrides ■ Alkali metal hydrides ■ Carbides* ■ Aluminum chloride (anhydrous)	■ Substances that react with water, releasing heat, and/or flammable gases such as hydrogen ■ Ignition in moist air can cause explosions ■ May produce acetylene or methane ■ Spontaneous decomposition during extended storage may cause container to explode upon opening	■ Isolate from other reactive substances ■ Store in cool, waterproof area ■ Wear protective gear

Reactive Chemicals			
Reactive Nature of Chemical	Examples	Specific Hazards	Precautionary Measures
Oxidation-Reduction sensitive	Oxidizers ■ Oxygen Mineral acids ■ Perchlorates* ■ Peroxides* (H_20_2 excepted) ■ Nitrites and nitrates ■ Chromates and dichromates ■ Permanganates ■ Halogens ■ Chlorates* Reducers ■ Hydrogen ■ Phosphorous* ■ Alkalai metals ■ Metallic hydrides ■ Formaldehyde*	All generate heat and can be explosive	■ Isolate from each other and other potentially reactive substances ■ Use adequate protection
Special Organic Substances	■ Acrolein* ■ Benzene* ■ Diethyl ether*	■ Flammable and may also polymerize violently and form explosive peroxides ■ Explodes with many oxidants ■ May be carcinogenic (benzene)	■ Store in an airtight container in a cool place ■ Isolate from oxidants
Pyrophors	■ Phosphorous* (white or yellow)	■ Substances that burn spontaneously when exposed to air	■ Protect from air

* These chemicals must not be present in school laboratories or storerooms because of their reactive nature.

Managing the Release or Spill of Toxic or Corrosive Substances

Deciding how to handle a spill first requires understanding of the health hazards associated with the substance. There are three immediate questions that must be answered:

- Is this substance highly toxic or corrosive?
- Does it give off toxic or corrosive fumes?
- Are the fumes potentially explosive?

Answers to these questions can be found in the pertinent MSDS sheets that should be accessible to users at all times and be reviewed before commencing activities with the materials. **For substances that are highly toxic or corrosive (ones that have a health rating of 3 or 4), any spills and releases of these substances must be handled by specially trained professionals who are equipped to deal with such emergencies.** This may require evacuation of the school, particularly if toxic fumes are associated with the substance. See Responding to Toxic Substance Leaks and Spills (on page 36) in Chapter 3 for emergency procedures.

In the case of minor spills of acids and bases, local action by knowledgeable staff can be taken to neutralize the spill using materials prepared for that purpose. Once neutralized, the products can then be cleaned up and disposed. **Major spills should be handled by specially trained professionals.**

Prompt clean-up is also the appropriate measure to deal with manageable quantities of other materials that are not highly toxic or corrosive. All wastes resulting from these clean-ups should be contained separately. Placing all spilled or waste chemicals in a general waste bin may result in reactions with other chemicals or wastes placed in the container.

Corrosive Liquids

Minor spills of corrosive liquids can be handled using the following steps:

1. Put on protective clothing/equipment (face shield, rubber gloves, rubber boots, and lab coat) if the spill is concentrated.
2. Contain the spill with asbestos-free vermiculite, clay cat litter (bentonite), or diatomaceous earth.
3. Neutralize the substance. For acids, liberally apply sodium bicarbonate (baking soda) or sodium carbonate (soda ash), or apply a spill kit pillow. For bases, sprinkle boric acid or citric acid on the spill, or apply a spill kit pillow. Test with pH paper to ensure the substance is completely neutralized.
4. Dilute with plenty of water and mop up using an absorbent cloth.
5. Wash contents down the sink and clean spill area with water. Wipe dry with paper towels.

Notes

Municipal bylaws and waste regulations may permit some substances to be disposed of through drains. If permitted in your area, wash the material down with plenty of water. Alternatively, absorbent materials (asbestos-free vermiculite or diatomaceous earth) may be used to soak up the solution. The resulting mixture can then be bagged, labelled, and sent for disposal.

Flammable Liquids

Small amounts of solvents can be cleaned up as follows:

1. Immediately shut off all ignition sources, and open windows and vents leading directly to the outside for ventilation.
2. Contain and cover the spill with a mineral absorbent such as asbestos-free vermiculite, bentonite, or diatomaceous earth.
3. Scoop the contaminated absorbent into a heavy gauge garbage bag or plastic bucket with lid.
4. Wash the spill area with soap and water, using a disposable cloth.
5. Dispose of the contaminated cloth in the same garbage bag.
6. Allow to evaporate under the fume hood.

Other Liquids (excluding mercury)

Water-Soluble Liquids

1. If necessary, contain with towels, asbestos-free vermiculite, bentonite, or diatomaceous earth.
2. Dilute with water.
3. Mop up using paper towels or cloths. Very small spills can be swabbed directly into a sink and flushed with large volumes of water.
4. Check the *Chemicals That Pose Excessive Risk* information table in Appendix G (on page G1) of this document. For a more comprehensive treatment of the hazards associated with chemical species, consult the online *Chemical Hazard Information Table* available at <www.edu.gov.mb.ca/k12/cur/science/index.html> and click on "Science Safety Resources."

Water-Insoluble Liquids

1. If necessary, contain with towels, asbestos-free vermiculite, bentonite, or diatomaceous earth.
2. Cover the spill with mineral absorbent and scoop the contaminated material into a suitable container for disposal.
3. Wash the spill area with water and soap and wipe dry with paper towels.
4. Discard contaminated towels or cloth. Check the MSDS for final disposal details.

Solids

The critical factor in cleaning up solid chemicals is to avoid raising particles into the air and inhaling them.

1. Slowly sweep up granules or powder into a dustpan.
2. Mop up smaller amounts with a damp disposable cloth.
3. Wipe the area clean.
4. Determine appropriate disposal procedures from the MSDS.