Phenol first aid and personal protective equipment V.2

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ABSTRACT

Phenol is a common chemical used for nucleic acid extraction. Phenol can be a component in a commercial reagent (e.g. QIAzol, TRIzol) or prepared as part of a mixture in the laboratory (e.g. chloroform:phenol). Because phenol solutions are an integral part of routine life science applications, their hazards may be taken for granted. Phenol can be **very dangerous**, and the hazards are not just those of a typical corrosive. The hazards of phenol are 2 fold: it is both **corrosive** (can cause severe burns) and **toxic** (absorbed phenol acts as a systemic toxin). In one case, death resulted from ingestion of as little as 15 ml. Liquid phenol can penetrate the skin with efficiency approximately equal to that of inhalation. **Deaths have been reported for exposures of 25% or more of body surface area. Phenol has an** anaesthetic **effect and can cause severe burns that may not be immediately painful or visible**. The threshold concentration of human skin damage from phenol is 1.5%. It can cause permanent **eye injury and blindness.**

Prevention

Anyone working with phenol should be familiar with its risks, chemical properties, and ways of handling spillages or exposure. Please read the MSDS and this protocol before starting to work with phenol. Work with phenol is only allowed in a working chemical hood, and a phenol decontamination kit should be at reach. The user must wear protective equipment described in this protocol at all times.

First aid for dermal (skin) exposures

It is recommended to use polyethylene glycol 300 or 400 (PEG-300 or PEG-400) rather than water for immediate first aid treatment of dermal exposures.

First aid for spills

For phenol spill on a floor or bench (non-body case), use an absorbent (e.g. Vermiculite). After it soaks the liquid, collect them into a plastic bag and store them together with other toxic/phenol waste below the fume hood in a ventilated cabinet.

ATTACHMENTS

SDB-A980-GB-EN.pdf

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GUIDELINES

SYMPTOMS OF PHENOL EXPOSURE

The most common route of occupational exposure for phenol is skin contact and absorption. Phenol does not readily form a vapour at room temperature and is unlikely to pose an inhalation hazard unless it is heated or misted. Additionally, **it has a distinct, sweet, acrid odour** that most people detect at levels well below the OSHA airborne permissible exposure limit (PEL). **Phenol burns and intoxications can be life-threatening**. Symptoms include:

Eye Contact: Severe irritation, permanent damage, blindness.

Inhalation: Respiratory irritation, sore throat, headache, and shortness of breath.

Ingestion: Phenol is very toxic; death can occur rapidly following ingestion. Symptoms include irritation, swelling, burns, and damage to the mouth, throat, stomach, internal bleeding, vomiting, diarrhoea, decreased blood pressure, shock, collapse, coma, and death.

Skin Contact: Initial exposure can cause numbness or slight tingling, so contact may not be immediately apparent. However, even minor contact can result in burns, blisters, permanent skin damage, and gangrene. Absorption of phenol through the skin can result in phenol toxicity with symptoms including muscle weakness, tremors, loss of coordination, shock, sudden collapse, coma, convulsions, organ damage, and death. When phenol contacts the skin, a white covering of precipitated protein forms. It soon turns red and eventually sloughs off, leaving the surface stained slightly brown. If phenol is left on the skin, it will penetrate rapidly and lead to cell death and gangrene.

EXPOSURE CONTROL AND PERSONAL PROTECTIVE EQUIPMENT

Emergency Showers and Eyewashes: Any laboratory using phenol (or any corrosive/caustic chemical) must have an emergency eyewash station located in the same room where the hazard is being used and accessible within 10 seconds. Emergency showers must be accessible within 10 seconds and located within the room or in the hallway.

Administrative Controls: Never work alone when using phenol. Procedures requiring the use of phenol should have written safety SOPs associated with them.

Engineering Controls: Phenol **should be used in a fume hood** when working with stock solutions and making formulations and dilutions. Even when working with small amounts of diluted phenol, the best practice is to work in a fume hood because of the splash protection the sash provides and the ability of the hood to contain emissions, especially in the event of a spill.

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Eye/Face Protection: Safety glasses should be worn if working with small quantities of phenol in a fume hood with the sash properly positioned to provide splash, spray, and mist protection. Otherwise, chemical splash goggles should be worn. A face shield (in addition to goggles) may also be necessary. Consider that small facial burns caused by splatter may not be life-threatening but can result in permanent scars.

Skin Protection: Lab coat, long sleeves, closed-toe shoes, and long trousers should be worn when working with phenol. If body splash potential exists, wear a butyl rubber or neoprene apron.

