**Standard Operating Procedure**

**Piranha Solution**

***This is an SOP template and is not complete until:*** *1) lab specific information is entered into the box below 2) lab specific protocol/procedure is added to the protocol/procedure section and
3) SOP has been signed and dated by the PI and relevant lab personnel.*

 Print a copy and keep with your
*Chemical Hygiene Plan* and/or *Lab Safety Resources Binder*

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| **Department:** | Click here to enter text. |
| **Date SOP was approved by PI/lab supervisor:** | Click here to enter a date. |
| **Principal Investigator:** | Click here to enter text. |
| **Lab Safety Coordinator/Lab Manager:** | Click here to enter text. |
| **Lab Phone:** | Click here to enter text. |
| **Office Phone:** | Click here to enter text. |
| **Emergency Contact:** | Click here to enter text. |
| *(Name and Phone Number)* |
| **Location(s) covered by this SOP:** | Click here to enter text. |
| *(Building/Room Number)* |

**Type of SOP:** ☐ Process ☐Hazardous Chemical ☐Equipment

1. **Purpose**

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.

1. General Information

"Piranha" is used to remove organic residues from substrates. Two different solutions are used. Two different solutions are used.

* Acid piranha: a 3:1 mixture of concentrated sulfuric acid (H2SO4) with 30% hydrogen peroxide (H2O2).
* Base piranha: a 3:1 mixture of ammonium hydroxide (NH4OH) with 30% hydrogen peroxide (H2O2).

Both 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 takes off.

1. **Procedure/Scope:**

[Identify when the procedure is to be followed]

[Include laboratory procedure and specify hazardous stages of the procedure]

1. **Physical & Chemical Properties/Definition of Chemical Group**

CAS#: Sulfuric Acid: 7664-93-9, Ammonium Hydroxide: 1336-21-6, Hydrogen Peroxide: 7722-84-1

Class: Corrosive & oxidizer

Potential explosive

Potential Hazards/Toxicity

* Explosion hazards
* Splash hazards
* Container rupture/failure (due to pressure build-up)
* Skin burns
* Irritation of mucus membrane

Piranha solutions is a mixture of concentrated sulfuric acid (H2SO4) and 30% hydrogen peroxide (H2O2).

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| --- | --- |
| https://upload.wikimedia.org/wikipedia/commons/thumb/a/a1/GHS-pictogram-acid.svg/2000px-GHS-pictogram-acid.svg.png | **Sulfuric Acid**Signal word: DangerHazard statement(s): H290 May be corrosive to metals. H314 Causes severe skin burns and eye damage. |
| https://upload.wikimedia.org/wikipedia/commons/thumb/e/e5/GHS-pictogram-rondflam.svg/2000px-GHS-pictogram-rondflam.svg.pnghttps://upload.wikimedia.org/wikipedia/commons/thumb/a/a1/GHS-pictogram-acid.svg/2000px-GHS-pictogram-acid.svg.png | **Hydrogen Peroxide**Signal word: Danger Hazard statement(s):H271 May cause fire or explosion; strong oxidizer. H314 Causes severe skin burns and eye damage. H318 Causes serious eye damage. |

Danger! Piranha solutions are extremely energetic and may result in explosion if not handled with extreme caution.

Piranha solution is a strong oxidizer. Both liquid and vapor forms are extremely corrosive to skin and respiratory tract. Direct contact will create skin burns and will be extremely destructive to mucous membranes, upper respiratory tract and eyes. The vapor is highly corrosive and can be destructive to mucosal membranes and lungs.

**Reactivity, Fire and Explosion Hazards**

Piranha solution is very energetic, exothermic, and potentially explosive. Mixing the solution is exothermic. The resultant heat can bring solution temperatures up to 120°C. Handle with care! When preparing the Piranha solution, always add the peroxide to the acid. One must allow the solution to cool reasonably before applying any heat. The sudden increase in temperature can also lead to violent boiling, or even splashing of the extremely acidic solution. Also, explosions may occur if the peroxide solution concentration is more than 50%. 30% peroxide in water solution is more reasonable. Piranha solution reacts violently with any organic materials. Avoid mixing with incompatible materials such as acids, bases, organic solvents (acetone, isopropyl alcohol) or nylon. Only use clean glass or Pyrex containers; Piranha solutions are not compatible with plastic.

**Potential Health Effects:**

**Inhalation:** Harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.

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

**Eyes:** Causes severe eye burns.

**Ingestion:** Harmful if swallowed.

\*Always refer to the Safety Data Sheet for the most detailed information\*

1. **Safety Data Sheet (SDS) Location**

Online SDS can be accessed at (<http://oregonstate.edu/ehs/sds>). A hard copy can be found at Oak Creek Building with Environmental Health & Safety.

1. **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.

Laboratory personnel must always wear a lab coat when working in a lab. Closed-toed shoes are also required at all times.

