

# IMPORTANT SAFETY NOTICE

## Occupational Health & Safety



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**SUBJECT: AQUA REGIA**

**DATE: DECEMBER 4, 1998.**

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In September of this year, a graduate student in the Department of Chemistry was using aqua regia for the cleaning of NMR tubes. When he was finished with the material, he placed the residues in a 4 litre Winchester waste bottle and capped it tightly. He then placed the waste bottle in a flammable solvents cabinet.

Approximately 60 minutes after the bottle was placed in the cabinet, it burst, breaking an adjacent bottle of pyridine. Nearby, bottles containing other flammable solvents remained intact. Aqua regia is a strong oxidizer and it is fortunate that the pyridine was not ignited and that the other bottles remained intact.

The lab supervisor, as a result of this spill, wrote the following notice, which was circulated to the Chemistry Department. Since the incident, we have learned that there may be other areas on campus where aqua regia is being used. In order to raise awareness about this material and to prevent a similar incident elsewhere the notice is reprinted below. Please circulate or post so that others in your department can be made aware of the hazards of aqua regia and the appropriate precautionary measures.

### **Memo Circulated to Chemistry**

There was a recent accident in our lab. Fortunately, no one was hurt but it was potentially dangerous. What happened was that some waste aqua regia (ca. 50-60 mL) was placed in a 4L bottle, capped and placed temporarily in a solvent storage cupboard prior to disposal. About an hour later, it exploded, filling the lab with acid fumes. A bottle of pyridine broke and leaked onto the floor, where it dissolved floor tiles and created a lingering bad smell.

Clearly, there are some lessons to be learnt and, since I understand that at least two other accidents involving aqua regia have occurred at the university, this memo is intended to heighten awareness of the potential dangers.

### **What is aqua regia?**

Chemists have used aqua regia for centuries, especially as a medium for dissolving noble metals but also for other purposes. No recipe will be given here (talk to your supervisor if you think you need to use it) but it is a mixture of concentrated hydrochloric and nitric acids. It forms a powerful oxidizing medium. Even without other materials present, a chemical reaction occurs slowly and brown fumes of  $\text{NO}_2$  can be observed (in freshman chemistry terms, nitric acid is reduced and hydrochloric acid is oxidized). The activity as a dissolving agent decreases slowly and so, by definition, the solution is unstable - it should be used *^freshly prepared@*.

## Rules for using aqua regia

1. Aqua regia is corrosive and strongly oxidizing and is essential for some purposes. However, it is naturally hazardous and, if a milder reagent will suffice, try to avoid using aqua regia. It is not recommended to use aqua regia for routine cleaning of glassware.
2. If it is decided that aqua regia is needed, wear protective clothing (goggles, gloves, coat) and work in a clean well-ventilated fume hood. Keep the sash down when reactions are in progress. Never take aqua regia out of the hood. Prepare it, use it and destroy any excess in the hood in which it was prepared.
3. Only prepare the amount you need for immediate use. Never store aqua regia and never put it in a closed vessel, since evolved gases will cause a pressure build-up and possible explosion.
4. Aqua regia a strong oxidizer. It is incompatible with organic solvents and any reducing agents. Putting aqua regia in an organic solvent cabinet is forbidden, for this reason as well as for the reasons given in rules 2 and 3.

## Lessons to be learned from this accident

Do not take aqua regia out of the fume hood in which it was prepared and do not store it there either - make only what you need and destroy the residue. Never put it in a closed container or near flammables. Aqua regia can be destroyed by cautious and *careful* dilution with water - talk to your supervisor for a detailed procedure. If necessary, the solution can then be neutralized. It is then possible to dispose of any residue as either acid or chemical waste respectively in the approved manner.

This experienced supervisor was surprised that sufficient pressure could build up in so short a time to burst the container from so small a volume of aqua regia, but it did. Please avoid future accidents by strict adherence to the principles outlined above and by getting specific instructions from your supervisor before handling aqua regia or other potentially hazardous chemical reagents.