Cascade Wastewater Treatment Plant Laboratory

Safety Standard Operating Procedure

Safety is just as important in the laboratory as in the rest of the treatment plant. State laws and the Occupational Safety and Health Act (OSHA) demand proper safety procedures to be exercised in the laboratory at all times. OSHA states that "each employer has the general duty to furnish all employees, employment free from recognized hazards causing, or likely to cause death or serious physical harm." This SOP provides information to those plant employees whose duties require them to be in the lab.

Personnel working in this wastewater treatment plant laboratory must realize that a number of hazardous materials and conditions exist. They must be alert, careful, and aware of potential dangers at all times. Safe practice in the laboratory requires hardly any more effort than unsafe practice, and the important results are prevention of injury or bodily damage.

Laboratory Hazards

Working with chemicals and other materials in the wastewater treatment plant laboratory can be dangerous. Dangers include:

- Infectious Materials
- Poisons
- Explosions
- Cuts and Bruises
- Electrical Shock
- Toxic Fumes
- Fire
- Burns

The above dangers to yourself and others can be minimized, however, by using proper techniques and equipment.

Wastewater and sludge contain biological organisms, some of which are infectious and dangerous and can cause diseases such as tetanus, typhoid, dysentery, and hepatitis. Personnel handling these materials should thoroughly wash their hands with soap and water, particularly before handling food or smoking. Special antibacterial soaps are present in the lab and in the plant restroom for this purpose. Additionally, lab personnel should make sure their immunizations are up to date.

To avoid exposure to potentially infectious bacterial material or dangerous chemicals, do not pipet **ANYTHING** by mouth. Pipet all samples and reagents by mechanical means (rubber pipet bulbs) to avoid taking a chance on severe illness, injury, or death.

Pipette Bulb

Never drink from a beaker or other laboratory glassware. A beaker left "specifically" for drinking is a menace in the laboratory.

Corrosive Chemicals

- **Acids**

Examples:

- Sulfuric acid - H_2SO_4
- Hydrochloric (or *muriatic*) acid - HCl
- Nitric acid - $HN0_3$
- Glacial acetic acid - $H_4C_20_2$
- Chromic acid - H_2CrO_4

Acids are extremely corrosive to human tissue, metals, clothing, wood, cement, stone, and concrete. A commercial spill clean-up kit is stored in the lab to neutralize acids in the event of an accidental spill.

Emergency Spill Kit

If the eyes or skin are exposed to acids, the body area must be flushed with large amounts of water IMMEDIATELY! Unless it is known for sure that no harm was done to the body, the person should seek medical attention. An eyewash station and emergency shower are available in the lab for this purpose. Preventing injury takes precedence over modesty in case of a major spill of acid on clothing (the same goes for bases such as sodium hydroxide).

Eyewash Station

Emergency Shower

- **Bases**

Examples:

- Sodium hydroxide (caustic soda or lye - NaOH),
- Potassium hydroxide (KOH),
- Alkaline iodine - sodium azide solution (used in the dissolved oxygen Winkler titration).

Bases are extremely corrosive to skin, clothing, and leather. A commercial spill cleanup kit is stored in the lab to neutralize bases acids in the event of an accidental spill. If the eyes or skin are exposed to strong bases, the body area must be flushed with large amounts of water IMMEDIATELY! Unless it is known for sure that no harm was done to the body, the person should seek medical attention. An eyewash station and emergency shower are available in the lab for this purpose.

- **Miscellaneous**

Examples:

- Chlorine (a gas which is very corrosive to the lungs)
- Ferric salts (ferric chloride), and
- Other strong oxidants such as potassium permanganate

Toxic Materials

- **Solids:** Cyanide, chromium, orthotolidine, cadmium, and other heavy metals.
- **Liquids**: Carbon tetrachloride, chloroform, ammonium hydroxide, nitric acid, bromine, chlorine water, aniline dyes, formaldehyde, and carbon disulfide. Carbon tetrachloride is absorbed into the skin on contact; its vapors will damage the lungs; and it will build up in

your body to a dangerous level.

- **Gases**: Hydrogen sulfide, chlorine, ammonia, chlorine, and sulfur dioxide.