**Hand Protection**

* Single pair of heavy duty rubber gloves (regular Nitrile gloves will not provide sufficient protection)
* Sulfuric acid penetrates standard nitrile laboratory gloves in 5 minutes or less. Heavy rubber gloves are recommended when working with piranha.
* Used gloves after being rinsed with water, can be stored in plastic bags. Only ONE pair of gloves belongs in each bag. Please dry the gloves as much as possible prior to storing them following each use.

**Eye Protection**

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)

**Skin and Body Protection**

* Fire and chemical resistant lab coats (Blue lab coats)
* Acid Apron
* Closed toed shoes
* Long pants
* Long sleeved clothing

**Respiratory Protection**

Is not required when proper engineering controls are implemented. Respirator usage require training, fit testing and a medical evaluation. Contact EH&S for information on the Respiratory Protection Program prior to wearing respirator.

1. **Equipment and Supplies**

[List any equipment or supplies need for the procedure above.]

1. **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.
* A splash barrier is for face protection. Use the sash on fume hoods as a splash barrier. Keep the sash at or below the marked position. Do not raise the sash to a higher level. If for any reason, the sash has be to raised to a higher level, a full face shield must be worn as the splash barrier.
* 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.
1. **First Aid Procedures**

If an accident happens the following documents must be completed:

* Online OSU HR Advocate Public Incident Reporting Form within 24 hours of the incident
* If the employee’s incident resulted in the need for medical treatment, have the employee complete the worker section of the SAIF 801 Form and fax to risk management at 541-737-4855 within 24 hours.

**If inhaled**

Move to fresh air. If the person is not breathing, give artificial respiration. Avoid mouth to mouth contact. Call 911 from a phone. Call EH&S at 541-737-2273 after emergency services have been contacted to report the incident.

**In case of skin contact**

Immediately (within seconds) flush affected area for at least 15 minutes. Remove all contaminated clothing. Call 911 immediately. Call EH&S at 541-737-2273.

**In case of eye contact**

Immediately (within seconds) using the emergency eye wash, flush eyes for 15 minutes. Call 911.

**If ingested**

Do not induce vomiting. Contact 911 and/or poison control center if swallowed: 1 (800) 222-1222.

1. **Special Storage & Handling Requirements**

**Designated Area**

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.
* No other work should be carried out in the fume hood whenever active Acid Piranha solution is present;
* 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.

**Handling**:

* 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.
* Remove wash bottles containing solvents (such as the spray bottles of acetone, isopropyl alcohol) from the Piranha deck. They cannot share the same fume hood.
* Only make and use piranha in Pyrex containers (the solution is incompatible with plastic).
* Piranha solution is very energetic and potentially explosive. It is very likely to become hot, more than 100°C. Handle with care. Picking up a beaker that is this hot will be very painful, might melt your gloves, and may cause you to spill it!
* 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.).
* 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.
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**Storage:**

* Do not store bottles/materials containing organic compounds or other incompatibles in the fume hood with piranha.
* Do not store piranha. Mix fresh solution for each use. Excess solutions should be disposed of.
* Always allow hot piranha solutions in a fume hood 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.
* Piranha waste MUST be stored in a 2.5L coated glass bottle with a vented cap provided by EH&S.
* Do not over-fill piranha waste bottles. Leave at least 2” of head space in each bottle. Over-filling prevents the vented caps from allowing gas to escape. EH&S will not pick up bottles that are over-filled.

**Transporting:**

Do not transfer chemicals around the room in beakers.

1. **Chemical Spill (Change this for radioactive spills or biohazardous spills)**

**General Guidelines**

**For spills less than 100 ml in volume:**

Preparation: Ensure employees have adequate Personal Protective Equipment and spill control materials before attempting to clean up a spill

1. Assess the magnitude of the spill and the associated hazards (broken glass, toxic fumes, risk of fire, etc.).

2. If the hazards can be safely mitigated with available personal protective equipment (PPE), do so. This includes informing co-workers of the spill, removing ignition sources, and moving equipment that may be damaged by the spilled chemicals. (Note: If the spill is more than 1 gallon of liquid or 1 pound of solid, contact Public Safety at 541-737-7000 and ask them to notify EH&S.)

3. Once all hazards have been assessed, put on appropriate PPE (respiratory protection, goggles, body protection, gloves, impervious shoes/boots, etc.).

4. Apply the Pig Pads to the spill and give the pads time to absorb the chemical.

5. Use gloves and cardboard to move the used Pig Pads to a garbage bag.

6. Seal the garbage bag with a zip tie and label the bag with a Hazardous Waste Label.

7. Place the garbage bag in secondary containment (a cardboard box or plastic tote/bin) labeled “Hazardous Waste.” Place the box in a location in the laboratory where EH&S personnel will easily find it.

8. Request a Hazardous Waste Pickup (<http://oregonstate.edu/ehs/waste>).

9. Replenish you spill kit’s contents immediately.

**For spills greater than 100 ml in volume:**

1. In general, if a chemical spill is greater than 100 ml in volume or is a particularly hazardous material (strong acid or base, carcinogen, highly reactive chemical, etc.), call Public Safety (541-737-7000), and tell them to contact the on-call EH&S personnel to respond to the spill.

