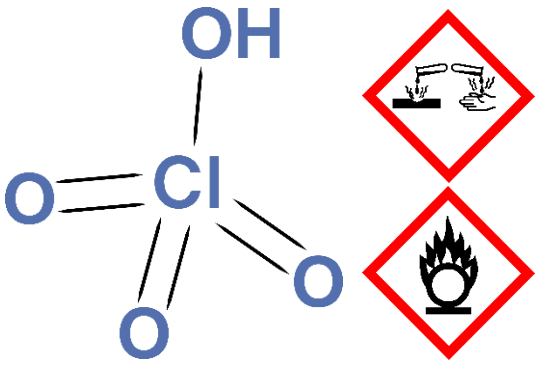
Perchloric Acid Handling Guidelines

Introduction

Perchloric Acid

Perchloric acid is an aqueous inorganic compound classified as highly corrosive and considered as a strong oxidizing agent. Mishandling this chemical may lead to serious health issues such as: irritation, burning sensation, and respiratory problems. Therefore, it is crucial to avoid inhalation, ingestion, skin, and eye contact.



Due to its high reactivity to flammable and organic substances, it is also a potential fire hazard. Precautionary measures, proper handling, and correct engineering controls are needed when working with perchloric acid to avoid serious incidents.

Perchloric Salts

When perchloric acid is heated, it vaporizes and condenses to form perchlorate salts, also known as perchloric acid crystals. Similar to its liquid counterpart, these crystals are highly reactive, potentially explosive, and likely to be strong oxidizers. These salts should be handled with the same caution as perchloric acid to avoid any accidents.

Usage and Handling

Due to the hazardous nature of perchloric acid, it is best to consider using alternative chemicals when possible. If there is no available alternative, the use and handling of perchloric acid should strictly follow the proper guidelines and safety precautions.

1. Training and Knowledge

Personnel who will use and handle perchloric acid should have prior training on its dangers and hazards. They should be knowledgeable on what to do in case of emergencies such as accidental exposure and spills.

2. Personal Protective Equipment (PPE)

Laboratory personnel handling chemicals should wear a complete PPE. It should be noted that the specific type of PPE may vary depending on the task. The general PPE requirement when handling any concentration of perchloric acid are as follows:

- Laboratory goggles and face shield
- Perchloric acid compatible gloves (natural rubber, neoprene, PVC, nitrile)
- Chemical apron over laboratory coat with long sleeves
- Closed-toe shoes

3. Safe Work Practices

a. Perchloric Acid (<72% w/w) at Room Temperature

- Dilute solution (<60% w/w) when possible.
- Avoid contact with strong dehydrating agents.
- Always transfer perchloric acid over compatible containment to catch any spillage.
- Have materials for cleanup and disposal prepared.
- Avoid contact with cellulose materials (wood, paper, and cotton).
- Perform all operations on chemically resistant surfaces and in a certified and properly functioning chemical fume hood.

b. Heated Perchloric Acid (<72% w/w)

- Never heat perchloric acid in an oil bath or open flame.
- Use electric hot plates, electrically or steam-heated sand baths, heating mantles, or steam baths for heating (Preferably explosion-proof electrical equipment).
- Avoid contact with cellulose materials (wood, paper, and cotton).
- Avoid using greases and hoses that are incompatible with perchloric acid.
- When performing wet digestion with perchloric acid, treat the sample with nitric acid first to destroy highly oxidizable substances.
- Do not distill perchloric acid to avoid the formation of anhydride, which is unstable and may spontaneously explode.
- All apparatus should have glass-to-glass joints that use silicon-based lubricants.
- Do not use rubber stoppers, tubes, or stopcocks.
- If an apparatus cracks or breaks due to thermal or mechanical shock, consider using quartz apparatus because the rapid cooling of perchloric acid is needed for many experiments.
- Handle beakers of hot acid with properly designed tongs or other remote-handling devices.
- Perform perchloric acid digestion and other operations at elevated temperatures in a specially designed perchloric acid fume hood.
- Wash down the perchloric acid fume hood after each use following the instructions provided by the manufacturer.

c. Anhydrous Perchloric Acid (>85% w/w)

- For safety purposes, never work alone or inform your safety offices prior to handling anhydrous perchloric acid.
- Use a safety shield for protection against the possibility of an explosion.
- Wear long and thick gauntlets.
- Freshly prepare and use the amount of anhydrous perchloric acid required for the day only.
- Perform all operations in a designated perchloric acid fume hood equipped with a wash-down system.
- No extraneous chemicals should be prepared in the fume hood during operation.

