

Aqua Regia





HSE Guide

Aqua regia is a corrosive and oxidizing, 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 (HNO₃) with hydrogen chloride (HCl) to form nitrosyl chloride (NOCl), chlorine (Cl₂), and water; both chlorine and nitrosyl chloride are yellow-colored and volatile. It is commonly used as a cleaning agent to remove trace amounts of organic compounds, and due to its highly corrosive nature, should be handled with extreme caution.

Do NOT use aqua regia unless it is necessary.

Please consult with your PI or senior researchers before you use aqua regia for the first time.

Hazards

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|  | Extremely corrosive and may result in explosion or skin burns if not handled with extreme caution. It causes destruction of living tissue at site of contact. Corrosive effects can occur not only on the skin and eyes, but also in respiratory tract, causing respiratory tract irritation. |
|  | A very strong oxidizer. It may ignite flammable/combustible materials. DO NOT mix it with ORGANIC solvents (e.g. ethanol). |
|  | Toxic if inhaled, and causes severe burns and eye damage. |
|  | Very toxic to aquatic life. |

Aqua regia solutions are extremely corrosive and oxidizing and may result in explosion or skin burns if not handled with extreme caution. It causes destruction of living tissue at site of contact. Corrosive effects can occur not only on the skin and eyes, but also in the respiratory tract.

Precautions

- Ensure that a Standard Operating Procedure is available.
- Review safety data sheets prior to use.
- Prepare only the minimum amount necessary.
- Identify the location of the nearest eyewash and shower and verify that they are accessible.
- Locate and verify that appropriate corrosive spill cleanup materials are available.
- Perform all work in a secondary container that is clean and free of organic matter.

WARNING: Never add any organic chemicals to aqua regia solution, it could react violently. This includes any chemical containing a C-H bond, e.g., acetone, isopropanol, ethanol, photoresist, or detergents. Even small amounts of organic chemicals can react with aqua regia solutions.

- The traditional solution is comprised of a 3:1 mixture of hydrochloric acid and nitric acid, respectively.

- When preparing aqua regia, always add nitric acid to hydrochloric acid, never vice versa.
- **Do not store aqua regia.** Mix a fresh solution for each use.

During Work

- **Avoid inhalation.** Perform all operations in a chemical fume hood.
- All handling of aqua regia must be done with glassware inside a fume hood.
- **Avoid contact.** Wear appropriate PPE including, lab coat, closed toed shoes, double gloves or acid resistant gloves and safety glasses.
- When handling large amounts (>500mL), or when splashing is more likely, in addition to working in a fume hood, wear acid resistant gloves, acid-resistant apron, and face shield.
- Wash hands thoroughly each time gloves are removed.
- Use materials and containers appropriate for aqua regia (e.g. glass) and remain aware of potential incompatibilities.
- Always use glass (preferably Pyrex) containers. It is also very likely to become hot - more than 100°C. Handle with care.
- Aqua regia will melt some plastics and corrode most metals.
- Never put aqua regia in a closed vessel; evolved gases will cause a pressure build-up and possible over-pressurization of your container.

After Completing Work

- Used aqua regia should be allowed to cool and cease gas generation, and then should be handled as hazardous waste.
- To quench aqua regia, pour onto ice and carefully neutralize the solution by adding small portions of sodium or potassium carbonate with stirring. When the solution no longer foams upon addition of carbonate, it can be disposed.
- Dispose of aqua regia waste following hazardous waste procedures.
- Use glass bottles, ensure that the waste container you are using is clean, dry, and does not have residual solvent or other organic materials in it.
- Aqua regia should be the sole waste constituent in the waste bottle.

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Emergency Procedures

SKIN CONTACT

Flush skin with tepid water for 15 minutes using the closest available sink, portable drench hose or safety shower. Remove any exposed clothing as well as any jewelry that may be trapping aqua regia.

Call 911 on a landline phone for medical assistance or 012-808-0911 from a mobile phone.

EYE CONTACT

Using eyewash, flush eyes while holding eyelid open and away from exposed eye.

Call 911 on a landline phone for medical assistance or 012-808-0911 from a mobile phone.

Continue flushing with water until emergency medical personnel arrive.

INHALATION

If aqua regia mist or vapors are inhaled, immediately move to get fresh air.

Call 911 on a landline phone for medical assistance or 012-808-0911 from a mobile phone.

INGESTION

Do not induce vomiting.

Call 911 on a landline phone for medical assistance or 012-808-0911 from a mobile phone.

Spill Response

- Alert others and evacuate to a safe distance
- Prevent entry to the laboratory.
- If trained and confident, wearing PPE apply acid neutralizer.
- Collect residue, place in container, label and dispose of as hazardous waste.
- Otherwise close fume hood and await support by calling 911 on a landline for assistance or 012-808-0911 from a mobile phone.