Standard Operating Procedures

Peroxide Forming Chemicals (PFC) – Class 3

Acrylic Acid

Print a copy and insert into your laboratory SOP binder.

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<th>Department:</th>
<th>Chemistry</th>
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<tr>
<td>Date SOP was written:</td>
<td>June 14, 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>Signature:</td>
<td>______________________________</td>
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<tr>
<td>Internal Lab Safety Coordinator or Lab Manager:</td>
<td>Name: Rebecca Murphy</td>
</tr>
<tr>
<td>Lab Phone:</td>
<td>510-643-2485</td>
</tr>
<tr>
<td>Office Phone:</td>
<td>510-642-6312</td>
</tr>
<tr>
<td>Emergency Contact:</td>
<td>Name: Richmond Sarpong</td>
</tr>
<tr>
<td>Phone Number:</td>
<td>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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1 - Purpose

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

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<th>Chemical</th>
<th>Use</th>
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<td>Acrylic Acid</td>
<td>1. Use of acrylic acid in an experiment.</td>
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2 - Physical & Chemical Properties/Definition of Chemical Group

CAS#: 79-10-7
Molecular Formula: C₃H₄O₂
Form: liquid,
Color: colorless
Melting point/freezing point: 13 °C (55 °F) - lit.
Boiling point: 139 °C (282 °F) - lit.
Vapor pressure: 5 hPa (4 mmHg) at 20 °C (68 °F)
Density: 1.051 g/cm³ at 25 °C (77 °F)
Flash point: 46 °C (115 °F) - closed cup
Lower explosion limit: 2 % (V)
Upper explosion limit: 13.7 % (V)
Odor: acrid
Odor Threshold: no data available

3 - Potential Hazards/Toxicity

GHS Classification
- Flammable liquids (Category 3)
- Acute toxicity, Oral (Category 4)
- Acute toxicity, Inhalation (Category 4)
- Acute toxicity, Dermal (Category 5)
- Skin corrosion (Category 1A)
- Serious eye damage (Category 1)
- Specific target organ toxicity - single exposure (Category 3)
- Acute aquatic toxicity (Category 1)

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
- H226 Flammable liquid and vapor.
- H302 + H332 Harmful if swallowed or if inhaled
- H313 May be harmful in contact with skin.
- H314 Causes severe skin burns and eye damage.
- H335 May cause respiratory irritation.
- H400 Very toxic to aquatic life.

Precautionary statement(s)
- P261 Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
- P273 Avoid release to the environment.
- 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): 2 ppm (5.9 mg/m³) – 8 hour TWA (Skin Notation)

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://ceehs.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 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://ccehss.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 personal 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
12 - Protocol/Procedure – Acrylic Acid

| Preparation | Know the location of the nearest fire extinguisher, eyewash, and safety shower before beginning work. Never open a dented or otherwise compromised container of Acrylic Acid. Alert lab safety contact immediately. Eliminate incompatible materials (e.g. strong oxidizing agents, strong bases, polymerizing initiators and peroxides) from potential spill area. Reacts violently in contact with acids, amines, driers, polymerization accelerators and easily oxidized materials. Polymerization can occur. Eliminate ignition sources such as open flames, hot surfaces, steam baths, and static electricity. Never work alone. Make sure there is another worker present who is also trained in the use of Acrylic Acid. |
| Chemical Storage and Disposal | **Storage** Store containers in an approved area, such as a ventilated flammable storage cabinet. Segregate from incompatible materials (e.g. strong oxidizing agents, strong bases, polymerizing initiators and peroxides). Keep containers in a cool, dry, well-ventilated area. Avoid all possible sources of ignition (spark or flame). Protect from flames, static electricity and sources of heat. Prolonged exposure to air and light may form unstable explosive peroxides unless inhibited against peroxide formation. Store and transport containers in secondary containment (for example polyethylene bottle carrier). Keep storage containers closed (air tight) when not in use. Purchase acrylic acid with inhibitors added, when possible. Due to its peroxide-forming hazard, acrylic acid containers must be dated upon receipt and at the time they are opened (mark the date on the bottle). If tested, note the date it was tested on the bottle. Unopened containers of acrylic acid have a maximum shelf life of 18 months. Opened containers of acrylic acid have a maximum shelf life of 12 months if inhibited, and 24 hours if uninhibited. Dispose of unused amounts after reaching the maximum shelf life (or if polymerization has occurred). Store opened containers of acrylic acid in inhibited condition and under air (inhibitor is activated by oxygen) to prevent premature polymerization. Do not store opened containers of acrylic acid under an inert atmosphere. **Disposal** Acrylic acid waste is considered hazardous. Collect all liquid waste in labeled 1 gallon plastic containers. Store hazardous waste in closed containers, in secondary containment and in a designated location. Mix ONLY with compatible waste streams, such as other organic solvents. |
### Procedure Steps and Precautions

