Standard Operating Procedure

Carbon Monoxide Gas

This is an SOP template and is not complete until: 1) lab specific information is entered into the box below 2) lab specific protocol/procedure is added to the protocol/procedure section and 3) SOP has been signed and dated by the PI and relevant lab personnel.

Print a copy and insert into your *Lab-Specific Chemical Hygiene Plan*.

Section 1 – Lab-Specific Information

Building/Room(s) covered by this SOP:	706
Department:	Chemical Engineering
Principal Investigator Name:	Zhiqiang Niu

Section 2 – Hazards

Carbon monoxide gas is a highly-flammable, compressed gas. It may form explosive mixtures with air. It is colorless, odorless and tasteless, and can be asphyxiating even with adequate oxygen present. It is highly toxic/poisonous and binds to myoglobin and mitochondrial cytochrome oxidase. Containers may rupture or explode if exposed to heat. It is highly recommended that oxygen cylinders in storage be separated from carbon monoxide or other fuel-gas cylinders or combustible materials (especially oil or grease) by a minimum distance of 20 feet or by a non-combustible barrier at least five feet high and with a fire resistance rating of least one-half hour. Furthermore, the barrier should be at least 18 inches above the tallest cylinder. In simple words, DO NOT store carbon monoxide and oxygen/other oxidizing gases, oxidizing materials together.

Section 3 – Engineering Controls and Personal Protective Equipment (PPE)

Engineering Controls: Use of carbon monoxide gas must be conducted in a properly functioning gas cabinet or chemical fume hood. The chemical fume hood must be approved and certified by REM and have a face velocity between 80 – 125 feet per minute.

Hygiene Measures: Avoid contact with skin, eyes, and clothing. Wash hands before breaks and immediately after handling the product.

Hand Protection: Chemical-resistant gloves must be worn, nitrile gloves are recommended. Wearing two pairs of nitrile gloves is recommended. **NOTE:** Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the specific chemical being used.

Eye Protection: ANSI approved properly fitting safety glasses or chemical splash goggles are required. A face shield may also be appropriate depending on the specific application.

Skin and Body Protection: Flame resistant laboratory coats must be worn and be appropriately sized for the individual and buttoned to their full length. Personnel must also wear full length pants, or equivalent, and close-toed shoes. Full length pants and close-toed shoes must be worn at all times by all individuals that are occupying the laboratory area. The area of skin between the shoe and ankle must not be exposed.

Respiratory Protection: Carbon monoxide gas should never be used outside of a contained unit (i.e., glove box, chemical fume hood, or gas cabinet); therefore respiratory protection should not be required.

Section 4 – Special Handling and Storage Requirements

Safety can be achieved while handling carbon monoxide gas by adhering to the below mentioned protocols, *but not limited to the following*;

- If compressed gas cylinder holding metal rack is used to restrain the cylinders, the rack must be bolted to the floor and the chains or rods must be at 1/3rd from the bottom and 1/3rd from the top of the cylinders. Clam shell (a cylindrical metal casing bolted to the floor) can be used to secure cylinders that need to be stored and used next to the experimental set-up.
- Always use Stainless Steel (SS) tubing to convey carbon monoxide gas. Teflon tubing is okay *if* specified by the manufacturer.
- Remove the regulator and place the safety cap on, when the cylinder is not in constant use.
- Carbon monoxide gas leak detector installation is recommended.
- Prevent carbon monoxide leaks by meticulously connecting gas regulator and tubing.
- Keep constant vigilance to immediately detect accidental leaks.
- Prevent accumulations of leaked carbon monoxide using plentiful ventilation.
- Eliminate likely ignition sources, and suspect unknown ignition sources.
- Store carbon monoxide gas cylinders away from electrical panels and emergency eyewash & safety shower.
- Always assume carbon monoxide is present, and verify the system has been purged to less than 1 percent when performing system maintenance on a carbon monoxide system. Inert gases such as Nitrogen & Argon can be used for purging.
- Always assume oxygen is present, and verify the system has been purged to the appropriate level when reintroducing carbon monoxide into a system.
- Have a lab buddy system in place when working with highly flammable gases such as carbon monoxide
- All users must have had hands-on training to work with highly flammable gases. The training must be documented.
- Lab personnel handling highly flammable gases must have easy access to an Emergency Eyewash & Safety Shower within 10 seconds (i.e., travel distance no greater than 100 feet).

Section 5 – Spill and Accident Procedures

In the event of a CO leak, take the following immediate actions:

- Evacuate the Area: Quickly evacuate personnel from the affected area to prevent CO exposure. Ensure that individuals move to a well-ventilated location.
- Ventilation: Increase ventilation in the area by opening doors and windows or using mechanical ventilation systems to disperse the gas.

- Emergency Shutoff: If safe to do so, close the valve on the leaking CO tank or cylinder to stop the flow of gas. Use appropriate tools and PPE to avoid injury.
- Alert Emergency Services: Contact emergency services and report the incident, providing details about the location, the amount of CO released, and any potential
- injuries.
- First Aid: Provide first aid to anyone who has been exposed to CO. Move the affected person to fresh air, monitor their breathing, and provide CPR if necessary. Seek medical attention immediately

Section 6 – Waste Disposal Procedures

Store hazardous waste in closed containers that are properly labeled, and in a designated area (flammable cabinet is recommended) away from incompatible chemicals such as aqueous solutions. Complete a Chemical Waste Pickup Request Form to arrange for disposal by REM; detailed instructions are provided at the following link: http://www.purdue.edu/ehps/rem/hmm/chemwaste.htm.

Section 7 – Protocol (Add lab specific Protocol here)

Click here to enter text.

NOTE: Any deviation from this SOP requires approval from Principal Investigator.

Section 8 – Documentation of Training (signature of all users is required)

Prior to conducting any work with carbon monoxide gas, the Principal Investigator must ensure that all laboratory personnel receive training on the content of this SOP.

I have read and understand the content of this SOP:

Name	Signature	Date
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