

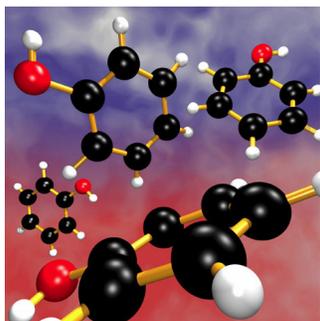
Phenol is a widely used chemical in numerous chemistry, biology, and medical laboratories. Despite its seeming innocuous chemical structure, phenol is extremely toxic toward living cells. Like many small organic molecules of intermediate to high polarity, phenol is readily adsorbed through intact skin.

This combination of properties makes phenol very hazardous. It is essential that phenol users understand its properties, and know correct handling procedures

OCURRENCE AND APPLICATIONS

- Chemistry labs — common reagent for synthesis.
- Polymer synthesis, e.g. phenol-formaldehyde resin.
- Disinfectants, sterilants, embalming fluids.
- Biology labs — phenol-chloroform extraction for isolating RNA.

Extractions with phenol-chloroform employ an extremely concentrated phenol solution (phenol:chloroform 1:1 to 5:1 by volume) that penetrates gloves and other materials.



HAZARD DETAILS

Phenol is quickly adsorbed by all routes of exposure, but awareness of harm may be dangerously delayed as phenol numbs sensory nerve endings. Cellular damage and death results from chemical burn; also, systemic poisoning will rapidly

manifest if sufficient phenol is absorbed. **Any exposure covering more than a few cm² of skin is potentially fatal and must be considered as a medical emergency.**

HAZARD MITIGATION

- Ensure phenol users study and understand this Fact Sheet and the Safety Data Sheet (SDS).
- Generate a standard operating procedure (SOP) for use of phenol. Ensure that users understand the SOP and are trained by experienced personnel..
- A documented risk-assessment is recommended; this can be included as part of the SOP.
- Wear lab coat, safety glasses (goggles required if there is a splash hazard), and gloves. **All contaminated PPE must be immediately removed!**

Chemical Properties

- C₆H₅OH (PhOH); CAS 108-95-2
- Crystalline solid at room temperature; m.p. 40-42 °C.
- Appreciably volatile, with a strong, distinctive, “sweet” smell; v.p. 0.36 mm Hg (20 °C); b.p. 181-182 °C.
- Colorless when pure, but old samples may be pink or brown due to slow oxidation during storage.
- Phenol and water have substantial mutual solubilities, but are not miscible at room temp. The addition of only a few % water is sufficient to liquify phenol.
- Highly soluble in many organic solvents.
- More acidic than alkanols or water, but weaker than aqueous CO₂, hence the (obsolete) former name of carbolic acid.

- Use phenol in a fume hood where possible. A fume hood must be employed if phenol is heated, sprayed, or powdered.
- Use secondary containment including spill trays.
- Consult EH&S if respiratory protection may be required. All respirator users must be trained and fit tested.
- Clearly label all phenol-containing materials.
- Decontaminate work areas and equipment after use.



Toxic



Hazardous to Health



Corrosive



Dangerous to the Environment

Safety Tip: Phenol is commonly supplied as a solid lump and chipping at the material may result in flying crystals and consequent arm injury. Warm the container in a water bath and pipette out the melted phenol.

GLOVE SELECTION

Phenol and Aqueous Phenol



- Disposable nitrile gloves are rapidly penetrated by phenol. If contaminated, use fresh gloves immediately. Double-gloving is recommended.
- Disposable neoprene (polychloroprene) provides somewhat greater protection than nitrile, but gloves must still be changed if contaminated.
- Butyl, Viton®, and Viton®-coated butyl (e.g. ChemTek® butyl, ChemTek® butyl/Viton®) provide superior protection with long breakthrough times. These gloves can be re-used if suitably decontaminated before removal.

Phenol-Chloroform

- Penetrates a wider variety of glove materials than pure phenol, and penetrates more rapidly.
- Disposable gloves (nitrile or neoprene) provide minimal protection. Double-glove and exchange for fresh gloves immediately upon becoming contaminated.
- Laminate film (Barrier®, Silver Shield®) provides reasonable protection but poor ergonomics.
- Viton® and Viton®-coated butyl provide the longest breakthrough time and much the best protection.
- Butyl alone is penetrated rapidly by chloroform—do not use.

Note: Butyl and Viton® gloves can become extremely slippery when wet. Butyl gloves are easily penetrated by low-polarity solvents (e.g., hydrocarbons). Viton® is dissolved/degraded by ketones and related solvents—do not clean Viton gloves with acetone! Consult manufacturer for information on glove compatibilities (e.g., [Ansell Glove Chem Resistance Guide](#)).

PHENOL FIRST AID KIT

It is required that all labs utilizing phenol keep a first aid kit on hand containing:

- 1 liter pharmaceutical-grade polyethylene glycol, 300 or 400 molecular mass (e.g., Kollisol® PEG 400).
- Laminate film gloves (e.g., Barrier®, Silver Shield®). Do not put gloves on contaminated hands!
- Large cotton roll (e.g., VWR 470161-446).
- Wiping cloths (e.g., VWR 500030-610 or -611).

- Large poly bags for waste (e.g., Ziploc®).
- Large squeeze-bottle of liquid hand soap (A squeeze bottle allows much faster application than a pump-dispenser).
- Copy of this Fact Sheet.

Note: PEG suffers peroxidation on storage; therefore, store out of light, do not open the bottle unless needed, and replace after the expiration date (or after two years if no expiration date is given).

PHENOL ACCIDENT RESPONSE AND FIRST AID



Skin Exposure

- Immediately remove all contaminated clothing.
- Irrigate, swab, or wipe small area exposures with polyethylene glycol (PEG 300 or 400; an excellent phenol solvent). Continue to apply PEG even after phenol odor has dissipated.
- For large-area exposures, wash all contaminated areas with copious amounts of soap and water (safety shower/drench hose). Phenol is not very soluble in water and insufficient water may spread it over more skin. Soap helps disperse and remove phenol.
- After the phenol, continually swab with PEG until medics arrive. If PEG is not available, continue under shower until medics arrive.
- **DO NOT** attempt decontamination using ethanol, isopropanol, or other solvents as they often increase phenol adsorption!

Eye Exposure

- Immediately use eyewash for at least 15 minutes holding eyelids open.
- Have a colleague contact DPS for emergency medical attention. DPS Emergency: **UPC 213-740-4321; HSC 323-442-1000**

24-hour emergency treatment advice may be obtained from the California Poison System at **800-222-1222**.

REFERENCES

Occupational Health Guide

<http://www.cdc.gov/niosh/docs/81-123/pdfs/0493.pdf>

Hazardous Substances Database (HSDB)

<http://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm>

Toxic Substances Portal, Phenol

<http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=27>