Nitric Acid

Chemical and Physical Properties

Nitric acid is a colorless to yellow-colored liquid with an acrid, suffocating odor (Figure 1). Nitric acid is a strong oxidant that decomposes on warming to produce nitrogen oxides. **It reacts violently with combustibles, reducing materials, and organic solvents to cause fires and explosion hazards.** It is a strong acid, reacts violently with bases, and is corrosive to metals and biological tissue. Fuming nitric acid is concentrated nitric acid that contains dissolved nitrogen dioxide; fuming forms may be pale yellow to reddish brown in color.

Fig. 1. Globally Harmonized System symbols for oxidizer, corrosive, and toxic hazards.

Health Hazards

Acute Health Effects: The following **acute (short-term)** health effect may occur immediately or shortly after exposure to nitric acid:

- Exposure can result in mild to severe irritation or burns to the skin , nose, throat, and eyes with possible tissue damage.
- Inhalation can irritate the lungs causing coughing and/or shortness of breath. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency.
- Exposure may result in nausea, vomiting, diarrhea, and abdominal pain.
- **Chronic effects:** The following **chronic (long-term)** health effects can occur at some time after exposure to nitric acid and can last for months or years:
- Prolonged or repeated contact can cause a skin rash, pain, redness, and ulceration.
- Repeated inhalation exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath.
- Exposure to the high concentrations may cause erosion of the teeth.

Accidental Exposure

Any accidental exposure requires immediate medical attention. Call 911 for medical assistance.

Nitric acid causes burns by all exposure routes. Take the following steps while emergency assistance is en route.

- **Inhalation:** If nitric acid mist or vapors are inhaled, immediately move to fresh air.
- **Skin Contact:** Immediately remove contaminated clothing and rinse affected area profusely with water for at least 15 min.
- **Eye Contact:** Using eyewash, flush eyes with plenty of water for at least 15 min.; ensuring the underside of the eyelids are also flushed. Ensure contact lenses (if worn) have been removed.
- **Accidental ingestion:** Rinse mouth with water. Do not induce vomiting.

Special Hazards of Nitric Acid

- Contact with organic material (organic chemicals, wood, paper, clothing, oil, etc.) may result in fire.
- Thermal decomposition releases hazardous gases and vapors, including nitrogen oxides (including NO and NO_2).
- Contact with metals produces hazardous gases, including NO and NO_2.

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Safe Work Practices

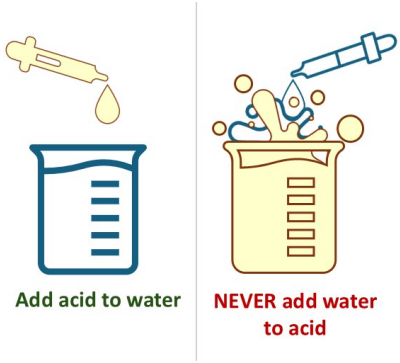

Fig. 2. Yellow drop is added to a blue beaker with text "add acid to water." Blue drop is added to a yellow beaker undergoing a violent reaction, causing liquid to splash out of the beaker with text "never add water to acid."

- Whenever possible, substitute nitric acid for a less hazardous alternative.
- **Only use nitric acid inside of a fume hood.** Ensure that an eyewash and safety shower are nearby prior to use.
- When using large volumes of concentrated nitric acid, or when heating nitric acid above room temperature, work should be done in a fume hood equipped with a water wash down system. **Contact HSRM for additional information.**
- Gloves (butyl rubber or neoprene), chemical splash goggles, and a face shield should be worn when handling high concentrations or large quantities (greater than 4 L) of nitric acid. Nitrile gloves do not adequately protect against nitric acid exposure.
- When diluting nitric acid, **add the acid to water slowly** (Figure 2).
- Nitric acid must be stored in a compatible containment tray. If possible, do not store any other chemical in the same containment tray as nitric acid.
    - Store away from organic chemicals, bases, and strong oxidizing agents
    - Store away from metals. Never store in a metal container.
    - If stored in a metal cabinet or a cabinet with metal shelf clips, periodically check for signs of corrosion on metal components.
- Over time, nitric acid may corrode the cap of it's main container. A common indicator is a white or yellow discoloration appearing on the caps of nitric acid bottles (Figure 3). When this occurs, the cap is no longer containing all nitric acid fumes as its integrity has been compromised from long-term nitric acid exposure. When damage is apparent on storage containers, immediately replace them. Ensure that replacement caps are purchased from reliable sellers and are the correct replacement (threading and material) for your specific nitric acid bottle.

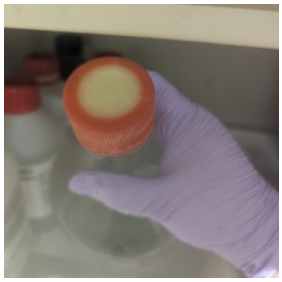

Fig. 3. A nitric acid bottle with it's orange cap discolored by a pale yellow circle in the middle, indicating corrosion of the cap.

Spill Response

Please review the Chemical Spills Fact Sheet for details regarding emergency and non-emergency spill cleanup. Review this fact sheet prior to work with chemicals in the lab and annually thereafter.

If there is a non-emergency spill within your capability to clean up, be sure not to use organic absorbing material, such as paper towels or sawdust, as a fire could result. After the initial cleanup, neutralize the area with a sodium carbonate solution and rinse with copious amounts of water.

Waste Disposal

Dispose of nitric acid in unused waste containers or containers that have previously held nitric acid solution. **DO NOT re-use containers** that previously contained incompatible materials, such as organic solvents. Always ensure that the waste container is made of a compatible material.

Additional Information

For general information regarding the safe use of nitric acid, please contact Health, Safety, and Risk Management (HSRM) at hsrm@umn.edu or (612) 626-6002.

Resources

Prudent Practices Lab Safety Summary—Nitric Acid

Pub Chem Nitric Acid Laboratory Chemical Safety Summary (LCSS)

Video of the reaction between ethanol and nitric acid