

PERCHLORIC ACID: SAFE WORKING PRACTICES INFORMATION PAGE

(Revised 6/20/11)

PURPOSE

The purpose of this page is to provide the principal investigators with information regarding health threats, exposure routes, proper work methods, and provisions of suitable personal protective equipment for development of research protocols that effectively reduce the risk of occupational exposure to perchloric acid.

BACKGROUND

Perchloric acid (CAS # 7601-90-3) is a colorless liquid with no or a slight chlorine odor. Perchloric has a molecular weight of 100.46 and a specific gravity of 1.67 g/cm³ at a 70% concentration. Perchloric acid has freezing/melting point of negative 20°C and boiling point of 203°C (Seastar Chemicals, 2008).

Perchloric acid is one of the strongest mineral acids with a pKa of -10 on the Bronsted-Lowery acid scale. Pure anhydrous perchloric acid is unstable and is an oily liquid at room temperature and produces a minimum of five hydrates. The hydrate solids consist of the perchlorate anion linked by hydrogen bonds to water and a hydronium ion center (Almlof et al., 1971). Used as an aqueous solution, consisting of about 72.5%, perchloric acid is stable indefinitely and available commercially (Mediratta et al., 1996). When chilled or diluted perchloric acid is used as an oxidizing agent; however, when heated and concentrated the substances oxidizing properties increase resulting in explosion or fire in the presence of a reduction agents, organic materials, and strong bases (Smith, 1951). The combination of perchloric acid's strong oxidizing ability, acidic strength, and solubility make it an ideal analytical agent and often utilized in experiments where the absence of complex ions is required (Mediratta et al., 1996). Upon heating, the substance produces corrosive and toxic fumes. The acid is unstable over 72% and becomes shock sensitive upon drying. If mixed with combustible material the combination may ignite at room temperature (National Institute of Occupational Safety and Health, 2000).

OCCUPATIONAL EXPOSURE HAZARDS

Primary routes of occupational exposure to perchloric acid include: inhalation, dermal contact, ocular exposure, and ingestion. Epidemiological data available for occupational exposure to perchloric acid is limited and exposure limits have not been defined (National Institute of Occupational Safety and Health, 2000). Acute exposure effects include corrosivity to the skin and mucous membranes. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pains, and bronchitis.

Prolonged or repeated eye contact may cause conjunctivitis. Repeated dermal exposure may cause sensitization dermatitis and destruction and/or ulceration of the skin. Perchloric acid has an oral LD₅₀ in rat of 1100 mg/kg (Seastar Chemicals, 2008).

1. **Inhalation**: Inhalation exposure is characterized by a sore or burning sensation within the throat. Exposure may produce a cough as well as breathing problems. The onset of symptoms may be delayed.
2. **Dermal**: Dermal exposure to perchloric acid results in redness and pain. Serious skin burns have been associated with perchloric acid.
3. **Ocular**: Eye contact with perchloric acid results in redness and pain followed by the potential loss of vision and severe burns.
4. **Ingestion**: Ingestion results in a sore throat, abdominal pains, and a burning sensation. Severe ingestion of perchloric acid can result in diarrhea, shock, collapse, and vomiting.

SAFE WORKING METHODS

The list of potential perchloric acid related health hazards identified above necessitate the need for principal investigators to conduct a thorough risk assessment and prepare protocols which include measures for minimizing staff exposure. To date, governmental regulatory agencies have not established exposure limits for perchloric acid. In lieu of the availability of regulatory guidance, the prudent course for principal investigators to follow is to either eliminate or reduce exposure potential as much as feasible through implementation of safe working methods.

1. Administrative Controls.

- a. Management considerations for perchloric acid and other potentially hazardous chemicals must be included in the laboratory Chemical Hygiene Plan.
- b. Principal investigators will develop and implement standard operating procedures (SOPs) by which laboratory staff will prepare/administer perchloric acid with minimal exposure.
- c. All lab personnel shall be trained on SOPs prior to working with perchloric acid.
- d. Perchloric acid digestion will not be performed in a laboratory fume hood unless such hood is dedicated for perchloric acid use and equipped with a wash down system.

