# **Standard Operating Procedure (SOP) Title: Piranha Solution**

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| Assessor:  | Joshua Linfoot | Location of work:  | MSRH 502 |
| Principal Investigator:  | Prof Alan Spivey |
| Date of approval:  | 13/09/2021 | Date for review: | 13/09/2022 |

## **Justifying the hazards:**

Piranha solution is used in order to remove organic residues from glassware. It is a mixture of 3:1 conc. sulfuric acid and 30 % hydrogen peroxide. Mixing of the components is highly exothermic and should be treated with care. Piranha solution is a strong oxidiser, which can prove extremely corrosive, reactive, or even explosive. College guidance is available online:

<https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/chemical-safety/>

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| Identify hazards with specific risk assessments and a College or a departmental approval process  |
| [Ionising radiation sources](https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/) | [ ]  | [Biological sources](https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/) (microorganisms, human/animal tissues, plants) | [ ]  |
| [Class 3R, 3B or 4 Lasers](https://imperiallondon.sharepoint.com/sites/fons/faculty/safety/lasers/SitePages/laserhome.aspx)  | [ ]  | [Offsite work](http://www.imperial.ac.uk/safety/safety-by-topic/off-site-working/) | [ ]  |
| Confirm if [Lone working](https://www.imperial.ac.uk/safety/safety-by-topic/lone-working/) is permitted with this SOP? [ ]  If it is permitted, describe the control measures for lone workers: |

## **Preparing for the SOP:**

* **DON’T** start work without wearing a suitable PPE to avoid splashes.
* **DO** decant concentrated acids in the fume hood.
* **DON’T** close container with the solution tightly.
* **DON’T** mix piranha solution with bases, organic acids or organic solvents.
* **DON’T** seal (Don’t close tightly) a vessel containing piranha solution.
* **DO** clean and dry glassware before placing it in the piranha solution (it is supposed to remove only trace residues).

## **Procedure:**

# **Before the procedure:**

1. Wear appropriate PPE before starting any work with concentrated acids and acid solutions.
2. Work in a fume hood where possible. Refer to SOP for Fume hoods and Acids.
3. Read and familiarize yourself with the Safety Data Sheets (SDS) for each of the hazardous materials that you will be using.

# **Procedure:**

#### Piranha solution preparation:

* Prepare a glass, Teflon or Pyrex container with concentrated sulfuric acid. Pour acid in the container in the fume hood.
* Slowly add hydrogen peroxide (one volume part) to sulfuric acid (three volume parts) under gentle stirring (never the other way around). Mixing the components is a highly exothermic process, usually exceeding 100 oC, handle with care to avoid splashes and skin burns.
* Ensure that hydrogen peroxide concentrations are around 30%. Over 50% concentration of hydrogen peroxide can result in explosion.
* Always make fresh piranha solution, just before the cleaning process starts. After use, allow piranha to react overnight in a labelled, open container in a fume hood, before final disposal.
* Remember to rinse gloves thoroughly after use.
* Avoid and be aware of splashes.

#### Cleaning glassware

1. Pre-clean glassware of organic materials and metals/ salts. Organic material can react violently and result in explosion. Piranha solution is not appropriate for cleaning metal traces.
2. Always dry the glassware before cleaning it with piranha.
3. Wear PPE as stated below.
4. Turn on water in sinks, if the piranha cleaned glassware is being rinsed in the sink. Avoid water getting in the piranha solution!
5. The glassware is cleaned with piranha solution by either being filled with it (e.g. in the case of round bottom flasks), or by immersing the glassware in an appropriately sized beaker with piranha (e.g. in the case of taps). If latter, to retrieve the small pieces from the beaker carefully pour out the piranha solution and rinse the beaker with copious amount of water.
6. Gather the used piranha solution in a container for final disposal.
7. Rinse the glassware with distilled water, ensuring no Piranha solution remains. Take care that all parts of tubes and especially frits are well rinsed. Suck water through frits into Buchner flask.
8. Thoroughly rinse table and sink. Test pH of the sink and bench top surface with the pH indicator strips (should be pH 6-7).
9. Remove the gloves and let them dry.
10. Check workspace for splashes and cover them with sodium bicarbonate before washing the surface with water. Check for neutral pH after washing the surface.
11. Turn off water.

