

Health & Safety

With the launch of the new [Health and Safety Network Forum](#) on July 12, the group thought it might be a good time to get back to basics. We hope to publish some articles focusing on the fundamentals of chemicals that conservators use in their labs regularly. This should be useful for both seasoned conservators and those new to the field. If you have a chemical that you would like to know more about, let the Health and Safety Network know via email or post your suggestions on our Forum.

Nitric Acid in Conservation

Nitric acid (CAS 7697-37-2) is both a powerful oxidizer that may intensify fires and a strong acid/corrosive agent. As an oxidizer it can react violently with organic chemicals such as organic solvents and organic acids like acetic acid (vinegar) or formic acid. When in contact with air it can oxidize to nitrogen dioxide (NO₂), which is potentially fatal if inhaled. Solutions of nitric acid are characterized by their concentrations as “weak” (≤68 wt%, ~15M) or “strong” (69–99 wt%). Strong solutions are further classified as “fuming” at concentrations above 86 wt% (~21M). Highly concentrated solutions will develop a yellow color with decomposition due to the formation of NO₂. It should be emphasized that a “weak” solution of nitric acid does not denote a weak acid or weak oxidizer.

Because nitric acid is so highly reactive, it is incompatible with many materials. Nitric acid usually oxidizes materials to their highest oxidation states as acids, which is also accompanied by the formation of NO₂ when the solution is concentrated. The compounds formed after nitric acid reacts with organic materials tend to be more flammable or explosive than prior to exposure.

Reactions with concentrated nitric acid can generate enough heat to ignite combustible materials. Fire conditions may cause the formation of hazardous nitrous fumes. Because of this high reactivity, accidents in industrial environments and universities have been reported, usually caused by the mixing of nitric acid with organic solvents leading to explosion. Physical injuries and death have resulted due to flying glassware and inhalation of nitrous fumes.

CONSERVATION USE

Common uses of nitric acid in conservation include its use in several microchemical tests. Nitric acid reacts with most metals, excepting precious metals, which is why it is used in gold purity tests. In object conservation, the acid has been used to remove insoluble salts from archaeological pottery. In marine archaeological metal conservation, nitric acid is used to clean sacrificial anodes and for chloride concentration analysis. Nitric acid can also be encountered in collections when it off-gasses from objects made from cellulose nitrate as this material ages.

SAFETY

NIOSH hierarchy of controls recommends that the most effective safety protocol is to eliminate use of nitric acid where it can be substituted by less dangerous acids. If nitric acid can't be substituted, purchase only quantities that are needed. Ensure that the proposed work with nitric acid can be done safely following the protocols at your institution prior to purchase or use; if applicable protocols do not exist, work with allied professionals to develop ones that work within your space and application. In addition to the standard safety protocols when handling any hazardous material (splash goggles, lab coat, closed toed/foot shoes, etc.), the following is recommended for use of nitric acid:

Gloves: Heavy-duty gloves such as butyl rubber gloves are recommended, especially when handling concentrated nitric acid or more than 1L of the acid. Nitrile gloves are generally not recommended for nitric acid, especially for concentrated solutions. As with any hazardous material, check with the glove manufacturer to ensure that the specific gloves in use are compatible with the chemicals being used.

Working with nitric acid: Dependent on the concentration (higher concentrations are more dangerous), recommendations are to use a face shield and splash goggles and use only in well-ventilated areas, i.e., fume hoods. NOTE: when working in a hood with nitric acid, make sure all incompatible materials are removed. Most fume hoods are not rated for nitric acid work, and extensive use of this chemical can corrode components of the hood ventilation system. Respiratory protection recommended is dependent on exposure.

Storage: Keep away from incompatible materials: Alkali metals, reducing agents, cyanides, aldehydes, powdered metals, ammonia, and acetic anhydride, organic acids, and all organic materials including organic solvents. Because of the high number of incompatible materials, ideally nitric acid should be stored in its own cabinet, in its original container away from direct sunlight. Keep the container within secondary containment (Nalgene/polypropylene tray or tub). If possible, store in a cabinet made of plastic laminate rather than wood or metal. Do not store above eye level.

Disposal: Nitric acid is incompatible with many materials and nitric acid waste should be segregated, including from other acids.

—Christina Bisulca, *Detroit Institute of Arts*, and Molly McGath, *Associate Research Scientist, The Mariners' Museum and Park, Newport News, VA*

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Protecting People Versus Artifacts: Resolving the COVID Conflict

Major changes to surface cleaning and HVAC operation are being made in an attempt to control the spread of COVID-19. When it comes to museums, however, these modifications can be damaging to collections. This article questions the need for COVID control measures which impact air quality and thus create conditions contributing to artifact deterioration. Alternative strategies are presented which minimize occupant health risk while protecting collections.

COVID studies show that most infections are transmitted directly by a nearby individual, which neither HVAC systems nor sanitizing can prevent. While costly upgrades to air-conditioning and cleaning are being advocated to address the pandemic, available information suggests that relatively minor HVAC adjustments and cleaning enhancements may be sufficient to minimize COVID-19 spread, especially when personal infection control measures (masking, social distancing, handwashing, case identification/isolation) are in place and are now being reported as the most effective measures for reducing the spread of this disease.

Understanding how COVID-19 is actually spreading in buildings is critical to establishing a prioritized and evidence-based COVID response program. Review of the related science indicates:

- › Nearby exposure (within several feet of an infected individual) is the primary transmission route.