Standard Operating Procedures

Strong Corrosives - Strong Acids (SA)

Sulfuric Acid

Print a copy and insert into your laboratory SOP binder.

<table>
<thead>
<tr>
<th>Department:</th>
<th>Chemistry</th>
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<tbody>
<tr>
<td>Date SOP was written:</td>
<td>June 11, 2013</td>
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<tr>
<td>Date SOP was approved by PI/lab supervisor:</td>
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<tr>
<td>Principal Investigator:</td>
<td>Name: Richmond Sarpong</td>
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<td></td>
<td>Signature: ____________________________</td>
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<tr>
<td>Internal Lab Safety Coordinator or Lab Manager:</td>
<td>Name: Rebecca Murphy</td>
</tr>
<tr>
<td></td>
<td>Lab Phone: 510-643-2485</td>
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<tr>
<td></td>
<td>Office Phone: 510-642-6312</td>
</tr>
<tr>
<td>Emergency Contact:</td>
<td>Name: Richmond Sarpong</td>
</tr>
<tr>
<td></td>
<td>Phone Number: 626-644-2407</td>
</tr>
<tr>
<td>Location(s) covered by this SOP:</td>
<td>Latimer Hall: 834, 836, 837, 838, 839, 842, 847, 849, 907</td>
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</table>

1 - Purpose

This SOP covers the precautions and safe handling procedures for the use of Sulfuric Acid in the Sarpong group, which include the following uses:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Use</th>
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<tbody>
<tr>
<td>Sulfuric Acid</td>
<td>1. Sulfuric acid is a reagent used in organic reactions, and is a strong, corrosive acid and dehydrating agent.</td>
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</table>

2 - Physical & Chemical Properties/Definition of Chemical Group

CAS#: 7664-93-9
Molecular Formula: H₂SO₄
Form: Liquid
Color: Clear, colorless to slightly yellow
Melting point/freezing point: 3 °C (37 °F)
Boiling point: 290 °C (554 °F) - lit.
Vapor pressure: 1.33 hPa (1.00 mmHg) at 145.8 °C (294.4 °F)
Density: 1.84 g/cm³ at 25 °C (77 °F)
Flash point: not applicable
Lower explosion limit: no data available
Upper explosion limit: no data available
Odor: no data available

6/11/2013
Odor Threshold: no data available

3 - Potential Hazards/Toxicity

GHS Classification
Skin corrosion (Category 1A)
Serious eye damage (Category 1)
Acute aquatic toxicity (Category 3)

GHS Label elements, including precautionary statements

Pictogram
Signal word Danger

Hazard statement(s)
H314 Causes severe skin burns and eye damage.
H402 Harmful to aquatic life.

Precautionary statement(s)
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/ physician.

Cal/OSHA Permissible Exposure Limits (PEL): 0.1 mg/m³ TWA; 3 mg/m³ STEL

4 - Engineering Controls

Use the engineering controls listed below unless other lab-specific information is included in the Protocol/Procedure section.

- A laboratory type fume hood with the sash position closed as much as possible;
- A glove box for pyrophorics and water reactive chemicals. Glove boxes may also be required for other chemicals, such as regulated carcinogens and particularly hazardous substances;
- Supplemental protective equipment like a blast shield, where appropriate, to protect from explosions when using peroxide formers, pyrophorics, water reactives, and potentially explosive chemicals.

5 - Personal Protective Equipment

For additional information on PPE requirements, go to:
http://cehss.berkeley.edu/section5#Personnel_Protective_Equipment_Required_in_College_Laboratories

Use the PPE listed below unless other lab-specific information is included in the Protocol/Procedure section.

Eye and Face Protection

ANSI-approved safety glasses with side shields or chemical splash goggles must be worn at all times when handling chemicals in the lab.
Skin and Body Protection

1. Gloves are required when handling hazardous chemicals.
   a. Specific glove type recommendations are provided in the Protocol/Procedure section.
   b. Inspect gloves prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Wash and dry hands after handling chemicals, before breaks, and at the end of the workday.
   c. For additional information on glove selection, go to:

2. Lab coats are required when handling hazardous chemicals in the lab.
   a. Nomex 3A flame-resistant lab coats are required when working with pyrophorics (H250) and explosives (H200, H201, H202, H203)
   b. Flame resistant lab coats (Nomex or other material) should be worn when working with materials such as Category 1 or 2 flammable liquids (H224 and H225).

3. Cotton-based, non-synthetic clothing (including long pants; no skin exposed below the waist) should be worn.

4. Closed-toe and closed-heel shoes are required in the lab.

Respiratory Protection

Respiratory protection is normally not required for UC Berkeley laboratory activities. Any lab personnel considering the use of a respirator must contact EH&S for a workplace assessment. Respirator users will be provided with specific instructions if a respirator is deemed necessary by EH&S.