Explosive or Flammable Materials

- **Liquids**: Carbon disulfide, benzene, ethyl ether, petroleum ether, acetone, and gasoline.
- **Gases**: Acetylene and hydrogen.

Personal Safety and Hygiene

• Laboratory Safety

Laboratory work can be dangerous if proper precautions and techniques are not taken. ALWAYS follow these basic rules:

1. NEVER work in the laboratory when you are the only person at the treatment plant, and when others are present in the plant, make sure they know you are working in the lab. Someone should always be available to help you in case you have an accident and need assistance.

2. Always wear protective goggles or eye glasses in the laboratory. Contact lenses should not be worn even under safety goggles because fumes can seep between the lens and the eyeball and irritate the eye.

Safety Goggles

3. A face shield should be worn if there is any danger of a hot liquid erupting from a container or flying pieces of glassware from an exploded apparatus. If in doubt as to its need - wear it!

Face Shield

4. Always wear a lab coat or apron in the laboratory to protect your skin and clothes.


Lab Apron


Lab Coat

5. Protective gloves should be worn when handling hot equipment or very cold objects, or when handling liquids or solids which are skin irritants.


Latex Gloves


Heat Resistant Gloves

6. Never eat or smoke in the laboratory. Never use laboratory glassware for serving food or drinks.


No Smoking


No Eating/Drinking

7. Do not keep your lunch in a refrigerator that is used for sample or chemical storage.

8. Good housekeeping is the best way to prevent accidents.

- **Personal Hygiene**

Although it is highly unlikely that personnel will contract diseases by working in this wastewater treatment plant, such a possibility does exist with certain diseases.

1. Some diseases are contracted through breaks in skin, cuts, or puncture wounds. In such cases the bacteria causing the disease may be covered over and trapped by flesh, creating a suitable ANAEROBIC ENVIRONMENT in which the bacteria may thrive and spread throughout the body.

For protection against diseases contracted through breaks in the skin, cuts, or puncture wounds, everyone working in or around wastewater must receive immunization for tetanus. Immunization must be received BEFORE the infection occurs. To prevent diseases from entering open wounds, care must be taken to keep wounds protected either with band aids or, if necessary, with rubber gloves or waterproof protective clothing.

2. Diseases that may be contracted through the gastrointestional system or through the mouth are typhoid, cholera, dysentery and amebiasis (both intestinal diseases), worms, salmonella, infectious hepatitis, and polio virus. These diseases are transmitted when the infected wastewater materials are ingested or swallowed by careless persons. The best protection against those diseases is furnished by THOROUGH CLEANSING. Hands, face, and body should be thoroughly washed with soap and water, particularly the hands, in order to prevent the transfer of any unsanitary materials or germs to the mouth while eating.

A change of working clothes into street clothes before leaving work is highly recommended to prevent carrying unsanitary materials to your home. Personal hygiene, thorough cleansing, and washing of the hands are effective means of protection.

Immunization is available for typhoid, polio and hepatitis B. Little is known about infectious hepatitis except that it can be transmitted by wastewater. Hepatitis is frequently associated with gross wastewater pollution.

3. Diseases that may be contracted by breathing contaminated air include tuberculosis, infectious hepatitis, and San Joaquin fever. There has been no past evidence to indicate the transmission of tuberculosis through the air at wastewater treatment plants. However, there was one case of tuberculosis being contracted by an employee who fell into wastewater and, while swimming to safety, inhaled wastewater into his lungs. San Joaquin fever is caused by a fungus which may be present in wastewater. However, there is no record of treatment plant operators contracting the disease while on the job.

The best insurance against these diseases is proper personal hygiene and immunization. This plant has an immunization program against (1) tetanus, (2) polio, and (3) hepatitis B. Immunization against typhoid will considered if the possibility exists that typhoid could be found in this area. The immunizations are provided to protect lab and plant personnel and also to preclude spread of disease to the comunity. Check with your local or state health department for recommendations regarding immunization.

In the washing of hands, the kind of soap is less important than the thorough use of the soap. (Special disinfectant soaps are not essential but they are available in the plant restroom.)

The use of protective clothing is very important, particularly gloves and boots. The protection of wounds and cuts is also important. Report injuries and take care of them. The responsibility rests upon YOU.