- e. Researchers using perchloric acid should consider the substitution of a less hazardous chemical.
- f. Only a minimum amount of perchloric acids should be stored in the laboratory.
- g. Perchloric acid is incompatible with acetic acid, acetic anhydride, alcohols, aniline, bismuth, combustible material, dehydrating agents, hydrochloric acid, organic chemicals, and oxidizers. As such, perchloric acid should be stored away from these chemicals as well as wood or paper.
- h. Perchloric acid should be inspected monthly for discoloration. Discolored perchloric acid should be disposed of through Chemical Safety. Contact Chemical Safety at 828-1392 to make a waste disposal appointment.
- i. Opened bottles of perchloric acid should be dated and disposed of within one year. Old bottles of perchloric acid should not be opened or removed from the laboratory. Contact Chemical Safety at 828-1392 for a consultation regarding the old bottle of perchloric acid.
- k. Decontaminate perchloric acid work areas using a solution of 10% sodium carbonate solution.

2. Personal Protective Equipment (PPE).

- a. Use nitrile or vinyl examination gloves which cover hands and wrists completely through overlapping sleeve of lab coat when working with perchloric acid. Wearing two sets of gloves (“double gloving”) is advised whenever performing tasks involving perchloric acid and other hazardous substances. Laboratory personnel should thoroughly wash hands with soap and water before and immediately upon removal of examination gloves.
- b. Safety glasses or safety goggles (ANSI Z-87 approved) are considered the minimum appropriate level of eye protection. The Institutional Biosafety Committee recommends donning of full-face shield when conducting tasks posing potential for any generation of aerosol or droplets.
- c. Full length lab coat and rubber apron are required for working with perchloric acid. Laboratory personnel whose clothing has been contaminated should change into clean clothing promptly.
- d. Laboratory personnel handling perchloric acid should don attire which when worn in combination with lab coat and other PPE provides entire coverage of the body. Short pants, dresses, and open-toed shoes are not appropriate laboratory attire.

3. Engineering Control.

a. All work being conducted with perchloric acid less than 72% should be conducted in a chemical fume hood. Work requiring heating of perchloric acid or concentrations exceeding 72% must be conducted in specially designed perchloric acid hood that is equipped with a wash down system. Perchloric acid fume hoods are located in Oliver Hall room 3002B and Kontos Medical Science Building room 720.

b. Eye wash/drench hose combination unit must be available in the immediate work area.

c. An emergency shower must be in the immediate work area when handling perchloric acid.

4. Waste Disposal.

a. All perchloric acid waste should be disposed of through Chemical Safety. A waste disposal appointment can be made by contacting 828-1392.

b. Store perchloric acid waste in designated satellite accumulation area (SAA), clearly label waste, and ensure all bottles are sealed by positive means.

c. Special consideration regarding perchloric acid waste is required. Bottles of perchloric acid exceeding one year of age require inspection by Chemical Safety prior to being relocated to the SAA. Do not relocate perchloric acid to a SAA that is housed within a wooden cabinet.

5. Spill Procedures. Laboratory personnel must don appropriate PPE prior to attempting to manage any spill involving hazardous chemicals. University policy for addressing spills involving perchloric acid is provided below.

a. Small spills of perchloric acid should be neutralized by applying sodium bicarbonate, sand, or dry lime. Place material in a closed container for disposal through Chemical Safety.

b. For larger spills of perchloric acid, contact the OEHS emergency line (828-9834) for assistance.

c. Organic materials (ex. spill pads, bench paper, paper towels, saw dust, etc.) are **NEVER** to be used for decontamination of a perchloric acid spill.

d. Do not allow spill to dry. Absorbent material must remain wet.

REFERENCES

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