6 - First Aid Procedures and Medical Emergencies

Notify supervisor and EH&S immediately. Follow up with a call to 510-642-9090 to report the incident.

Life Threatening Emergency, After Hours, Weekends and Holidays – Call 911 or go to the nearest emergency room. Note: All serious injuries must be reported to EH&S within 8 hours. Follow up with a call to 510-642-9090 to report the incident.

Assess the extent of danger. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible, help contaminated or injured persons. Obtain medical attention for the individual as soon as possible by calling 911. Provide a copy of the appropriate SDS to the emergency responders or physician, as needed.

If inhaled

Move into fresh air. Go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room. If person is not breathing, call 911 and give artificial respiration. If unconscious, call 911.

In case of skin contact

Immediately flush with flowing water for no less than 15 minutes; remove any jewelry or clothing as necessary to facilitate clearing of any residual materials. Wash off with soap and plenty of water for 15 minutes. If skin contact requires medical assistance, go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room. If this is a large or serious injury, call 911.

In case of eye contact

Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible. Call 911.
If swallowed

Call 911. Do not induce vomiting unless directed otherwise by the SDS. Never give anything by mouth to an unconscious person. Rinse mouth with water. Go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room.

Needle stick/puncture exposure

Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure such as eyes, mouth and/or nose, flush the affected area for 15 minutes using an eyewash station. Go to the Occupational Health Facility (Tang Health Center) and after hours, go to the nearest emergency room.

All needle stick/puncture exposures must be reported to EH&S within 8 hours. Follow up with a call to 510-642-9090 to report the incident.

7 - Special Handling and Storage Requirements

Lab-specific information on handling and storage may be included in the Protocol/Procedure section.

Working alone - Certain extremely hazardous operations should not be performed if the PI or Lab Safety Contact(s) are not present. Never work alone with extremely hazardous materials/operations. See the Protocol/Procedure section below for specific prohibitions (if any) on working alone.

Precautions for safe handling

- Avoid contact with skin and eyes. Avoid formation of vapors, dusts, mists and aerosols.
- Use appropriate exhaust ventilation.
- Use appropriate personal protective equipment.
- Remove incompatible chemicals from immediate work area.
- Keep flammable, pyrophoric, potentially explosive and water reactive chemicals away from sources of ignition
- Use care when preparing chemical solutions.

Conditions for safe storage

- Keep quantities to a minimum.
- Keep containers tightly closed and in a cool, dry and well-ventilated location.
- Keep in proper storage cabinets and shelving. Use lowest shelf as possible.
- Assure chemicals are properly labeled.
- Segregate incompatible chemicals.
- Store carcinogens in a designated area.
- Provide secondary containment for chemicals in accordance with the ccEHS "Chemical Hygiene Plan": http://cehhs.berkeley.edu/section5#Chemical_Handling_Storage_and_Transportation

8 - Chemical Spill

Spill – Assess the extent of danger; if necessary request help by calling 911 and 510-642-9090. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors from spill. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Minor Spill – In the event of a minor spill, if there is no potential for hazardous chemical exposure, report the spill to 510-642-9090 and proceed to clean it, if you are trained. Use appropriate protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up location.
Call 510-642-9090 to report the spill to ccEHSS and for assistance.

**Major Spill** – Any hazardous chemical spill that involves chemical exposure, any chemical spill that due to size and/or hazard requires capabilities beyond your training, or any chemical spill that gives the perception (because of odor, for example) that there has been a hazardous release.

Call **911** and 510-642-9090 to report the spill to ccEHSS and for assistance.

**9 - Cleaning and Decontamination**

Lab-specific information on decontamination may be included in the Protocol/Procedure section.

- Wearing proper PPE, laboratory work surfaces should be cleaned at the end of each work day.
- Dispose of contaminated materials in accordance with hazardous waste disposal guidelines referenced below.
- Decontaminate all equipment before removing from a designated area.

**10 - Hazardous Waste Disposal**

Label Waste

Label all containers with the label provided at:


See the EH&S Fact Sheet, “Hazardous Waste Management” for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

- Dispose of regularly generated chemical waste within 6 months.
- Call EH&S with questions.

