# Chapter 3: Safety

Every laboratory manager, laboratory technician, and operator must be committed to working in a safe and environmentally conscious manner. The lifestyle in a laboratory is a very structured one. Learning good safety practices is just as easy as learning bad safety practices. Certain codes of conduct pertaining to your safety and that of others must be observed at all times. Working in a wastewater treatment plant exposes the laboratory technician to a large variety of hazards such as

1. Weather
2. Hazardous chemicals
3. Biohazards
4. Electrical
5. Confined Space
6. Lifting/Back injury

## Weather Hazards

The laboratory technician must often collect samples in inclement weather. Lightning, wind, snow and rain often challenge the laboratory technician. Proper sample collection planning will help reduce the "hurry" associated with collecting samples in bad weather.

Lightning is a major component of storms. If caught outside during a lightning storm, seek proper shelter immediately. General safety tips regarding lightning include:

1. Immediately get away from ponds, clarifiers, aeration basins and other bodies of water.

2. Never use a tree as a shelter.

3. Avoid areas higher than the surrounding landscape such as tops of biotowers, clarifiers, and reservoirs.

4. Keep away from metal objects such as metal stairs and railings.

Strong winds with blowing dust may also be a frequent problem in New Mexico. Strong winds can occur at any time especially during the spring months. Wear appropriate clothing, dust masks, and protective eye equipment when collecting samples during a dust storm.

Snow and rain create the obvious safety hazard of slipping. Wet stairs, icy gratings and a technician carrying sampling equipment is a formula for disaster. In addition, stairways, railing, and gratings can be slippery even on a sunny day. Wastewater overspray from the aeration basin or other treatment units can often create a slipping hazard as well as a biohazard.

## Hazardous Chemicals

Chemical exposure is a serious hazard and may contribute to a variety of serious health effects such as heart ailments, kidney and lung damage, sterility, burns, and rashes. Chemicals also have the potential to cause fires, explosions, and other serious accidents. Because of the seriousness of these safety and health problems, the Occupational Safety and Health Administration (OSHA) has issued a standard entitled the Hazard Communication Act.

The purpose of the Hazard Communication Act is to insure that all chemicals used in the workplace are evaluated and the hazard information is transmitted to affected employers and exposed employees. Chemical manufacturers convey the hazard by means of a label on the container and a form called a Material Safety Data Sheets. (MSDS's) In addition, all covered employers are required to provide the information to their employees by means of container labeling, and other forms of warning, MSDS forms and training. This has been dubbed the "Right to Know Act". The employee has a right to know what hazards are in his/her work area.

## Written Hazard Communication Program

Employers (including lab managers) must develop, implement, and maintain at the workplace a written, comprehensive hazard communication program that includes provisions for container labeling, MSDS sheets, and an employee training program. The written program must contain a list of the hazardous chemicals in each work area and the means the employer will use to inform employees of the hazards.

### Labels

Chemical manufacturers must be sure that hazardous chemicals are labeled, tagged, or marked with the identity, appropriate hazard warnings, and the name and address of the manufacturer or other responsible party.

In the laboratory, each container must be labeled, tagged, or marked with the identity of the hazardous chemical and must show hazard warnings appropriate for employee protection. The warning can be any type of message, words, pictures or symbols that convey the hazard of the chemical. Hazardous chemicals removed from the original manufacturer's container must also be labeled. For instance, alcohol transferred from a large one gallon container into a small capped bottle must be labeled the same as the original container. The NFPA (National Fire Protection Association) labeling system is a good system for secondary labeling. The NFPA labeling system rates the hazards from 0 low to 4 high. Each chemical is divided into 4 categories - fire, reactivity, health (toxicity) and any specific hazard. The four categories are color coded to help segregate the chemicals properly. Don't be fooled by a low number such as 2. Anything labeled 2 or above is extremely dangerous and may pose life threatening conditions.

