TARLETON STATE UNIVERSITY

CHEMICAL SAFETY PROGRAM

TARLETON STATE UNIVERSITY
SAFETY DEPARTMENT
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CHEMICAL SAFETY PROGRAM - SECTION I

GENERAL

The following information is provided to assist Tarleton Departments in developing procedures to meet chemical safety requirements to protect students, employees, and the environment.

PURPOSE

This program sets forth recommended minimum requirements that need to be followed to maximize the safety of all workers handling chemicals.

SCOPE

Affected departments of Tarleton are expected to establish Chemical Safety Procedures. The Chemical Safety Procedures shall include provisions to:

1) General Safety Guidelines;
2) Hazard Communication Program;
3) Corrosives;
4) Flammables;
5) Solvents;
6) Toxic Chemicals;
7) Reactives and Explosives;
8) Cleaning Agents;
9) Fume Hoods;
10) Spill Response;
11) Chemical Storage;
12) Shipping/Receiving.

RESPONSIBILITIES

*The Tarleton Environmental Safety and Health Office will:
- assist in identifying safety procedures as necessary
- assist with training as appropriate
- monitor program compliance
- assist in the selection of atmospheric monitoring equipment, personal protective equipment, and other necessary equipment.

*The department/supervisor will:
- identify person handling chemicals
- provide atmospheric monitoring equipment, personal protective equipment and all other

necessary equipment
- provide proper training for persons authorizing chemicals

*The employee will:
- follow guidelines described in this program and other required programs to assure safe chemical procedures.

GENERAL SAFETY

Almost everyone works with or around chemicals and chemical products every day. Many of these materials have properties that make them hazardous: they can create physical (fire, explosion) and/or health hazards (toxicity, chemical burns). However, there are many ways to work with chemicals which can both reduce the probability of an accident to a negligible level and reduce the consequences to minimum levels should an accident occur. Risk minimization depends on safe practices, appropriate engineering controls for chemical containment, the proper use of personal protective equipment, the use of the least quantity of material necessary, and substitution of a less hazardous chemical for the more hazardous one. Before beginning an operation, ask “What would happen if…?” The answer to this question requires an understanding of the hazards associated with the chemicals, equipment and procedures involved. The hazardous properties of the material and intended use will dictate the precautions to be taken.

Another important distinction is the difference between hazard and risk. The two terms are sometimes used as synonyms. In fact, hazard is a much more complex concept because it includes conditions of use. The hazard presented be a chemical has two components: (1) its inherent capacity to do harm by virtue of its toxicity, flammability, explosiveness, corrosiveness, etc.; and (2) the ease with which the chemical can come into contact with a person or other object of concern. The two components together determine risk (the likelihood or probability that a chemical will cause harm). Thus, an extremely toxic chemical such as strychnine cannot cause poisoning if it is in a sealed container and does not contact the handler. In contrast, a chemical that is not highly toxic can be lethal if a large amount is ingested.

Chemical safety is inherently linked to other safety issues including laboratory procedures, personal protective equipment, electrical safety, fire safety, and hazardous waste disposal. Refer to other chapters for more information on these topics.

Knowledge + Common Sense + Caution = Chemical Safety

Not all chemicals are considered as hazardous. Examples of nonhazardous chemicals include buffers, sugars, starched, agar, and naturally occurring amino acids.

The following sections provide general guidelines for chemical safety.

Chemical Safety Guidelines:
Always follow these guidelines when working with chemicals:

- Assume that any unfamiliar chemical is hazardous.
- Know all the hazards of the chemicals with which you work. For example, perchloric acid is a corrosive, an oxidizer, and a reactive. Benzene is an irritant that is also flammable, toxic and carcinogenic.
- Consider any mixture to be at least as hazardous as its most hazardous component.
- Never use any substance that is not properly labeled.
- Follow all chemical safety instructions precisely.
- Minimize your exposure to any chemical, regardless of its hazard rating.
- Use personal protective equipment, as appropriate.
- Use common sense at all times.

The five prudent practices of chemical safety sum up these safety guidelines:
1. Treat all chemicals as if they were hazardous.
2. Minimize your exposure to any chemical.
3. Avoid repeated exposure to any chemical.
4. Never underestimate the potential hazard of any chemical or combination of chemicals.
5. Assume that a mixture or reaction product is more hazardous than any component or reactant.

