TEMPLE UNIVERSITY
A Commonwealth University
Environmental Health & Radiation Safety (EHRS)

STANDARD OPERATING PROCEDURE (SOP): Piranha Solution

TYPE OF SOP:

☐ Process ☒ Hazardous Chemical ☐ Hazardous Class

DESCRIPTION

This standard operating procedure outlines the handling and use of piranha solution. Review this document and supply the information required in order to make it specific to your laboratory/area. In accordance with this document, laboratories should use appropriate controls, personal protective equipment, and disposal techniques when handling piranha solution. This SOP must be reviewed and revised (if necessary) on an annual basis or whenever changes are made to the use and/or location.

LABORATORY/USER INFORMATION

Principal Investigator (PI):_____ Phone #_____

Department:_____

Building #:_____ Office Room#:_____

Creation Date: _____ Revision Date:_____

Location/Area (s) Covered by this SOP.

Building (s)	Lab (s) #
_____	_____
_____	_____
_____	_____
_____	_____

USE & PROCEDURE

Use this section to describe the process or circumstances of use, including the chemical name (s) (IUPAC), common name, CAS #, concentration and quantity. Attach experimental protocol or written lab specific procedures.

GENERAL INFORMATION

- **Piranha solution, traditionally a 3:1 mixture of sulfuric acid and 30% hydrogen peroxide, is highly energetic and has many potential hazards. A less hazardous solution/process should be used if possible.**
- **Principal Investigator (PI) approval is required prior to performing this procedure**.
- All work involving Piranha Solution must be conducted in a certified operating chemical fume hood.
- Individuals planning a family or pregnant can contact EHRS for exposure determination, consultation, and recommendations.
- All workers must meet the training requirements listed in the training section of this SOP prior to using any Piranha Solution.
- Any deviation from this SOP requires approval from the PI.

POTENTIAL HAZARDS

- An explosion or sudden release can result from strong piranha in a closed container due to pressure buildup. Never store piranha for later use, especially in a close 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 into contact with organic materials) the reaction is exothermic. This reaction can heat to over 212°F (100°C.)
- Piranha is highly corrosive and its acid vapors cause a severe inhalation hazard which can be destructive to the mucosal membranes and result in severe burns.
- The OSHA Permissible Exposure Limit (PEL) for sulfuric acid is 1 mg/m^3 as an 8-hour time–weighted average (TWA.)
- The OSHA Permissible Exposure Limit (PEL) for Hydrogen Peroxide is 1 ppm (1.4 mg/m^3) as an 8-hour time–weighted average (TWA.)

- Consult your Safety Data Sheet (SDS) for additional information.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The level of skin and eye protection should be selected based on the potential for splashing and other forms of exposure. A site specific risk assessment and review of SDS must be conducted by the PI to determine if any additional PPE is required. The specific type of PPE determined is required to be specified in the section below.

- Minimum potential for splash & exposure:
  - Single pair of chemical resistant gloves (Change gloves frequently and immediately replace with new gloves when gloves become contaminated.)
  - Sulfuric acid penetrates standard nitrile laboratory gloves in 5 minutes or less. Heavy rubber gloves are recommended when working with piranha.
  - Protective clothing shall be worn to prevent any possibility of skin contact with piranha.
    - Lab coats
    - Acid Apron
    - Closed toed shoes
    - Long pants
    - Long sleeved clothing
  - Safety goggles and a full face shields shall be worn during operations involving piranha solutions.
    - Safety goggles must meet ANSI/OSHA specifications(ANSI Z.87.1 1989)
- Respiratory protection- Is not required when proper engineering controls are implemented. Respirator usage may require training, fit testing and a medical evaluation. Contact EHRS (2-252) for information on the Respiratory Protection Program prior to wearing respirator.

NOTE: A certified chemical fume hood must be used in any task involving the piranha solution.

INSERT ADDITIONAL PPE AS NECESSARY:

ENGINEERING CONTROLS

- All work involving Piranha must be conducted in a certified operating chemical fume hood.

- 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.
- Work with piranha solution should be avoided and not permitted if there is a reasonable likelihood of workers exceeding regulatory exposure limits.
- Safety Shower and Emergency eyewash should be easily accessible within the immediate work environment in areas where a piranha is used.
- Laboratory rooms shall have general room ventilation and must be at negative pressure with respect to the corridors and external environment.
- Laboratory/Room doors must be kept closed at all times.

INSERT ADDITIONAL ENGINERING CONTROL AS NECESSARY:

SPECIAL HANDLING PROCEDURES & STORAGE REQUIREMENTS

- Designate areas where piranha solutions are stored or manipulated.
- Piranha should never be used or handled by individuals working alone in the laboratory. Work within sight or hearing of at least one other person who is familiar with the hazards and procedures.
- Only make and use piranha in 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 the solution should be done with extreme caution.
- All working containers of piranha solutions must be labeled with contents and hazard warnings.
- 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.
- Piranha etches should not be stored. Only make enough for immediate use.
- Always allow store hot piranha solutions in a fume hood to allow to cool to room temperature. Piranha solution stored in a close container will likely explode. Place a

- sign on the container that's states "Piranha Solution Only-Do Not Touch" during the cool down phase.
- Do not transfer chemicals around the room in beakers.
- Wash hands, forearms, face and neck thoroughly with soap and water after removing your gloves and any other PPE.
- Use the smallest practical quantities for the experiment being performed.
- All areas which use piranha solution must have a chemical spill kit present.
- The PI should consult Occupational Health to determine if medical surveillance is required.