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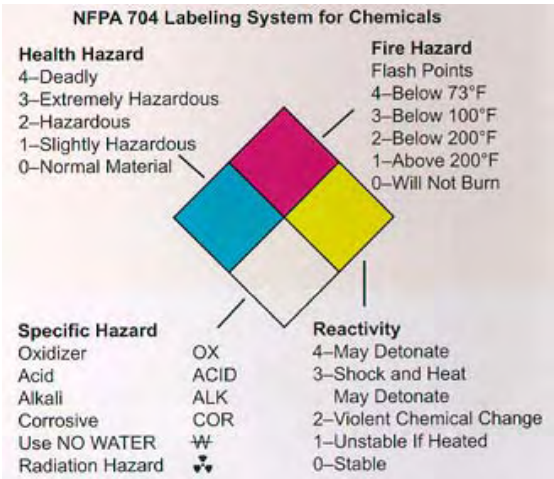



### Material Safety Data Sheets

MSDS sheets are provided by the manufacturer at the time of shipment. For laboratory chemicals the MSDS is a detailed reference for the chemical prepared by the manufacturer. It contains technical, safety and health information about the chemical. The MSDS document must be available to all people who utilize the laboratory including office personnel. All personnel must know what the MSDS is and where they are located. (Usually in the laboratory not the main office.) The laboratory manager is usually responsible for maintaining a set of MSDS sheets for hazardous materials used in the laboratory. Remember, each person using the laboratory has a "Right to Know" about the hazards they are exposed to and they should be readily available during each work shift.

### Chemical Storage

Storage of chemicals presents a safety problem to the lab technician because of the diverse characteristics of the chemicals used. There are oxidizers, corrosives, combustibles, carcinogenics, radioactives, water reactives, light reactives, and general non-reactive chemicals. OSHA regulations describe the proper storage procedures. Chemical suppliers label the chemicals as to their proper storage location. Ideally, storage cabinets should be in cool, well lighted, and well ventilated rooms, separate from laboratory itself. Chemicals

should be dated and inventoried when received and again when opened. Excess, out-dated, or unused chemicals should be discarded appropriately.

**Training**
Employers must establish a training and information program for employees exposed to hazardous chemicals in their work area at the time of initial hiring.

The employee training program must consist of:
1. A discussion of the hazard communication program.
2. How to read and interpret labels, MSDS forms, and how to use the available information.
3. The specific hazards of the chemicals in the work area.
4. Measures the lab technician can take to protect themselves from hazards.
5. Specific procedures required by the employer to provide protection such as work practices and the use of personnel protection equipment (PPE)
6. Methods and observations that the lab tech can take to detect the presence of hazardous conditions. (i.e. smell, color, gas production)

**Personal Protective Equipment**
Clothing is a critical factor in the safety of laboratory personnel. The lab technician must understand that failure to wear or failure of the PPE can cause life threatening conditions. At a minimum, lab technicians must wear:

1. Safety glasses must be worn at all times in areas where chemicals are being used. Splash goggles or face shields must be worn for protection from harmful chemical splash. Safety glasses must fit properly, not obscure the vision and be comfortable. Accidents may be caused by others working in the laboratory and directly impact the lab technician.

2. Pants, full coverage lab coats, aprons, or tyvek-type coveralls must be worn. Routine chemical and microbiological analysis often results in "micro" splashes. Wearing lab coats protects the lab technician and prevents taking the hazardous material home.

3. Protective gloves must be worn when the potential for contact with corrosive, toxic, or microbiological materials exists. Wastewater technicians are always exposed to microbiological hazards and wearing gloves is a must. Ideally, gloves should not be reused. They should be disinfected prior to removal then disposed of in the trash. Hands should be washed with disinfectant after removing the gloves.

