

V. General Procedures

I. Working with Aqua Regia

Introduction

Aqua regia is a corrosive, fuming yellow liquid prepared by slow mixing of one volume of concentrated nitric acid with three volumes of concentrated hydrochloric acid. It is used to dissolve metals such as gold, platinum, silver, etc. Its fumes and yellow color are caused by reaction of nitric acid, HNO_3 , with hydrogen chloride, HCl , to form nitrosyl chloride (NOCl), chlorine (Cl_2), and water; both chlorine and nitrosyl chloride are yellow-colored and volatile. It is commonly used as a cleaning agent, and due to its highly corrosive nature, should be handled with extreme caution.

Personal Protection Equipment

When working with aqua regia, all work should be done inside the acid fume hood. Goggles, gloves and a lab apron should be worn at all times while handling aqua regia.

Preparation

Add 1 part HNO_3 to 3 parts HCl with slow pouring inside of the acid fume hood. The appearance of an orange/red solution color and gas bubbles is an indication that the reaction is progressing.

Handling

Glassware should be cleaned with soap and water to remove residual organics prior to cleaning with aqua regia. Never remove aqua regia from the fume hood. Only prepare the amount of aqua regia necessary to clean the glassware of interest, as the reaction proceeds upon mixing and extra aqua regia both increases the safety concern and increases the amount of wasted reagents. When working with aqua regia in the hood, the extent of reaction can be observed visually by the production of gas, which can be liberated by tapping on the side of the container. Under no circumstances should aqua regia be placed in a closed container. The gases generated will build up pressure, which will create a hazardous situation. When you are not actively using aqua regia, always ensure that the fume hood sash remain down and closed.

First Aid

If an individual is harmfully exposed to aqua regia the following measures summarized below can be taken. For serious injuries, 911 should be called and immediate medical attention should be sought.

Inhalation - Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Keep the affected person warm and at rest. Get prompt medical attention. When unconscious, loosen tight clothing and position in secured recovery position.

Ingestion - NEVER MAKE AN UNCONSCIOUS PERSON VOMIT OR DRINK FLUIDS! Promptly get affected personnel to drink large volumes of water to dilute the swallowed chemical. DO NOT induce vomiting. Get medical attention immediately.

Skin - Wash off promptly and flush contaminated skin with water. Promptly remove clothing if soaked through and flush skin with water. Get medical attention if irritation persists after washing.

Eyes- Promptly wash eyes with plenty of water while lifting the eye lids. Continue to rinse for at least 15 minutes and get medical attention.

Spill/Accident

The level of response for an aqua regia spill depends on the amount of spill, completion of the reaction and the location of the spill. If a volume exceeding 200 mL is spilled at anytime, EOHS should be called at 330-972-7123 to activate the spill response team. For spills less than 200 mL in the hood with the reaction is complete (no bubbles in solution), the acid can be neutralized using an acid spill kit followed by the use of adsorbent pig mat to soak up the spill. If the reaction has not yet completed, close the hood sash and wait for reaction completion before cleaning up the spill as described above. If aqua regia of any volume is spilled outside of the acid fume hood, evacuate the lab and call EOHS.

Disposal

When disposing aqua regia, place the solution in the properly labeled glass waste containers. The waste containers should never be filled more than halfway and the cap should never be completely tightened. Ensure that nothing but aqua regia is placed in the waste containers as aqua regia is a strong oxidizing agent and will react with organic chemicals. When the container is half full, lightly cap and submit to EOHS for disposal.