INSERT ADDITONAL HANDLING & STORAGE REQUIREMENTS AS NECESSARY:

SECURITY REQUIREMENTS

Use this section to describe what security measure(s) you will utilize for the receipt, storage and use of the Piranha Solution

TRAINING REQUIREMENTS

- All personnel are required to complete the EHRS chemical safety training prior to working with Piranha.
- The Principal Investigator (PI) must provide lab specific training to all laboratory workers specific to the hazards (physical and health) involved in working with the piranha solution, sources of exposure, risk assessment, personal protective equipment, engineering controls, waste disposal, work area decontamination and emergency procedures. In addition, the PI must review and provide a copy of the SDS and this SOP to any lab worker prior to working with any of the materials covered by this SOP.
- The PI must ensure that all lab personnel have attended the required training and/or refresher training.

DESIGNATED AREAS

- Designated area(s) for use and storage of piranha solution must be established where limited access, special procedures, knowledge and work skills are required. A designated area can be the entire lab, a specific lab, workbench or hood.
- Piranha solution may only be used and stored in designated areas.
- All chemicals must be in secondary containment with proper signage.
- Designated chemical fume hoods must be clearly marked with signs that identify Piranha solution, hazards and includes the appropriate warning: Example:

  CAUTION
  PIRANHA SOLUTION IN FUME HOOD
  HIGHLY ENERGETIC AND CORROSIVE

- All PPE should be removed and properly disposed prior to leaving a designated area.
- Access to the designated areas shall be limited to trained and knowledgeable personnel.

INSERT LOCATION OF DESIGNATED AREA(S):

SPILL PROCEDURES

- Spills-General Instructions
  - Notify others of the spill and keep spill area confined.
  - Review SDS
  - Don appropriate PPE (Heavy rubber gloves, splash goggles, Acid apron, face shield and lab coat
  - Extinguish all ignition sources
  - Collect all spilled material and clean up material and place into an appropriate waste container or double lined bag. Label the bag/container with a Hazardous waste label.
  - Call EHRS at 215-707-2520 and report the spill.
- Minor Spills-Liquid (<200 ml) inside the fume hood and no longer evolving gases.
  - Neutralize and/or absorb freestanding liquid with spill kit absorbent, inert material (vermiculite, sand, etc.) or absorbent pads.
  - Wait 10 minutes and wash spill area with soap and water
  - Place clean up items in waste container or double lined bag. Dispose of as Hazardous Waste through EHRS.
- Major Spills-outside hood, still evolving gases or large amounts.
  - Close hood sash if spill is inside hood or open sash fully if spill is outside the hood
  - Evacuate room or immediate area
  - Do not take any action to cover the spill.
  - Contact Campus Police at 1-1234.
  - Post signs at entrances/exits notifying others of spill.
  - Provide assistance and information to spill responders.
  - Call EHRS at 215-707-2520

INSERT LOCATION OF PHS SPILL KIT:

FIRST AID/ EXPOSURES

- General Instructions
  - Obtain SDS
  - Contact Campus Police at 1-1234 if immediate medical assistance is necessary.
  - Notify Supervisor
  - Notify EHRS at 215-707-2520
- Seek medical assistance after any accidental exposure.

INSERT LOCATION OF NEAREST STUDENT HEALTH, EMPLOYEE HEALTH AND HOSPITAL

- Inhalation
  - Remove exposed individual to fresh air
  - Seek medical attention
- Skin/Body Contact
  - Remove clothing and rinse body in emergency shower for at least 15 minutes
  - Seek medical attention
- Eye Contact
  - Immediately rinse eyeball and inner surface of eyelid for at least 15 minutes
  - Seek medical attention
- Ingestion
  - Seek immediate medical attention

DECONTAMINATION PROCEDURES

- All work areas, lab benches, equipment (glove boxes, hoods) and glassware where piranha solution is prepared and/or used should be cleaned immediately following each task completion.
- Specific decontamination methods and procedures for personnel, equipment and area must be described in the section below.
- Decontaminate all equipment before removing from the designated area.
- Decontamination shall be carried out in a glove box or fume hood.
- Contaminated PPE must not be removed from the designated area until properly decontaminated.
- After working with piranha solution, immediately remove gloves, wash hands and arms with soap and water.

INSERT ADDITIONAL DECOMTAMINATION PROCEDURES

WASTE DISPOSAL

- All piranha waste must be disposed of through EHRS. The EHRS Waste Management section can be reviewed for information on how to properly identify and dispose of Hazardous Waste.
- All piranha waste must be collected in a PVC coated glass container. These containers are designed to prevent material loss in the vent of cracking or breaking.
- All piranha waste must be allowed to cool down for several hours or longer inside a properly operating chemical fumehood prior to transferring it into a PVC coated glass waste container. You must make sure that the piranha has cooled down and you are confident that no over-pressurization can occur prior to transferring to the waste container (PVC coated).
- Do not add any other chemicals to the waste container.
- All piranha waste containers (PVC coated) must have a piranha waste cap which allows the solution to vent and avoid over-pressurization. You can cap the waste container only after the waste solution has cooled completely.
- All waste container must be stored in secondary containment that is acid resistant.
- Label all waste containers with an EHRS approved Hazardous Waste Label- Specify the chemical(s) and type (s) of hazard on the label (example-Carcinogen, Toxin, reproductive hazard, etc...). In addition, please label the container “Piranha Solution Only-Do not add any other chemicals.”

INSERT ADDITONAL WASTE DISPOSAL PROCEDURES

PRINCIPAL INVESTIGATOR CERTIFCATION

I certify that I have read and understand the requirements of this Standard Operating Procedure (SOP) and that I agree to fully adhere to its requirements.

Principal Investigator (PI):_____ Title:_____

Signature:_____ Date:_____