4. Closed-toed shoes must be worn in areas where hazardous chemicals are used or stored.

## Biological Hazards
Wastewater laboratories are a great place to find microorganisms. Not only are the samples potential health hazards, but some tests actually grow bacteria. Safe handling of microbiological materials is very important to not only the lab technician but all others who enter the facility (including tour groups). The first barrier to microbiological exposure is disinfectant. The lab bench should be routinely and periodically disinfected. The disinfectant is usually left to dry on the lab bench. The second protection is rubber latex gloves and proper washing procedures. Finally, contaminated materials must be safely disposed of by sterilization before discarding in the trash. The autoclave is used to sterilize contaminated materials before disposal. A written record of the temperature, pressure and time of sterilization must be maintained. After proper sterilization, the materials can be discarded in the trash.

## Electrical Hazards
Water and electricity don't mix. While not a common hazard, the lab technician is exposed to electrical equipment both in the lab and in the treatment plant. A sampling plan should include an evaluation for electrical hazards. For

instance, will a metal pole be used to collect the sample around electrical equipment?

## Confined Space Entry

Confined space sampling is not a common activity for lab technicians but it may occur occasionally and the lab technician must know that specific procedures are required before entering a confined space. Confined space is defined as a space which has:

1. Limited means of entrance and exit
2. Is subject to the accumulation of toxic or flammable contaminants
3. is subject to the unanticipated introduction of liquids or solids
4. Has the potential of developing an oxygen-deficient atmosphere.

Common sources of confined space in wastewater treatment would be collection lines, deep lift stations, tanks, and possibly even pump pits.

A confined space entry procedure shall include the following essential features.

1. Permit systems
2. Testing and Monitoring
3. Labeling and Posting
4. Rescue procedures
5. Training

**Permit Systems**

Entry into a confined space is only allowed by permit authorized in writing by the employer. By completing the permit system, the lab technician will have evaluated the condition of the confined space. Typical permits will contain:

1. Location and description of work
2. Hazards that may exist
3. Isolation checklist
    a. Blank or disconnect
    b. Electrical lockout
    c. Mechanical lockout
4. Special clothing and equipment
    a. PPE
    b. Harness, lines, winch
    c. Tools or collection equipment needed
5. Atmospheric tests required before entry and re-entry
    a. oxygen level
    b. flammable or explosive levels
    c. Toxic substance levels
6. Training required and completed by the lab technician
7. Atmospheric control (ventilation) needed

**Testing and Monitoring**

Once the permit is completed and approved, entry is prohibited until the atmosphere has been tested and confirmed to be safe.

**Label and Post**

All entrances to any confined space shall be posted with a warning sign and copy of the authorizing permit.

**Rescue Procedures**

Rescue procedures shall be designed for each entry and for each participant: worker, standby person, rescue team. Safety equipment such as harnesses, lifelines, atmospheric monitoring equipment must be on site, must be in working condition and must be used if conditions indicate.

**Training**

It is the responsibility of the lab manager to assure that the lab personnel are trained appropriately in confined space entry. Training should include:

1. Rescue techniques and equipment
2. Use of respirators (SCBA)
3. Lockout/tag out procedures
4. Permit system
5. Atmospheric testing and monitoring equipment.

The lab manager should assure that each person is trained and reviewed annually. ***Training is not considered completed until the employee***

***demonstrates proficiency for entering and working in confined spaces. Records of the training must be maintained.***

## Lifting/Back Injury

Back injuries are among the majority of reported injuries. Proper sample planning will help reduce back injuries. One common source of back injury is the lifting of the composite sampler. There is a large difference between an empty and full composite sampler. Failure to use a hoist often results in back injuries. The following recommendations will help reduce back injury.

1. Loads over 25 pounds may require assistance
2. Lifting objects above your shoulder is risky
3. Position yourself so that the load is kept close to your body
4. Lift with your legs
5. Maintain your balance by placing one foot slightly ahead of the other.
6. Complete the lift before turning or twisting your torso with the load.

## General Lab Safety

Because the laboratory personnel are exposed to so many potential hazards, it is essential that all employees be empowered to recognize and remedy any safety problems. The following precautions should help reduce lab accidents.