Storage

Store the perchloric acid in its original container within a compatible secondary containment, ideally made of glass or porcelain. Do not store large amounts of perchloric acid to avoid salt build-up. Any glass trays used should be wiped periodically.

To avoid unwanted reactions, perchloric acids must only be stored with inorganic acids in a metal cabinet designed for acid and corrosive storage.

Do not store with organic chemicals, flammable or combustible materials, and strong dehydrating agents.

Spill Clean-up

a. For Small Spills

1. Neutralize it with soda ash (sodium bicarbonate) or other appropriate neutralizing agents.
2. If possible, soak up the neutralized spill with an inorganic-based absorbent.
3. Do not use organic materials, like Kimwipes or toweling since they may spontaneously ignite on contact with perchloric acid.
4. If rags, paper towels, or sawdust were accidentally used, wet them with water and place in a tightly sealed plastic bag and disposed of as flammable waste.
5. Having a second neutralization and thorough washing and rinsing of the wetted area is recommended.
6. Perchloric acid waste should not be mixed with other waste and should be disposed of in acid-resistant containers that are clearly labeled “Perchloric Acid Waste”.

b. For Large Spills

1. Advise and warn co-workers.
2. Immediately evacuate the area.
3. Restrict access to the area.
4. Notify personnel trained to handle explosives and provide them with information such as the identity of hazardous material and quantity involved.

Perchloric Acid Fume Hoods

Operations involving perchloric acid with concentrations above 70% and at elevated temperatures should be performed in a specially designed perchloric acid fume hood equipped with a wash-down system. Unlike at room temperature, working with heated perchloric acid may cause vapor to enter the hood. Therefore, having a wash-down system will help prevent this from happening. Furthermore, operations involving anhydrous perchloric acid should always be done in a dedicated perchloric acid fume hood. The dedicated fume hood and its ducts should be made of stainless steel. Additionally, a scrubber should be installed in the ducting system and behind the baffle to spray water to dilute and wash down any acid fumes and vapors in the fume hood during use.

Wash-down Procedures

It is very important to perform a complete and proper wash-down of the fume hood after every use to prevent the accumulation of perchloric salts in the corners and baffle system of the hood. The general steps are as follows:

1. Open the wash-down valve and allow water to rinse the interior of the fume hood.
2. Turn the fan on and allow the wash-down cycle to run for 1-2 minutes.
3. Turn the fan off and continue the wash-down cycle for around 10 minutes.
4. Keep the internal spray nozzles activated for an additional 10 minutes after the wash-down cycle to clean the backside of the baffles.
5. Manually clean the work zone in front of the baffle.

Note: Wash-down times may vary depending on the type of operation and the amount of perchloric acid used.

EFP

Esco Frontier® Perchloric Acid Fume Hood

Prioritize your safety – use Esco Frontier® Perchloric Acid Fume Hood specially designed for the regular handling of hot perchloric acid. It is complete with a stainless steel internal chamber with coved corners for easy cleaning and wash-down system that rinses away any build-up of perchloric salts in the baffle and fume hood itself.

Click **here** for more product information or scan the code.

References

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[3] University of Concordia. (August 2016). Perchloric Acid Safety Guidelines. https://www.concordia.ca/content/dam/concordia/services/safety/docs/EHS-DOC-010_PerchloricAcidGuidelines.pdf

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Appendix

Chemicals Incompatible with Perchloric Acid

The following chemicals are incompatible with perchloric acid and should never be stored with it because of the possibility of triggering an explosion or spontaneous combustion:

- Acetic acid
- Acetic anhydride
- Alcohols
- Aniline
- Antimony compounds (trivalent)
- Bismuth
- Dehydrating agents
- Diethyl ether
- Formaldehyde mixtures
- Fluorine
- Glycerine
- Glycols
- Glycol ethers
- Hydriodic acid
- Hydrochloric acid
- Hypophosphites
- Ketones
- Lead oxide mixtures
- Nitrogen triiodide
- Nitrosophenol
- Organic matter (paper, wood, charcoal, rags, cotton, etc.)
- Sodium iodide
- Sulfoxides
- Sulfur trioxide