2. Provide the following information:

* Your name and contact phone number
* Location of the spill (Building and room number)
* Approximate volume of spilled liquid
* Name of chemical

3. Do not attempt to clean up large and/or hazardous chemical spills.

4. Notify all other workers who could be affected by the spill and vacate the laboratory/floor/building, particularly if the chemical produces hazardous fumes or poses other potential health hazards.

5. Wait at the building entrance for EH&S personnel.

6. Serve as a point of contact and provide information about the spill, as requested by EH&S personnel.

**Personal precautions**

**Hand Protection**

* Single pair of heavy duty rubber gloves (regular Nitrile gloves will not provide sufficient protection)
* Sulfuric acid penetrates standard nitrile laboratory gloves in 5 minutes or less. Heavy rubber gloves are recommended when working with piranha.
* Used gloves after being rinsed with water, can be stored in plastic bags. Only ONE pair of gloves belongs in each bag. Please dry the gloves as much as possible prior to storing them following each use.

**Eye Protection**

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)

**Skin and Body Protection**

* Fire and chemical resistant lab coats (Blue lab coats)
* Acid Apron
* Closed toed shoes
* Long pants
* Long sleeved clothing

**Environmental precautions**

Do not let product enter drains. Discharge into the environment must be avoided.

**Methods and materials for containment and cleaning up**

 A hard copy of this Safety Instruction

 A hard copy of the Pink Pig Absorbent Pad Chemical Compatibility Chart <http://www.newpig.com/wcsstore/NewPigUSCatalogAssetStore/Attachment/documents/ccg/HAZMAT.pdf>

 Bucket with screw-on lid

 6 Pink Pig Absorbent Pads (Item number MAT301 at [www.newpig.com](http://www.newpig.com))

 Heavy duty plastic garbage sized bags

 Zip ties (to seal bags)

 Hazardous Waste Labels (available at <http://oregonstate.edu/ehs/waste>)

 Cardboard rectangles/squares for handling used Pig Pads, if necessary

 Appropriate lab-specific PPE, such as lab coats, goggles, gloves, etc., should be available in each laboratory

1. **Other Emergencies**

**Medical Emergency Dial 911**(This will connect you to Good Samaritan Hospital Corvallis where they will be able to treat the victim).

1. **Decontamination/Waste Disposal Procedure**

*General hazardous waste disposal guidelines:*

**Decontamination**

* Decontaminate face shield, googles for re-use by rinsing with a large amount of water then rinsed with a 10% sodium carbonate solution followed by rinsing with water again.
* 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. 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.

**Label Waste**

* Affix an EH&S hazardous waste label on all waste containers (<http://ehs.oregonstate.edu/sites/ehs.oregonstate.edu/files/pdf/hwlabelfull.pdf>) as soon as the first drop of waste is added to the container.

**Dispose of Waste**

* All piranha waste must be disposed of through EH&S.
* Waste must be under the control of the person generating & disposing of it
* 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 fume hood 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 EH&S approved Hazardous Waste Label- In addition, please label the container “Piranha Solution Only-Do not add any other chemicals.”
* Do not over-fill piranha waste bottles. Leave at least 2” of head space in each bottle. Over-filling prevents the vented caps from allowing gas to escape. EH&S will not pick up bottles that are over-filled.
* Put in a waste request at: <http://ehs.oregonstate.edu/waste>
1. **References**

[Include any references useful to employees]

1. **Training Requirements**

All individuals working with chemicals in OSU laboratories must take EH&S’s Laboratory Safety and Hazardous Waste Training. The use of HF must warrant additional safety training per the PI, and or EH&S. Additional training requirements are listed below.

* 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.

Specific lab-specific training such as:

* Trainee has reviewed the process specific standard operating procedure (SOP).
* Trainer discussed the injury and illness prevention measures including first aid supplies and emergency/treatment.
* Trainee was shown the location of spill response supplies.
* Trainee was shown specific waste collection and storage method(s).
* Trainee was provided appropriate process specific Blue lab coat, gloves, face shield and chemical splash goggle to protect against chemical splash/splatter.
* Trainee satisfactorily demonstrated the dispensation and process handling techniques, and waste collection and storage.
* Trainee satisfactorily demonstrated the correct fume hood sash height and able to recognize acceptable face velocity range.

**Documentation of Training**

* Prior to conducting any work with Piranha solution 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 this SOP and a copy of the SDS (can be available online) available to all laboratory personnel.
* The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training.

**Principal Investigator SOP Approval**

By signing and dating here the designee certifies that the Standard Operating Procedure (SOP) for *Piranha Solution* is accurate and effectively provides standard operating procedures for laboratory personnel.

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Signature Printed Name/Title Date

I have read and understand the content of this SOP:

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| **Name** | **Signature** | **Date** |
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WARNING

Piranha Solution In Use

 