1. First locate the safety equipment. Know where the fire extinguisher, safety shower, eye wash, fire blanket, first aid kit, and emergency exits are located.
2. Always wear safety glasses. Wear splash resistant goggles at all times. If prescription glasses are needed, purchase safety glasses that fit properly over the prescription glasses.
3. Long hair is a lab hazard. It may get caught in equipment, fall into hazardous chemicals, and may even catch fire in a Bunsen burner. Tie it back.
4. No horse play.
5. No eating, drinking, or smoking in the laboratory. Chemical dust and microorganisms are everywhere in the lab. Inadvertent ingestion of toxic materials can occur through something as simple as placing your pen in your mouth.
6. Do not use lab equipment to store, heat, or hold food or drink.
7. Add acid to water, never the reverse.
8. Assume all chemicals are toxic. Label all chemicals clearly. Never taste any chemical.
9. Discard unlabeled chemicals.
10. Open bottles that are under pressure by using a towel, i.e. Hydrochloric acid, ammonia.
11. Never smell a chemical directly. Use your hand to waft any odors to your nose to prevent damage to your nose and lungs.
12. Use bottle carriers to transport acids, bases, and toxics.
13. Chain gas cylinders. Keep caps on until the cylinder is needed.
14. Read the chemical label twice. There are many chemicals that look and sound similar. Pay particular attention to the suffix such as "ite", "ate", "ide" Using the wrong chemical may give a surprise!!
15. Never return chemicals to the stock bottle. It is better to remove only what you need. Any unused chemicals should be disposed of properly.
16. Broken or chipped glassware should be discarded or fire-polished. To avoid cuts from shattered glass on the floor, wear closed toed shoes. Sandals, flip flops, and old holy tennis shoes are not adequate protection.
17. Never pipet a solution by mouth. Always use a pipet bulb
18. Never open flammable liquids near an open flame. Vapors may escape and create a flash fire. Avoid storing solvents above eye level, or in refrigerators with other chemicals. An explosion proof refrigerator should be used if necessary.
19. Clean and disinfect all lab bench areas before and after use.
20. Always be a good housekeeper. Do not store things where they don't belong. Keep

aisles free from obstruction. Clean up broken glass and spills immediately.

## Safety Equipment

Once the safety equipment is located, it is important for all laboratory personnel to know its function and operation. Equipment that should be found in all laboratories includes:

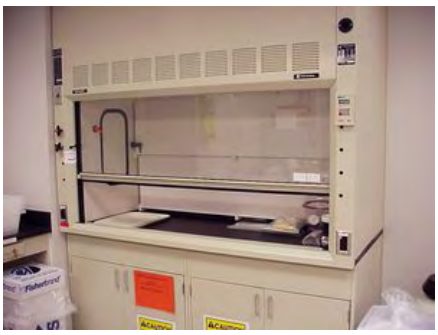
1. Fire extinguisher (ABC)
2. Fume hood
3. Safety shower
4. Eye wash
5. Fire blanket
6. Pipet bulbs

**Fire extinguisher**

The laboratory should be equipped with at least one ABC type fire extinguisher. It should be checked at least annually for proper operation and should always be replaced or recharged if it has been used. The lab manager should be sure all personnel have attended a fire extinguisher training program.

**Fume Hood**

A fume hood is used to remove toxic, flammable, and unpleasant vapors and dust. A hood should include a sink, water spigots, gas and electrical services. The hood is enclosed on 3 sides by a solid barrier and at the front by a safety glass shield which may be raised or lowered. To operate, simply turn on the fans and close the front shield to the desired level. The shield should be lowered far enough to protect the eyes against splashing or explosion. The air flow through the fume hood should be checked for proper operation annually. Fume hoods should not become storage facilities. Chemicals and equipment not in use should be removed from the fume hood.



