Dartmouth College Guidelines for Safe Use of

Aqua Regia

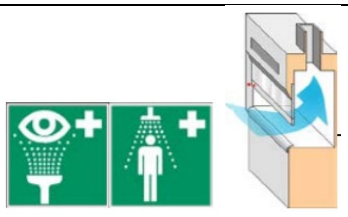
Laboratories should create their own lab-specific SOP's for the use of Aqua Regia

Mixture of Concentrated Nitric Acid and Hydrochloric Acid usually 1:3 ratio respectively

If you make a solution of Aqua Regia please notify Dartmouth EHS: via EHS@dartmouth.edu or calling 603-646-1762

Hazards	**Potential Hazards**	• Aqua regia is a **powerful oxidizer** that releases toxic gases that are fatal by inhalation (e.g. nitrosyl chloride (category 1), nitrogen dioxide (category 2), and chlorine (category 2)). • It can **EXPLODE** if stored in a closed container. • Solutions are **highly corrosive**: Causes burns to eyes, skin, or mucous membranes. • For further safety information, refer to Laboratory Chemical Safety Summary for Aqua Regia (PubChem) and manufacture Safety Date Sheet (SDS) for all the chemicals contained in the mixture.	
Hazard Controls	**Selection & Purchase**	• *Aqua Regia has many potential and health hazards. A less hazardous solution/process should be used if possible* • Buy specific absorbent **pads** or pillows **compatible with nitric acid** for absorbing small spills. • ***If you make a solution of Aqua Regia please notify Dartmouth EHS: via e-mail EHS@dartmouth.edu or calling 603-646-1762***	

	Storage & Transport	• **Never store Aqua Regia for later use; only make enough for immediate use**
		• *Once Dartmouth EHS is contacted they will discuss options for best handing the waste/left over solution.*
		• Keep away from:
		  ○ Organics
		  ○ Reducing agents
		  ○ Flammables
		  ○ Combustibles
		  ○ Ensure primary and secondary containers are free from organic chemicals/solvents.
			

	Engineering Controls & Safety Equipment	• **Eyewash and safety shower** required in immediate work area • Work in a **chemical fume hood** that contain **NO ORGANIC MATERIAL.** • **Keep sash down** while reactions are in progress.	
	Work Practice Controls	• Work with the smallest amount possible. • **NEVER CAP** a container holding active aqua regia solution. • Follow decision for handling waste determined by laboratory and Dartmouth EHS	

	Personal Protective Equipment (PPE)	• Dartmouth College has a Policy on PPE for Chemistry
		• Wear closed-toed shoes and clothing covering the legs.
		• **Minimum PPE**:
		  ○ Lab coat
		  ○ Safety goggles
		  ○ 18 mil NEOPRENE gloves or laminate (These gloves need to be resistant to nitric and hydrochloric acid
		  ○ Change gloves immediately if contaminated wash hands at time of glove change.
		• Dartmouth College Stockrooms provide **Purple Nitrile Gloves** which have a thickness of 0.09-0.15 mm (3.5-5.9 mil) from Cuff to Middle Finger.
		• **Risk of splash** or >100ml, in addition a face shield, impervious apron and sleeves (or coverall) is recommended.
			

Other	**Emergencies & Spills**	• For fire or potential for a fire – Pull nearest fire alarm pull station, evacuate the building and go to a safe location to dial 911. (In Borwell, Rubin and Williamson, dial 5555)
		• Serious injury or exposure to a hazardous material -- dial 911.
		  ○ Find the nearest eyewash station or safety shower
		  ○ Flush the contaminated area with large volumes of water
		  ○ While flushing, remove any clothing which may have been contaminated (including shoes)
		  ○ If the injury is to the eyes, hold the eyes open to ensure irrigation under the eyelids (15 minutes minimum)
		  ○ Continue flushing until EMS arrives
		• Spill is beyond your ability to control (See Spill below) Contact EHS 603-646-1762 or after hours contact Dartmouth Safety and Security at 603-646-3333.
		• For clean-up of small spills (<100 ml) use spill pads compatible with nitric acid and hydrochloric acid and mark all clean up materials as hazardous waste. Contact EHS via e-mail: ehs@dartmouth.edu for waste pick up.	

	Waste	• Label any waste containers with the appropriate waste labels. • Store in secondary containers. • For waste pick up and disposal contact Dartmouth EHS by e-mailing ehs@dartmouth.edu	
	Training	Dartmouth College requires certain training for employees. For this chemical Laboratory Safety/ Hazardous Waste Management is required. This training is mandatory for all personnel working in a teaching or research wet laboratory. It is an introductory program on laboratory safety and waste management in a biomedical, engineering, chemistry, earth science or physics lab at Dartmouth College. The course takes approximately 45 minutes to complete. Completion is required every three years.	
	Medical Surveillance	• Relevant exposure limits: nitric acid – 2 ppm, hydrochloric acid – 2 ppm, nitrogen dioxide – 0.2 ppm ceiling, chlorine – 0.5 ppm.	
	Monitoring Requirements		
	Questions	Contact Dartmouth Environmental Health and Safety by e-mailing us a ehs@dartmouth.edu calling 603-646-1762 or vising our website.	

Procedure for Neutralizing Aqua Regia	
	1. Calculate volume of water needed: ~ 7.5 dilution (e.g., 3L water for 400ml Aqua Regia) 2. Calculate mass of **magnesium hydroxide** ($Mg(OH)_2$ needed: 0.533 g per ml of Aqua Regia 3. Prepare **bromothymol blue** (BB) solution: add 0.8g BB to 100 ml of water and a small drop of NaOh 4. Wear FULL PPE shown on guidelines 5. Place stir plate inside secondary container (with NO organic chemical residue in it) 6. Place a clean GLASS beaker on the stir plate. It must be big enough that it will never be more than 2/3 full (even after dilution is complete). 7. Add water as calculated in step 1. Add stir bar and turn on stir plate. 8. Add $Mg(OH)_2$ as calculated in step 2 and a dash of Bromothymol blue solution. 9. SLOWLY add Agua Regia. Do not allow to overheat. If your solution turns yellow and there is still undissolved $Mg(OH)_2$ let solution stir longer. Test the pH and add more $Me(OH)_2$ if necessary. (pH must be between 6 and 9) 10. Allow solution to cool before moving, capping, or transferring to another container.

"I have read and understand this Guidelines. I agree to fully adhere to its requirements."

Last	First	Dartmouth ID	Signature

Acknowledgement: Special thanks for Duke's Occupational & Environmental Safety Office for their permission to use this great design for our chemical guidelines. All Dartmouth High Hazard Guidelines are based on Duke OESO Chemical SOP's and Guidelines