There is no absolute insurance against contraction of disease in a wastewater treatment plant. However, the likelihood of transmission is practically negligible. There appears to be no special risk in working at this treatment plant. In fact, operators may develop a natural immunity by working in this environment.

Prevention of Laboratory Accidents, First Aid

• Chemical Storage

An adequate storeroom for chemicals is essential for safety in a wastewater laboratory. The storeroom is properly ventilated and lighted and be laid out to segregate incompatible chemicals. Flammable liquids, acids, bases and oxidizing agents are separated from each other by distances, partitions or other means so as to prevent accidental contact between them. Order and cleanliness must be maintained. All chemicals and bottles or reagents are clearly labeled and dated. Never handle chemicals with bare hands. Use a spoon, spatula, or tongs.
Heavy items should be stored on or as near to the floor as possible. Volatile liquids which may escape as a gas, such as ether, must be kept away from heat sources, sunlight, and electrical switches.

Cylinders of gas in storage are capped and secured to prevent rolling or tipping. They are also placed away from any possible sources of heat or open flames.

Flammable gases are stored separately. The storage room is fitted with explosion-proof wiring and lighting fixtures. Appropriate warning signs prohibiting sources of ignition are posted in conspicuous locations.

The usual common sense rules of storage must be followed. Good housekeeping is a most significant contribution toward an active safety campaign.

• Movement of Chemicals

Transfer of chemicals, apparatus, gases, or other hazardous materials from the storeroom to the laboratory for use can be hazardous. To facilitate handling, carboys or other larger chemical vessels, cradles or tilters are used.

In transporting cylinders of compressed gases, a trussed handtruck is used. Never move or transport a cylinder without the valve protection hood in place. Never roll a cylinder by its valve. Immediately after they are positioned for use, cylinders must be clamped securely into place to prevent shifting or toppling.

Flammable liquids should be carried in safety cans or, in the case of reagent-grade chemicals, the bottle should be protected by a carrier. Protective gloves, safety shoes, and rubber aprons should be worn in case of accidental spilling of chemical containers.

- **Proper Laboratory Techniques**

Faulty technique is one of the chief causes of accidents and, because it involves the human element, is one of the most difficult to correct.

Because of their nature and prevalence in the laboratory, acids and other corrosive materials constitute a series of hazards ranging from poisoning, burning, and gassing, through explosion. Always flush the outsides of acid bottles before opening them. Do not lay the stopper down on the countertop where a person might lay a hand or rest an arm on it. Keep all acids tightly stoppered when not in use and make sure no spilled acid remains on the floor, table, or bottle after use. To avoid splashing, do NOT pour water into acid; ALWAYS POUR ACID INTO WATER.
Mercury requires special care. Even a small amount, such as from a broken thermometer, in the bottom of a drawer can poison the atmosphere in a room. After an accident involving mercury, the area should be gone over carefully until there are no globules remaining. Follow all of the safety requirements specified on the MSDS. All mercury containers should be kept well-stoppered. Mercury is bioaccumulative…small doses received over long periods of time can be harmful and potentially deadly.

ELECTRICAL SHOCK

Whenever there are electrical outlets, plugs, and wiring connections, there is a danger of electrical shock. The usual "do's" and "don'ts" of protection against shock in the home are equally applicable in the laboratory. Do not use worn or frayed wires. Replace connections, when there is any sign of thinning insulation. Ground all apparatus using plugs or pigtail adapters. Ground-fault circuit interrupters (GFIs) must be installed on all electrical circuits near laboratory sinks or liquid operations or activities. Do not continue to run a motor after liquid has spilled on it. Turn it off immediately and clean and dry the inside thoroughly before attempting to use it again.

Electrical units which are operated in an area exposed to flammable vapors should be explosion-proof. All permanent wiring should be installed by an electrician with proper conduit or BX cable to eliminate any danger of circuit overloading.

CUTS

Some of the pieces of glass used in the laboratory, such as glass tubing, thermometers, and funnels must be inserted through rubber stoppers. If the glass is forced through the hole in the stopper by applying a lot of pressure, the glass usually breaks. This is one of the most common sources of cuts in the laboratory.

