

SAFE OPERATING PROCEDURE PIRANHA SOLUTION

Introduction

A piranha solution is used to remove organic residues from substrates. Two types of solutions are used. The most common is the acid piranha: a 3:1 mixture of concentrated sulfuric acid (H_2SO_4) with hydrogen peroxide (H_2O_2). Also used is the base piranha: a 3:1 mixture of ammonium hydroxide (NH_4OH) with hydrogen peroxide (H_2O_2).

Special Authorization Required

Piranha solutions are **VERY DANGEROUS!** Do not attempt to mix and use piranha solutions without training and instruction.

Any users who want to use Piranha solutions **must** be qualified and trained by Principle Investigator/Designated Staff and the training documented . No exceptions.

Any accident regarding the use of Piranha solutions must be reported without delay to EH&S and the lab manager.

Hazards

National Fire Protection Association (NFPA) Hazard Ratings:

Sulfuric Acid

Health 4
Flammability 0
Reactivity 2
Special Hazard





Hydrogen Peroxide

Health 4
Flammability 0
Reactivity 1
Special Hazard Oxidizer



Ammonium Hydroxide

Health 3
Flammability 0
Reactivity 1
Special Hazard



All are equally dangerous when hot, although the reaction in the acid piranha is self-starting whereas the base piranha must be heated to 60 degrees before the reaction begins.

There are many conditions which will cause the reaction to accelerate out of control. "Out of control" can mean anything from the piranha foaming out of its bin and on the deck, to an explosion with a huge shock wave including glove and acid-gown shredding glass sharps. Piranha's burn (oxidize) organic compounds. If you provide sufficient fuel for them (i.e. photoresist, IPA), they will generate enormous quantities of heat and gas.

Personal Protective Equipment

1. The handling of Piranha solutions requires special protection equipment in addition to the standard laboratory clothing (lab coat), gloves, protective eyewear, and leather shoes.
2. The additional protective equipment includes: a full face shield, heavy duty rubber gloves (regular Nitrile gloves will not provide sufficient protection), as well as an acid apron to wear on top of the lab coat.

3. Legs must be covered (no shorts).
4. Leather shoes are strongly recommended. Open toed shoes are strictly forbidden.

Piranha Solution Handling

Piranha solutions, as well as any corrosive or hazardous substances, can only be used during operational hours and requires at all time the presence of a second knowledgeable user (buddy system).

Containers used during the experiment must be very clearly labeled with the words "Piranha Solution" and the components and percentages of the mixture.

A warning sign, visible by any user working under the fume hood, must be posted at all times to indicate that the solution contains a Piranha mixture.

Mix the solution in the hood with the sash between you and the solution. Wear the full protection.

Piranha solution is very energetic and potentially explosive. It is very likely to become hot, more than 100 degrees C. Handle with extreme caution. When preparing the piranha solution, always add the peroxide to the acid.

Leave the hot piranha solution in an open container until cool (a minimum 90 minutes). Never store hot piranha solutions.

Piranha stored in a closed container without sufficient time to cool could likely explode.

Adding any acids or bases to piranha or spraying it with water will accelerate the reaction. This includes materials such as Photoresist, which is a strong base.

Mixing hot piranha with organic compounds such as acetone, photoresist, isopropyl alcohol, and nylon may cause an explosion.

Do not store wash bottles containing organic compounds on the fume hood deck with piranha solutions.

Piranha Waste Disposal

The primary hazard from storage of piranha waste is the potential for gas generation and over pressurization of the container when the solution is still hot. If you store a hot solution in an air tight container, it will explode!

Therefore, prior to storing the piranha waste solution, it must be left in an open container in order to cool down for a minimum of 15 minutes. It is your responsibility to make sure that the open container is very clearly labeled and left in a safe area for overnight cool down.

Signs alerting anyone of the danger **MUST** be conspicuously posted. Including:

Do Not Touch
Piranha Solution
Absolutely NO Unauthorized Personnel

Once cooled down, the solution can be transferred into a closed container for waste storage. The container must be very clearly labeled with the solution name and composition and must include **VERY VISIBLE** warning signs not to add any other chemical components including water to the waste.

Emergency Response

In case of large exposure, the victim should be removed from the contaminated area, placed under a safety shower while emergency personnel are contacted (**Dial 2-3003**).

All contaminated clothing should be removed immediately with appropriate gloves and safely discarded.

In case of contact with the skin, the affected area must be immediately rinsed with large amounts of water for at least 15 min.

In case of contact with the eye, irrigate the eye for at least 30 minutes, keeping the eyelids apart and away from eyeballs during irrigation. Place ice pack on eyes until emergency treatment.

In case of inhalation, it may irritate the respiratory tract. Conscious persons should be assisted to an area with fresh, uncontaminated air. Seek medical attention in the event of respiratory irritation, cough, or tightness in the chest. Symptoms may be delayed.

Spill Response

Use extreme caution. Always wear personal protective equipment while cleaning a spill. Because of the vigorous action of sodium bicarbonate as an acid neutralizer, avoid spatter, and breathing noxious fumes generated by neutralization. Evacuate as necessary until neutralization reaction completes.

- Neutralize with sodium bicarbonate.
- Absorb with an inert material (vermiculite, dry sand, oil-sorb, or kitty litter).

Supply and Storage

Do not store piranha. Mix fresh solution for each use. Excess solutions should be disposed as explained in Piranha Waste Disposal.