Overview

Almost everyone works with or around chemicals and chemical products every day. Chemical safety is inherently linked to other safety issues including engineering controls, laboratory procedures, personal protective equipment, electrical safety, fire safety, and hazardous waste disposal. Many chemicals have properties that make them hazardous: they can represent physical hazards (fire, explosion) and/or health hazards (toxicity, chemical burns, and dangerous fumes). However, there are many ways to work with chemicals which can both reduce the probability of an accident and minimize the consequences 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 minimum quantity of material necessary, and/or substitution of less hazardous chemicals. 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 its intended use will dictate the precautions to be taken.

It is important to distinguish the difference between **hazard** and **risk**. The two terms are sometimes used as synonyms. In fact, the term 'hazard' is a much more complex concept because it includes conditions of use. The hazard presented by a chemical has two components: (1) its inherent capacity to do harm by 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 harmful consequence will occur. 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. It should be noted that not all chemicals are considered hazardous. Examples of nonhazardous chemicals include pH neutral buffers, sugars, starches, and naturally occurring amino acids.

CHEMICAL SAFETY GUIDELINES

Always follow these guidelines when working with chemicals:

- Assume that any unfamiliar chemical is hazardous and treat it as such.
- 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.
- Never underestimate the potential hazard of any chemical or combination of chemicals. Consider any mixture or reaction product to be at least as hazardous as – if not more hazardous than – its most hazardous component.
- Never use any substance that is not properly labeled. It may not be what you think it is!
- Date all chemicals when they are received and again when they are opened.
- Follow all chemical safety instructions, such as those listed in the Safety Data Sheets or on chemical container labels, precisely.
- Minimize your exposure to any chemical, regardless of its hazard rating, and avoid repeated exposure.
- Use personal protective equipment (PPE), as appropriate for that chemical.

- Use the buddy system when working with hazardous chemicals. Don't work in the lab alone.

SAFETY DATA SHEETS

Before using any chemical, read the appropriate Safety Data Sheet (SDS). An SDS is a document that details information about chemicals and along with the container label is a good source of information for chemical safety. It provides the following information in a 16-section format:

- Identification of chemical, manufacturer information, recommended use of chemical
- Hazard(s) identification
- Composition/Information on Ingredients
- First-Aid Measures
- Fire Fighting Measures
- Accidental Release Measures
- Handling and Storage
- Exposure Controls/Personal Protection
- Physical and Chemical Properties
- Stability and Reactivity
- Toxicological Information
- Ecological Information
- Disposal Considerations
- Transport Information
- Regulatory Information
- Other Information

Access SDS information at **safety.boeteams.com**

CHEMICAL LABORATORY SAFETY GUIDELINES

The following guidelines provide an overview of the areas to be considered during the planning and conduct of laboratory activities involving chemical usage.

GENERAL LABORATORY PRACTICES

- Mouth pipetting is prohibited.
- Required/appropriate caution and warning signs must be posted.
- Personnel working with extremely hazardous materials are prohibited from working alone in the laboratory. They should wash their hands frequently and before leaving the laboratory.

- Personnel are required to confine long hair, loose clothing, ties, jewelry, etc., when working in the laboratory.
- Glassware must be checked for cracks, sharp edges, and defects and discarded.
- The use of laboratory glassware, ice, chemical or other laboratory materials for human use/consumption is prohibited.
- Doors must be locked when the laboratory is unoccupied for extended periods of time.
- Storage of food and drink in laboratory refrigerators is prohibited.
- Eating and drinking are prohibited in the laboratory.

WORKING ENVIRONMENT

HOUSEKEEPING

- Working surfaces must be kept clean and orderly.
- Absorbent padding used on work surfaces must be changed regularly.
- Floors must be kept clean and clear of obstructions, slip and trip hazards.
- Adequate lighting must be provided for each task.

VENTILATION

- Local ventilation (i.e., dilution or exhaust) must be provided where necessary.
- Fume hoods should be used primarily for handling and not for storage of hazardous materials.
- Work within fume hoods should be conducted at least ~6 inches inside the front face of the hood.
- Materials that must be stored in fume hoods should be stored in secure and supported shelves.
- Fume hood air flows are to be measured at least semiannually by the Safety Department.
- Laboratory personnel should be aware of and respect notices posted on fume hoods concerning maintenance and repair activities.
- Unobstructed space should be available within and in front of the fume hood to allow sufficient air flow into the hood and access by all personnel.
- Portable non-exhausting fume hoods are not to be used to control fugitive emissions on a permanent basis.

CHEMICAL STORAGE GUIDELINES

Proper chemical storage is as important to safety as proper chemical handling. Often, seemingly logical storage ideas, such as placing chemicals in alphabetical order, may cause incompatible chemicals to be stored together. Follow these guidelines for safe chemical storage:

- Read chemical labels and the SDS for specific storage instructions.
- Store chemicals in a well-ventilated area; however, do not store chemicals in a fume hood.
- Date all chemicals when they are received and again when they are opened.
- Maintain an inventory of all chemicals in storage.

- Return chemical containers to their proper storage location after use.
- Store glass chemical containers so that they are unlikely to be broken. Glass containers should never be stored directly on the floor.
- Store all hazardous liquid chemicals below eye level of the shortest person working in the laboratory.
- Never store hazardous chemicals in a public area or corridor. Hazardous chemicals must be kept in a secured area.