**11 - Safety Data Sheet (SDS) Location**

SDS can be accessed online at [http://ucmsds.com](http://ucmsds.com)
### 12 - Protocol/Procedure – Sulfuric Acid

<table>
<thead>
<tr>
<th>Preparation</th>
<th>Know the location of the nearest fire extinguisher, eyewash, and safety shower before beginning work. Eliminate incompatible materials from potential spill area.</th>
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<tbody>
<tr>
<td>Chemical Storage and Disposal</td>
<td>Keep containers tightly closed and in a cool, dry and well-ventilated location. Keep in proper storage cabinets and shelving. Assure chemicals are properly labeled. Segregate incompatible chemicals, such as metals, oxidizing agents, reducing agents, bases, acrylonitrile, chlorates, finely powdered metals, nitrates, perchlorates, permanganates, epichlorohydrin, aniline, carbides, fulminates, picrates, organic materials, and flammable liquids.</td>
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<tr>
<td>Lab-specific Information</td>
<td><strong>Never</strong> work alone. When working with concentrated H₂SO₄, make sure there is another worker present who is also trained in the sulfuric acid SOP.</td>
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<table>
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<tr>
<th>Procedure/Use</th>
<th>Scale</th>
<th>Engineering Controls/Equipment</th>
<th>PPE (eye, face, gloves, clothing)</th>
<th>Procedure Steps and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sulfuric acid is a reagent used in organic reactions, and is a strong, corrosive acid and dehydrating agent.</td>
<td>&lt;1mL up to 1L used (concentrated sulfuric acid &amp; diluted solutions)</td>
<td>All work using sulfuric acid must be performed in a ventilated fume hood. <strong>Eye protection:</strong> Wear tight-fitting safety goggles or safety glasses with side shields. <strong>Face protection:</strong> Wear a face shield when not protected by a lab hood sash. <strong>Gloves:</strong> Wear Butyl or Butyl/Viton gloves when handling sulfuric acid. Remove gloves as soon as contaminated.</td>
<td>When working with concentrated sulfuric acid, it is important to make sure the work area is free of any bases which may react violently with the acid. When diluting sulfuric acid with water, the concentrated sulfuric acid should be added slowly to water to minimize the exothermic nature of the reaction and any dangers from splashing.</td>
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<tr>
<td>Notes</td>
<td>Any deviation from this SOP requires approval from PI.</td>
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**Clothing:** Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear acid resistant apron when pouring concentrated sulfuric acid.
Sarpong Group Notes for Sulfuric Acid

Sulfuric acid (alternative spelling sulphuric acid) is a highly corrosive mineral acid. The historical name of this acid is oil of vitriol. Possessing different chemical properties, the sulfuric acid has a wide range of applications including domestic acidic drain cleaner, electrolyte in lead-acid batteries and various cleaning agents. It is also a central substance in the chemical industry. Principal uses include mineral processing, fertilizer manufacturing, oil refining, wastewater processing, and chemical synthesis.

It is a diprotic acid which may show different properties depending upon its concentration. Its corrosiveness on metals, stones, skin, eyes and flesh or other materials can be mainly ascribed to its strong acidic nature and if concentrated strong dehydrating property and strong oxidizing property. Concentrated sulfuric acid can cause very serious damage upon contact as not only does it hydrolyze proteins and lipids, leading to chemical burn, but it also dehydrates carbohydrates posing secondary thermal burn. Permanent blindness can result if it contacts eyes. So, safety precautions should be done when using it. Moreover, it is hygroscopic which readily absorbs water vapor in air.

Potential Hazards/Toxicity
Sulfuric acid is a highly corrosive chemical. Inhalation may cause irritation to the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Contact with skin causes burns and irritation. Eye contact causes burns, irritation, a may cause blindness. Ingestion may cause permanent damage to the digestive tract.

Acute toxicity: Oral LD50 [rat] – 2140 mg/kg

CalOSHA Permissible Exposure Limit (PEL) - 0.1 mg/m³, 3 mg/m³ STEL

California Proposition 65: Strong inorganic acid mists containing sulfuric acid are listed as carcinogenic.

Precautions for safe handling
Do not allow water to get into the container because of violent reaction. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Use only with adequate ventilation. Do not breathe spray or mist. Do not use with metal spatula or other metal items. Inform laundry personnel of contaminant's hazards. When diluting sulfuric acid, always add acid (slowly) to cooled water. Never add water to acid.

Conditions for safe storage
Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, and well-ventilated area, away from incompatible substances. Do not store near alkaline substances. Store protected from moisture. Ideally, sulfuric acid should be stored in isolation from all other chemicals in an approved acid or corrosives safety cabinet. Sulfuric Acid is incompatible with metals, oxidizing agents, reducing agents, bases, acrylonitrile, chlorates, finely powdered metals, nitrates, perchlorates, permanganates, epichlorohydrin, aniline, carbides, fulminates, picrates, organic materials, flammable liquids.
13 - Documentation of Training (signature of all users is required)

- Prior to conducting any work with sulfuric acid, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.

- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.

I have read and understand the content of this SOP:

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<tr>
<th>Name</th>
<th>Signature</th>
<th>Identifier</th>
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