**Safety Showers**

Emergency showers should be located in a conspicuous area which is quickly and readily reached from anywhere in the laboratory. The shower is activated by pulling on the chain or ring. Water will flow at a very high rate and continue to flow after you release the ring. Showers should be located away from electrical equipment and must have a large drain. In the event of an acid spill, affected clothing must be immediately removed and the area rinsed rapidly. An acid burn can be flushed with a 10-20% sodium bicarbonate solution to neutralize the acid. An alkali (base) burn can be flushed with a saturated solution of boric acid to neutralize the base. The boric acid or sodium bicarbonate should be rinsed off. The burned area should be covered with a dry sterile dressing and the victim transported to a hospital.

**Eyewash Station**

Eye washes are often incorporated with the emergency shower but may be found separately. The water from an eyewash should be at a moderate temperature, aerated, and in soft streams sufficient to wash the eyes without damaging the tissues. If a corrosive or irritating chemical gets into the eyes, the safety glasses should be removed and your face (eyes) placed directly in the streams of water. It is important that eyelids be held open with your hands to allow the water to get to the eye. The eyes should be rinsed a minimum of 15 minutes to thoroughly remove the irritant. The victim should be transported to the hospital for further treatment.

**Fire Blanket**
A fire blanket is used if a lab technician has caught fire. Follow the drop and roll procedure.

**Pipet Bulbs**
All pipets used for laboratory reagents, biological samples, or hazardous liquids should be filled using a pipet bulb to provide the necessary suction. A pipet bulb is a necessary safety device and should be insisted upon in all lab work. Pipet bulbs eliminate contact between the analyst's mouth and the pipet, thereby eliminating accidental aspiration or inhalation. Pipet bulbs are often contaminated, so they must be handled carefully. Be sure to clean any contaminated pipet bulb with distilled water. A pipet bulb with a leaking valve should be cleaned or replaced.

## First Aid
It is important that all lab personnel be aware of first aid measures which should be employed if an accident occurs. Chemical dangers may be in gas, liquid, or solid form. Gases represent the most serious, fastest acting hazard. Very short exposure time may be fatal. Toxic gases require ~~immediate~~ removal from the contaminated area. Gases may be light, heavy, toxic, corrosive, asphyxiating, nauseous, flammable, or explosive. It is important to know the type of gas. In all cases, get the victim to fresh air as soon as possible.

Liquid chemicals present the greatest danger to the eyes and skin. Liquids may splash into the eyes, burn the skin, or absorb through the skin and do internal damage. The most common liquids are the corrosives, acids and bases. Acids and bases must be handled with extreme caution. The addition of water to acid rather than acid to water may cause a violent splashing. Chemical burns are often not noticed until they have proceeded for a long time. If your skin feels sun burned, slippery, or itchy, your skin may be being chemically burned. These burns occur rapidly and are potentially fatal. In case of contact with corrosive liquids, the exposed area should ~~immediately~~ be flushed with copious amounts of water. If the eyes are involved, flushing should be continued for a minimum of 15 minutes and a physician should be called. Another common accident involving liquids occurs during mouth pipetting. Untrained or unskilled pipetters usually get some solution into their mouth. Do not allow any lab personnel to mouth pipet. Ingestion of acids, bases, or toxins can be debilitating and potentially fatal. Lab managers must insist on the use of pipet bulbs.

Solids are usually the least dangerous because the affected person usually has time to wash the material off. The major problem with solids is their slowness in reacting. The damage is not immediately noticed or the contact is not noticed at all. Chemical dust causes this type of problem. Inhalation of toxic dust may go entirely unnoticed until several years later when toxic threshold limits are finally reached. Respirators and fume hoods should be used when working with dusty materials especially carcinogens. First aid for skin contact consists of washing with large amounts of water and calling a physician.

***Safety: When in doubt, use the MSDS sheets to identify the type of potential hazard.***.

**First Aid Kit**
A first aid kit should be available to treat minor burns and cuts. Major accidents require an ambulance and physician care. All lab accidents should be reported to the lab manager and Risk Management Office for documentation. Claims for workman's compensation benefits may be denied if the accident is not reported within 24 hours.