1. **Use of acrylic acid in an experiment**

   **Scale:** Up to 50 mL of neat acrylic acid.

   **Engineering Controls/Equipment:** All work using Acrylic Acid must be performed in a ventilated fume hood cleared of incompatible materials. Eliminate ignition sources such as open flames, hot surfaces, steam baths, static electricity, and operation of mechanical and electrical equipment that is not intrinsically safe. Ensure proper grounding and avoid creating static electricity. Be sure to ground metal containers when transferring flammable liquids.

   **PPE (eye, face, gloves, clothing):**
   - **Eye protection:** Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.
   - **Face protection:** Wear a face shield when handling containers of Acrylic Acid that are not behind a lab hood sash or blast shield.
   - **Gloves:** Wear nitrile, neoprene or natural rubber gloves when handling acrylic acid. Remove gloves when contaminated.
   - **Clothing:** Wear flame resistant lab coat; cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.

   **Procedure Steps and Precautions:**
   - Acrylic acid readily polymerizes without a stabilizer/peroxide inhibitor. Spontaneous polymerization of acrylic acid is highly exothermic and violent. These stabilizers require oxygen to function, thus acrylic acid should never be used in an inert atmosphere.
   - Check the bottle before usage for evidence of polymerization. If gel or solid materials are present, request pickup by EH&S.
   - Using Schlenk techniques, transfer the desired amount of acrylic acid to the reaction vessel.
   - Dispose of all contaminated material according to the waste disposal protocol.
Sarpong Group Notes for Acrylic Acid

Acrylic acid is a flammable liquid that is also an irritant, and corrosive. Acrylic acid is a hazard due to peroxide initiation of polymerization. It is generally used as a monomer for radical polymerizations. This compound should be inspected prior to use for peroxide crystals that may have collected around the cap, on the inside, or on the outside of the bottle by a starch iodide test paper. Acrylic acid should be labeled as a “peroxide forming chemical”.

Potential Hazards/Toxicity

**Acute toxicity**

**Oral LD50**
LD50 Oral - mouse - 830 mg/kg

**Inhalation LC50**
LC50 Inhalation - rat - 4 h - > 5,100 mg/m3

**Dermal LD50**
LD50 Dermal - rabbit - > 2,000 mg/kg

**Skin corrosion/irritation**
Skin - rabbit - Severe skin irritation - 24 h

**Serious eye damage/eye irritation**
Eyes - rabbit - Severe eye irritation

**Respiratory or skin sensitization**
guinea pig - Did not cause sensitization on laboratory animals.

**Germ cell mutagenicity**
Laboratory experiments have shown mutagenic effects.

**Specific target organ toxicity - single exposure (Globally Harmonized System)**
Inhalation - May cause respiratory irritation. - Respiratory system

**Specific target organ toxicity - repeated exposure (Globally Harmonized System)**
no data available

**Aspiration hazard**
no data available

**Potential health effects**

**Inhalation** May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.

**Ingestion** Harmful if swallowed.

**Skin** Harmful if absorbed through skin. Causes skin burns.

**Eyes** Causes eye burns. Causes severe eye burns.

**Signs and Symptoms of Exposure**
burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.
Hand Protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Immersion protection Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: > 480 min
Material tested: Butoject® (Aldrich Z677647, Size M)

Splash protection
Material: Nitrile rubber
Minimum layer thickness: 0.2 mm
Break through time: > 30 min
Material tested: Dermatril® P (Aldrich Z677388, Size M)

Data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 873000, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Decontamination/Waste Disposal Procedure

Drain disposal of chemicals is strictly prohibited. Empty containers of acrylic acid can still pose a significant hazard. The containers should be triple rinsed and the first rinsate (first rinse liquid) collected for disposal as hazardous waste immediately after the last amount is removed. After triple rinsing, if the container is deemed to be free of residue, the label must be crossed out or defaced and the container can be discarded into the regular trash. Recycle glass only.
13 - Documentation of Training (signature of all users is required)

✓ Prior to conducting any work with acrylic 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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