## **Disposal:**

Piranha solutions have the potential of generating gas, therefore over pressuring the container when the solution is still hot. Allow solution to cool down to room temperature in an open and clearly labelled container overnight before transferring into a clean and dry waste container for disposal. The waste container must be clearly labelled with the solution name and composition, and must include warning signs not to add any other type of waste. Be sure to use a vented cap on the waste container. **Always keep the waste container in secondary containment inside a fume hood prior to collection for disposal.**

## **Personal Protective Equipment (PPE):**

* Mandatory: Lab coat, Neoprene gloves, safety glasses.
* Optional: Chemical resistant apron, chemical resistant sleeves, facemask.

## **Risk Analysis of SOP and emergency procedures:**

### (In addition to [Safe Lab Practice](https://imperiallondon.sharepoint.com/sites/fons/faculty/safety/SitePages/Basic%20Laboratory%20Rules%20for%20All%20Laboratories%20in%20FoNS.aspx))

### **Always remember to include fire associated risks and control measures where appropriate**

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| Hazard | Raw risks | Current control measures | Residual risk(Low/Med/High) |
| Sulfuric acid | Spillage: Eye and skin burns, property damage | Use concentrated acids in a fume hood. A safety shower and eyewash must be available, accessible and regularly tested when working with corrosive liquids.Always wear PPE when handling acids.Label container with acids and acid solutions, do not leave them unattended. Return the stock bottles to the storage cabinets immediately after use. | Med |
| Glassware and glass parts | Cuts and splinters from broken glass  | Visually inspect glassware for cracks and other defects before and after use. If glassware is damaged, arrange for repair or dispose of. | Low |
| Hydrogen peroxide | Inhalation, skin and eye burns  | Use in a fume hood. Can form explosive peroxides in contact with organic material, especially acetone. | Med |
| Piranha solution | Inhalation, skin and eye burns | Prepare the required amount of piranha solution inside the fume hood. Skin or eye exposure to piranha solution can cause severe burns. The vapour is highly corrosive and can be destructive to mucosal membranes and lungs. Wear full PPE. Immediately clean up spillages using the local spill kit.Piranha solutions are extremely energetic and may result in explosion if not handled with extreme caution. | high |

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| **Additional control measures to minimise residual risks** | **Implementation date** |
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| **Who may be harmed** |
| Staff / students [x]  | Cleaners / Engineers [x]  |
| Supporting staff [x]  | Others (specify):  |

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| **Emergency procedures** – describe the response(s) required by the user and lab members |
| **Skin exposure:** Rinse affected skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Seek medical attention.**Eye exposure:** Splashes may cause tissue destruction. Wash eyes for at least 15 minutes in eye/face wash, lifting the upper and lower eyelids occasionally (ask for assistance). Seek medical attention immediately.**Small spills:** Do not attempt clean up if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operations. Cover spill with sodium carbonate or bicarbonate (or relevant absorbent such as Trivorex). When reaction stops, pickup with damp sponge or paper towels (wearing PPE). Rinse the affected area with water. Test liquid with pH paper. **Large Spills:** Notify others in area of spill. Turn off ignition sources in area. Evacuate area and do not allow entry to the area. Contact FoNS Safety team (07872850018 or 07566950899). Respiratory protection required for clean-up. The procedure will be risk assessed in conjunction with the Department and external contractors prior to commencing.Clear up **broken glass** using dustpan and brush, tweezers or other suitable equipment to prevent exposure to the glass then place into the appropriate waste bin (clean or contaminated glassware).If anyone is injured while using the equipment contact first aider.If any **cuts or exposures** to hazardous substances, ensure affected area is held under running water for at least 15 mins and the wound is encouraged to bleed, ask for first aid assistance. If water is not available use alcohol free wipe from the First Aid Kit and dress the wound. Seek further medical attention if required. |

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| Recommended trainings and records: |
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| List of individuals competent to demonstrate safe work practice and train others (level 1 trainers): | Names of those that have been trained and can work unsupervised (level 2) and date training completed: |
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