Use care in making rubber-to-glass connections. Lengths of glass tubing should be supported while they are being inserted into rubber. The ends of the glass should be FLAME POLISHED and either wetted or covered with a lubricating jelly for ease in joining connections. Never use oil or grease. Gloves should be worn when making such

connections, and the tubing should be held as close to the end being inserted as possible to prevent bending or breaking.

Never try to force rubber tubing or stoppers from glassware. Cut off the rubber or material.

In case of a cut (or more serious injury) a first aid kit is available in the laboratory.

First Aid Kit

BURNS

All glassware and porcelain look cold after the glowing-red from heating has disappeared. The red is gone in seconds but the glass is hot enough to burn for several minutes. After heating a piece of glass, put it out of the way until cool.

Spattering from acids, caustic materials, and strong oxidizing solutions must be washed off immediately with large quantities of water. Every worker in the wastewater lab must have immediate access to the sink, emergency shower, and eye wash. Frequent drills are conducted to make sure each employee could find the sink/shower/eye wash in the confusion of an emergency.

Many safeguards against burns are available. Special gloves, safety tongs, aprons, and emergency deluge showers are but a few examples. Never decide it is too much trouble to put on a pair of gloves or use a pair of tongs to handle a dish or flask that has been heated.

Perhaps the most harmful and painful chemical burn occurs when small objects, chemicals of fumes get into your eye. You should immediately flood your eyes with water or a special "eye wash" solution from a safety kit or from an eyewash station or fountain. Washing with large amounts of water for at least 15 minutes is recommended.

TOXIC FUMES

Use a fume hood for routine reagent preparation or whenever handling substances which may generate harmful atmospheric contaminants. The face velocity of the lab fume hood should be checked annually to make sure it has an airflow of 100 to 150 FPM (feet per minute) with the hood completely open. If this flow cannot be achieved with the hood completely open, the sliding glass door should not be lifted above a marked line where the 100 – 150 FPM air flow CAN be achieved. Two strips of cloth are hung on the glass door to continuously indicate that air is flowing. If sufficient air flow cannot be maintained, lab staff should notify the plant supervisor who should coordinate with whatever officials are necessary to get it fixed.

WASTE DISPOSAL

A good safety program requires constant care in disposal of laboratory waste. Corrosive materials should never be poured down a sink or drain. These substances can corrode away the drain pipe and/or trap. Corrosive acids should be poured down corrosion-resistant sinks and sewers using large quantities of water to dilute and flush the acid.

Hazardous chemicals/substances must be disposed of by methods that comply with local environmental regulations. Confirm the local requirements BEFORE disposal.

To protect maintenance personnel, separate, covered containers should be used to dispose of broken glass.

FIRE

The laboratory is equipped with a fire blanket. The fire blanket is used to smother clothing fires.

Fire Blanket

Small fires which occur in an evaporating dish or beaker may be put out by covering the container with a glass plate, wet towel, or wet blanket. For larger fires, or ones which may spread rapidly, promptly use a fire extinguisher. Do not use a fire extinguisher on small beaker fires because the force of the spray will knock over the beaker and spread the fire. Lab staff must become familiar with the operation and use of the fire extinguisher BEFORE an emergency arises.

The use of the proper type extinguisher for each class of fire will give the best control of the situation and avoid compounding the problem. The class of fires given here is based on the type of material being consumed.

Class A Fires: (For wood, paper, textiles, and similar materials.) Use foam, water, carbon dioxide gas or almost any kind of extinguisher.

Class B Fires: (For grease, oil, paint, and related materials.) Use foam, dry chemical or vaporizing liquid extinguishers.

Class C Fires: (All fires in electrical equipment and in areas where live electricity is present.) Use carbon dioxide, dry chemical, or vaporizing liquid extinguishers only.

Class D Fires: (Fires involving sodium, zinc, magnesium, and other elements.) These fires should be smothered with fine dry soda ash, sand, or graphite.

An all purpose A - B - C chemical type extinguisher is available in the lab which should handle most laboratory fire situations. A "D" type will be purchased if future operations require the use of burning metals such as sodium.

“A-B-C” Fire Extinguisher