Safe Handling Guidelines
Employees should treat all chemicals and equipment with caution and respect.

When working with chemicals, remember to do the following:

- Remove and use only the amount of chemicals needed for the immediate job at hand.
- Properly seal, label, and store chemicals in appropriate containers. Keep the containers clearly marked and in a well ventilated area.
- Check stored chemicals for deterioration and broken containers.
- Learn how to dispose of chemicals safely and legally. Follow Tarleton State University waste disposal requirements.

- Clean up spills and leaks immediately.
- Know what to do in an emergency.

Likewise, when working with chemicals, remember the following:

- Do not store chemicals near heat or sunlight or near substances which might initiate a dangerous reaction.
- Do not transport unprotected chemicals between the work area and other areas. Use a tray, rack, cart or rubber carrier. - Always use a secondary container when transporting hazardous or highly odorous chemicals on an elevator.
- Do not pour hazardous chemicals down the sink.
- Do not put fellow workers or yourself in danger.

Fume Hoods

Fume hoods provide primary confinement in a chemical laboratory. They exhaust toxic, flammable, noxious, or hazardous fumes and vapors by capturing, diluting, and removing these materials. Fume hoods also provide the best protection when the fume hood sash is in the closed position. All chemical fume hoods must be ducted to the outside of the building.

Laboratory books are given to each student in the lab and the first assignments are on safety in the lab. The following documents are filled out and signed by the students and are to be turned in and put on file.

Chemical Waste

Hazardous Waste disposal is addressed in a separate document. (TSU Safety Manual)

Hazard Communication Program

Tarleton State University has a written program (Tarleton State University Hazard Communication Program) that complies with OSHA standards and the Texas Hazard

Communication Act for hazardous chemicals. This program is available from the Safety Office. It requires the following:

- Employee training (including recognition of signs of exposure)
- Labeling procedures
- MSDS's for chemicals at each workplace
- Instructions on how to read and interpret MSDS's
- Chemical inventory reporting procedures
- Recordkeeping requirements
- Emergency response procedures

Refer to the Tarleton State University Hazard Communication Program and other section in the Safety Manual for detailed information on these topics.

WORK PLACE HAZARDS

Concentrated acids can cause painful burns that are often superficial. Inorganic hydroxides, however, can cause serious damage to skin tissues because a protective protein layer does not form. Even a dilute solution such as sodium or potassium hydroxide can saponify fat and attack skin. At first, skin contact with phenol may not be painful, but the exposed area may turn white due to the severe burn. Systemic poisoning may also result from dermal exposure.

To ensure safe handling of corrosives, the following special handling procedures should be used:

- Always store corrosives properly. Refer to the MSDSs and the Chemical Storage section of this manual for more information.
- Always wear gloves and face and eye protection when working with corrosives. Wear other personal protective equipment, as appropriate.
- To dilute acids, add the acid to the water, not the water to the acid.
- Corrosives, especially inorganic bases (e.g., sodium hydroxide), may be very slippery; handle these chemicals with care and clean any spills, leaks, or dribbles immediately.
- Use a chemical fume hood when handling fuming acids or volatile irritants (e.g., ammonium hydroxide).
- A continuous flow eye wash station should be in every work area where corrosives are present. An emergency shower should also be within 100 feet of the area.

Perchloric acid is a corrosive oxidizer that can be dangerously reactive. At elevated temperatures it is a strong oxidizing agent and a strong dehydrating reagent. Perchloric acid reacts violently with organic materials. When combined with combustible material, heated perchloric acid may cause a fire or explosion. Cold perchloric acid at less than 70% concentration is not a very strong oxidizer, but its oxidizing strength increases significantly at concentrations higher than 70%. Anhydrous perchloric acid (>85%) is very unstable and can decompose spontaneously and violently.

If possible, purchase 60% perchloric acid instead of a more concentrated grade. Always wear gloves and goggles while using perchloric acid. Be thoroughly familiar with the special hazards associated with perchloric acid before using it.

Heated digestions with perchloric acid require a special fume hood with a wash-down system.

A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate MSDSs before beginning work with flammables.