In addition to the guidelines above, there are storage requirements for separating hazardous chemicals. Follow these guidelines to ensure that hazardous chemicals are stored safely:

- Group chemicals according to their hazard category (i.e., corrosives, flammables, toxins, etc.), not alphabetically, and separated by some sort of physical barrier. An alphabetical storage system may place incompatible chemicals next to each other.
- Separate acids from bases and inorganic acids or bases from organic acids or bases. Store these chemicals near floor level.
- Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked.
- Time-sensitive chemicals, such as those that form peroxides, should not be kept longer than twelve months from purchase or six months after opening.
- If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard (household style) refrigerator.
- Chemicals may be stored in the cabinets underneath a chemical fume hood provided the cabinetry is designed for that use.
    - Cabinetry designed for flammable storage vents into the fume hood exhaust duct.
    - Cabinetry designed for corrosives storage vents directly into the fume hood. Flammable chemicals should never be stored in this type of cabinets!
    - Some cabinetry is only designed for general storage or with a drying rack. These cabinets are not meant to be used for hazardous chemical storage.
- Flammables should be stored in a well-ventilated area and large quantities in a flammable storage cabinet.

GENERAL

- An inventory is to be maintained of all hazardous chemical, biological, and radioactive materials in the laboratory.
- All primary and secondary containers of hazardous materials must be properly labeled.
- Cabinets and shelves shall be secured and supported.
- Hazardous materials, especially liquids, are not to be stored at or above 5 feet.
- Large or heavy containers shall be confined to lower shelves.
- Protective edges are to be provided on laboratory bench island shelves.

- Catch trays shall be used for containment of hazardous liquids when necessary.
- Carrier buckets or carts with side rails should be used to transport chemicals.
- Containers of hazardous liquids (e.g., over 5 gallons) are not to be kept in the laboratory.
- Proper physical separation of incompatibles must be maintained (i.e., segregation of acids from bases and flammables from oxidizers).
- Chemical storage areas must be adequately ventilated.
- Face shields and/or suitable barriers are provided for work with highly reactive or explosive materials.

HYGIENE AND CHEMICAL SAFETY

Good personal hygiene will help minimize exposure to hazardous chemicals. When working with chemicals, follow these guidelines:

- Wash hands frequently and before leaving the laboratory. Also, wash hands before eating, drinking, smoking or applying makeup.
- Wear appropriate personal protective equipment (PPE). Always wear protective gloves when handling any hazardous chemicals.
- Remove PPE before leaving the laboratory and before washing hands.
- Remove contaminated clothing immediately. Do not use the clothing again until it has been properly decontaminated.
- Follow any special precautions for the chemicals in use.
- Do not eat, drink, smoke or apply makeup around chemicals.
- Tie back long hair when working in a laboratory or around hazardous chemicals.
- Do not keep food, beverages, or food and beverage containers anywhere near chemicals or in laboratories where chemicals are in use.
- Do not wash food and beverage utensils in a laboratory sink.
- Do not sniff or taste chemicals.
- Do not touch door knobs, telephones, computer keyboards, etc. with contaminated gloves.

COMPRESSED GASES

- The contents of all gas cylinders must be legibly identified.
- Fuel gases and oxygen cylinders must be stored separated.
- All gas cylinders should be secured against falling by the use of appropriate chains, clamps and/or brackets.
- Cylinders, when not in use, must always be shut off at the main valve stem and not through the use of regulators.
- Appropriate regulators are to be used to control gas flow from cylinders.
- Valve protection caps should be in place when cylinders are not in use and also during transport.

- Empty and full gas cylinders should be stored in separate storage areas.

EQUIPMENT

- Indicator lights on all equipment must be in working order.
- Operation manuals for all laboratory equipment must be provided if available.
- Protective guards are to be provided for machinery moving parts.
- Hoses and tubing must be free of cracks and abrasions.
- Electrical cords must be free of breaks, exposed wires, or poor insulation.
- Electrical equipment should not be operated in areas containing explosive vapors.
- Refrigerators are to be clearly labeled as either laboratory safe, explosion proof, or non-explosion proof.
- All electrical outlets and equipment must be grounded. Ground fault interrupters should be installed in all outlets within 6 feet of a water source.
- Overloading of circuits is prohibited.
- Electrical panels are to be identified and to be accessible.

PERSONAL PROTECTION AND EMERGENCY EQUIPMENT

- Personal protective equipment is to be made available for all laboratory personnel including appropriate eye and face protection, hand protection, foot protection, body protection and respiratory protection.
- Laboratory personnel are required to wear body, hand, and eye and face protection for all laboratory procedures involving hazardous materials.
- Water tap eye wash stations are to be made available in working order.
- Squeeze bottle type eye wash stations are prohibited in the laboratory.
- Safety showers and eye wash stations are to be accessible to all laboratory personnel.
- Spill control kits or suitable absorbents must be in each lab.
- A first aid kit is to be available in each lab.

OTHER REQUIREMENTS

Insubordination in regards to this standard will be dealt with as per Big Ox Energy - Riceville LLC's Disciplinary Program.