

Specific Standard Operating Procedure

for work with

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| Chemical name/class: | <i>Acidic Piranha (AKA Piranha, Piranha Etch) (Customized SOP Required)</i> | CAS #: | 7664-93-1 (sulfuric acid) & 7722-84-1 (hydrogen peroxide) |
| PI: | <i>Ken Henderson</i> | Date: | 1-24-13 |
| Building: | <i>Stepan</i> | Room #: | Stepan 385 |
| Designated Work Area: | | <i>Stepan 386</i> | |

1. Circumstances of Use:

Acidic Piranha etch (or Piranha) is a mixture of varying ratios of concentrated sulfuric acid (typically 98% concentration) and hydrogen peroxide (usually 30% concentration) used to clean organic residues from substrates.

2. Potential Hazards:

Piranha is highly energetic and has many potential hazards. A less hazardous solution/process should be used if possible.

- An explosion or sudden release can result from storing Piranha in a closed container due to pressure buildup. Never store Piranha for later use, especially in a closed container.
- Piranha is incompatible with organic materials (including acetone, isopropyl alcohol, nylon, etc), acids, and bases.
Piranha is a very powerful oxidizer and can cause organic materials to spontaneously ignite.
- It will react with most metals and release flammable hydrogen gas (remember it is also an oxidizer), as well as provide enough heat for ignition if not handled properly.
- When the solution is made (or comes in contact with organic materials) the reaction is exothermic. This reaction can heat to over 100°C.
- Piranha is highly corrosive and its acidic vapors cause a severe inhalation hazard which can be destructive to the mucosal membranes and result in severe burns.
- Skin or eye exposure to Piranha solution can cause severe burns.
- The OSHA Permissible Exposure Limit (PEL) and ACGIH Threshold Limit Value (TLV) for sulfuric acid are both 1 mg/m³ as an 8-hour time-weighted average.
- The OSHA PEL and ACGIH TLV for hydrogen peroxide are both 1 ppm as an 8-hour time-weighted average.

3. Engineering Controls:

- An eyewash and safety shower must be available in the immediate work area for any work with Piranha.
- Always prepare and use Piranha solutions inside a fume hood with the sash between you and the solution. This helps prevent inhalation hazards and provides some protection in case of an explosion.

4. **Work Practice Controls:**

- Only make and use Piranha in glass or Pyrex containers (the solution is incompatible with plastic).
- Only prepare enough solution for immediate use. Due to its extreme reactivity it has a relatively short usage life.
- It is recommended that you add hydrogen peroxide to sulfuric acid very slowly (adding the smaller amount to the larger amount). If the hydrogen peroxide concentration exceeds 50% an explosion could occur; adding the hydrogen peroxide to the acid avoids this situation. Mixing this solution should be done with extreme caution.
- Do not mix Piranha with incompatible materials including acids, bases, and organic solvents (acetone, isopropyl alcohol, etc). Do not store bottles/materials containing organic compounds or other incompatibles in the fume hood with Piranha.
- Handle the container with care as it may be hot from the exothermic reaction.
- Ensure all substrates are rinsed and dried before Piranha solution comes in contact with them.
- Never put Piranha in an airtight container.
- Always keep acid neutralization materials at all locations where Piranha is made or used in the lab.
- Do not use or store metal tools or accessories that will directly contact Piranha solution.
- Work within sight and/or hearing of at least one other person who is familiar with the hazards and written procedures.
- Once work with Piranha is complete, wipe down the area with a soap and water solution.

5. **Personal protective equipment (PPE):**

- Wear closed-toed shoes (non-mesh upper), lab coat, safety goggles, and chemical-resistant gloves when working with Piranha.
- Sulfuric acid penetrates standard laboratory gloves in 5 minutes or less. Heavy rubber gloves are recommended when working with Piranha.
- No exposed jewelry should be worn including necklaces, rings, metallic bracelets, or hair bands.
- Exposed skin should be minimized.

6. **Transportation and Storage:**

Piranha etches should not be stored. Only make enough solution for immediate use.

Never cap Piranha waste unless it has cooled overnight or to room temperature (inside the fume hood). When storing spent Piranha etches for waste pickup, these containers should always be placed in secondary containment that is acid resistant. For more information on waste disposal procedures, read Section 7 below.

7. **Waste Disposal:**

After use, allow solution to cool and stop reacting in a labeled, open container inside a fume hood. Waste solution must be cooled overnight or to room temperature, and the reaction must go to completion, prior to waste storage/disposal. **After you believe the reaction has stopped, swirl the bottle to ensure that no further bubbling takes place. Cap the container only after the waste solution has cooled completely and there are no more bubbles being formed.** Waste Piranha etches should only be kept in glass containers having a plastic safety containment coating on the exterior surface. These containers are designed to prevent material loss in the event of cracking or breaking. These containers can be easily purchased or you can use empty sulfuric acid containers with this coating (make sure the label is removed before using to store waste). While waiting for pickup, Piranha waste must be stored in the described container.

Do not add any other materials to Piranha waste. Label the waste container "For Piranha Solution Disposal ONLY – Do Not Add Other Types of Chemicals."

8. **Exposures/Unintended contact:**

- Skin contact: Remove contaminated clothing, rinse affected area with water for at least 15 minutes. Seek medical attention.
- Eye contact: Immediately flush eyes with water for 20 minutes while holding eyelids open. Seek medical attention. Place ice packs on the eyes while in transit to medical facility.
- Ingestion: Do not induce vomiting and seek medical attention immediately.

Inhalation: Remove exposed individual to fresh air. Seek medical attention in the event of respiratory irritation, cough, or tightness in the chest. Symptoms may be delayed.

Contact RM&S for medical advice on occupational chemical exposures, **1-5037**. For an actual chemical exposure or injury, complete the work-related injury or illness report found at: <http://chemistry.nd.edu/safety/supervisors-report-of-injury-to-the-health-center.pdf>. If medical attention is needed, see <http://chemistry.nd.edu/safety/procedures-for-injury-illness-or-incident.pdf>.

9. **Spill Procedure:**

In the event of a minor spill (<200 ml) within the fume hood, neutralize the spill using an acid spill kit. Dispose of neutralized absorbent materials in accordance with the Chemical Hygiene Plan. After spill has been completely absorbed, wipe down contaminated area with soap and water.

"Large" spills or any spill outside of the fume hood must be referred to RMS by calling 1-5037 during working hours or by calling 911 from a campus phone after hours.

10. **Training of personnel:**

All personnel are required to complete the online General Lab Safety session through the OESO website. This session includes an introduction to general chemical safety.

Furthermore, training on the lab-specific procedures must be performed by knowledgeable designee for all personnel working with Piranha. All personnel shall read and fully adhere to the laboratory-specific SOP for Piranha, and shall document that they have read it by signing and dating the SOP.