Flammable chemicals are classified according to flashpoint, boiling point, ignition temperature. Flashpoint (FP) is the lowest temperature at which a flammable liquid gives off sufficient vapor to ignite. Boiling point (BP) is the temperature at which the vapor pressure of a liquid vaporizes. Flammable liquids with low BPs generally present special fire hazards. The FPs and BPs of certain chemicals are closely linked to their ignition temperature-the lowest temperature at which a chemical will ignite and burn independently of its heat source.

When working with flammables, always take care to minimize vapors which act as fuel.

Follow these guidelines when working with flammable chemicals:

**** Handle flammable chemicals in areas free from ignition sources.
* Never heat flammable chemicals with an open flame. Use a water bath, oil bath, heating mantle, hot air bath, etc.
* Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.
* Use a fume hood when there is a possibility of dangerous vapors. (Ventilation will help reduce dangerous
vapor concentrations.)
* Restrict the amount of stored flammables, and minimize the amount of flammables present in a work area.

* Remove from storage only the amount of chemical needed for a particular experiment or task.

Organic solvents are often the most hazardous chemicals in the work place. Solvents such as ether, alcohols, and toluene, for example, are highly volatile or flammable. Chlorinated solvents such as chloroform are nonflammable, but when exposed to heat or flame, may produce carbon monoxide, chlorine, phosgene, or other highly toxic gases.

Always use volatile and flammable solvents in an area with good ventilation or in a fumehood. Never use ether or other highly flammable solvents in a room with open flames or other ignition sources present.

Health hazards associated with solvents include exposure by the following routes:

* Inhalation:
Inhalation of a solvent may cause bronchial irritation, dizziness, central nervous system depression, nausea, headache, coma, or death. Prolonged exposure to excessive concentrations of solvent vapors may cause liver or kidney damage. The consumption of alcoholic beverages can enhance these effects.
* Skin Contact:
Skin contact with solvents may lead to defatting, drying, and skin irritation.
* Ingestion:
Ingestion of a solvent may cause severe toxicological effects. Seek medical attention immediately.

The odor threshold for the following chemicals exceeds acceptable exposure limits. Therefore, if you can smell it, you may be overexposed---increase ventilation immediately.

Chloroform
Benzene
Carbon tetrachloride
Methylene chloride

NOTE:
Do not depend on your sense of smell alone to know when hazardous vapors are present. The odor of some chemicals is so strong that they can be detected at levels far below hazardous concentrations (e.g., xylene).

In addition, some solvents (e.g., benzene) are known or suspected carcinogens.

To decrease the effect of solvent exposure, substitute hazardous solvents with less toxic or hazardous solvents whenever possible. For example, use hexane instead of diethyl ether, benzene or a chlorinated solvent.

NOTE:
The best all-around solvent is water; use whenever possible.

Dimethyl sulfoxide is unique because it is a good solvent with many water-soluble as lipid-soluble solutes. Due to these properties, dimethyl sulfoxide is rapidly absorbed and distributed throughout the body. It can also facilitate absorption of other chemicals such as grease, oils, cosmetics, and other chemicals that may contact the skin.

The toxicity of a chemical refers to its ability to damage an organ system (kidneys, liver), disrupt a biochemical process (e.g., the blood-forming process) or disturb an enzyme system at some site remote from the site of contact. Toxicity is a property of each chemical that is determined by molecular structure. Any substance can be harmful to living things. But, just as there are degrees of being harmful, there are also degrees of being safe. The biological effects (beneficial, indifferent or toxic) of all chemicals are dependent on a number of factors.

For every chemical, there are conditions in which it can cause harm and, conversely, for every chemical, there are conditions in which it does not. A complex relationship exists between a biologically active chemical and the effect it produces that involves consideration of dose (the amount of a substance to which one is exposed), time (how often, and for how long during a specific time, the exposure occurs), the route of exposure (inhalation, ingestion, absorption through skin or eyes), and many other factors such as gender, reproductive status, age, general health and nutrition, lifestyle factors, previous sensitization, genetic disposition, and exposure to other chemicals.

The most important factor is the dose-time relationship. The dose-time relationship forms the basis for distinguishing between two types of toxicity: acute toxicity and chronic toxicity. The acute toxicity of a chemical refers to its ability to inflict systemic damage as a result (in most cases) of a one-time exposure to relative large amounts of the chemical. In most cases, the exposure is sudden and results in an emergency situation.

Chronic toxicity refers to a chemical's ability to inflict systemic damage as a result of repeated exposures, over a prolonged time period, to relatively low levels of the chemical. Some chemicals are extremely toxic and are known primarily as acute toxins (hydrogen cyanide): some are known primarily as chronic toxins (lead). Other chemicals, such as some of the chlorinated solvents, can cause either acute or chronic effects.

The toxic effects of chemicals can range from mild and reversible (e.g., a headache from a single episode of inhaling the vapors of petroleum naphtha that disappears when the victim gets fresh air) to serious and irreversible (liver or kidney damage from excessive exposures to chlorinated solvents). The toxic effects from chemical exposure depend on the severity of the exposures. Greater exposure and repeated exposure generally lead to more severe effects.

Exposure to toxic chemicals can occur by:

- Inhalation
- Dermal absorption
- Ingestion
- Injection

NOTE:
Inhalation and dermal absorption are the most common methods of chemical exposure in the workplace.

The following sections provide examples and safe handling guidelines for the following types of toxic chemicals:

- Toxicants
- Carcinogens
- Reproductive Toxins
- Sensitizers
- Irritants

IMPORTANT:
Minimize your exposure to any toxic chemical.

Acute toxins can cause severe injury or death as a result of short-term, high-level exposure.

Examples of acute toxins include the following:

- Hydrogen cyanide
- Hydrogen sulfide

Nitrogen dioxide
Ricin
Organophosphate pesticides
Arsenic

Do not work alone when handling acute toxins. Use a fume hood to ensure proper ventilation.

Chronic toxins cause severe injury after repeated exposure.

Examples of chronic toxins include the following:

Mercury
Lead
Formaldehyde

Carcinogens are materials that can cause cancer in humans or animals. Several agencies including OSHA, NIOSH, and IARC are responsible for identifying carcinogens. There are very few chemicals known to cause cancer in humans, but there are many suspected carcinogens and many substances with properties similar to known carcinogens.

Examples of known carcinogens include the following:

Asbestos
Benzene
Tobacco smoke
Chromium, hexavalent
Aflatoxins

Zero exposure should be the goal when working with known or suspected carcinogens. Workers who are routinely exposed to carcinogens should undergo periodic medical examinations.

Reproductive toxins are chemicals that can produce adverse effects in parents and developing embryos. Chemicals including heavy metals, some aromatic solvents (benzene, toluene, xylenes, etc.), and some therapeutic drugs are capable of causing these effects. In addition, the adverse reproductive potential of ionizing radiation and certain lifestyle factors, including excessive alcohol consumption, cigarette smoking, and the use of illicit drugs, are recognized.

While some factors are known to affect human reproduction, knowledge in this field (especially related to the male) is not as broadly developed as other areas of toxicology. In addition, the developing embryo is most vulnerable during the time before the mother knows she is pregnant. Therefore, it is prudent for all persons with reproductive potential to minimize chemical exposure.

Sensitizers may cause little or no reaction upon first exposure. Repeated exposures may result in severe allergic reactions.

Examples of sensitizers include the following:

Isocyanates
Nickel salts
Beryllium compounds
Formaldehyde
Diazomethane

Irritants cause reversible inflammation or irritation to the eyes, respiratory tract, skin, and mucous membranes. Irritants cause inflammation through long-term exposure or high concentration exposure. For the purpose of this section, irritants do not include corrosives.

Examples of irritants include the following:

Ammonia
Formaldehyde
Halogens
Sulfur dioxide
Poison ivy
Phosgene

Reactive chemicals are sensitive to either friction or shock or they react in the presence of air, water, light, or heat. Explosive chemicals decompose or burn very rapidly when subjected to shock or ignition. Reactive and explosive chemicals produce large amounts of heat and gas; they are extremely dangerous.

Many of the chemicals contained in cleaning agents are corrosive. Follow these guidelines when working with any cleaning agent:

* Always read and understand the label instructions or the MSDS before using any cleaning agent.
* Mix solutions to the recommended strength.
* When diluting acid with water, always add the acid to the water, not the water to the acid. (Concentrated acids may
 splatter when mixed improperly.)
* Wear appropriate eye protection and gloves for the job (e.g., neoprene, nitrile, or rubber).
* Do not leave aerosol cans in direct sunlight or areas where the temperature may exceed 120?F. Heated aerosol cans
 may explode.