Hand Protection: Hand protection needs to be selected based on projected use (concentration and exposure). For working with phenol at concentrations >70%, butyl rubber, Viton, Barrier, and Silver Shield gloves provide good resistance. Neoprene and polyvinyl alcohol are suitable for short-term work (resistance to breakthrough within 1-4 hours) but should be thicker than 0.3 mm.
Thin disposable gloves are generally for splash protection only and should immediately be removed if phenol gets on them. A good practice is to use a heavyweight disposable (0.2 mm; 8 mil) and double glove. In general, nitrile is not recommended as a material of choice when working with phenol.
Chloroform and Phenol Mixtures. Phenol is often used in combination with chloroform in nucleic acid purification procedures. Unfortunately, chloroform rapidly degrades both neoprene and nitrile.

FIRST AID

Eye: Rapid and immediate decontamination is critical. Flush with copious amounts of **water for at least 15 minutes**, lifting eyelids occasionally. Remove contact lenses if easily removable without additional trauma to the eye. Do not interrupt flushing. Get medical attention immediately.

Inhalation: Move the victim to an uncontaminated and ventilated area. **Get medical attention immediately.**

Ingestion: Do not induce vomiting. If the victim is conscious and able to swallow, give 1 dl of milk or water. Get medical attention immediately. **Never give anything by mouth to an unconscious person.** Get medical attention immediately.
Skin Contact: Rapid and immediate skin decontamination are critical to minimize phenol absorption. Anyone assisting the victim should wear protective clothing and gloves.

Small Exposures
Rapidly **remove contaminated clothing** (including all jewellery and any leather and jewellery leather-like belts or watchbands) and **wipe the exposed areas** immediately and repeatedly with low-molecular-weight polyethylene glycol (**PEG 300** or **PEG 400**). Treatment should be continued until there is no detectable odour of phenol. If PEG is not available, a glycerine solution can be used instead. If neither of these is available, rapid and prolonged washing under a strong stream of water (such as an emergency shower) will reduce phenol uptake, but small amounts of water will merely dilute the phenol and expand the area of exposure. If using water, wash for at least 15 min.

Large Exposures
First aid treatment is similar to small exposures, but the surface area to be decontaminated must be considered. If the amount of phenol on the skin cannot be quickly removed by swabbing or irrigating with PEG, then an emergency shower should be used. A high-pressure shower is preferable to reduce phenol uptake. Lesser amounts of water will merely dilute the phenol and expand the area of exposure. If possible, use PEG after the initial decontamination. Otherwise, the victim should stay in the shower until the emergency responders arrive to provide assistance. For any exposure, double-bag contaminated clothing and personal belongings. Get medical attention. Even if the exposure is small, it is still important to be evaluated by a medical professional to determine if follow-up treatment is necessary. Immediately call your local emergency number.

Even if you feel it is unnecessary, call 112 (Europe) or 155 (Czechia) and get emergency help for evaluation to determine if follow-up treatment is necessary.

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MATERIALS TEXT

Binding and neutralisation agent ENTSORGER-SET-ROTH® Disposal mix **Carl Roth Catalog #0055.1**

Universal absorber ROTISORB® in a square HDPE container **Carl Roth Catalog #1710.1**

Vermiculite 2-3 mm **Merck Catalog #Z765422-9KG**

Silver Shield® gloves **Merck Catalog #Z529567-1PAK**

BEFORE STARTING

PHENOL FIRST AID KIT

Laboratories that use phenol are advised to assemble a kit for first aid treatment of dermal exposure. The kit should be located in a visible area where the phenol work is being done (for instance, in the fume hood) or nearby, with the location clearly posted. The recommended contents of the kit and instructions for use are listed below (the list of the kit contents can be taped to the outside of the large zip lock bag while the instructions for use are placed on the fume-hood). Date the bag with the expiration date of the PEG and replace the bottle when it expires (use the opportunity to inspect the integrity of the other items in the kit, such as the gloves, and replace as necessary).
The kit should include the following:

1. **PEG 300 or PEG 400**. Pharmaceutical grade (USP or NF), at least 2 500-ml bottles. PEG is recommended and available from most chemical suppliers. A 500 ml bottle is meant to treat small exposure areas, such as might occur when using DNA/RNA extraction kits.
2. **Universal absorber or Vermiculite (10 l)**
3. **Medical cotton pads**
4. **Cotton wipes**
5. **Biohazard-labelled plastic bags**
6. **Small room and shovel**

Some vendors offer pre-assembled kits, but making your own is easy and cheaper.

Instructions Phenol Skin (Dermal) Exposure First Aid

1 Remove all contaminated clothes, including jewelry or any leather items such as watch bands or belts.

2 Put on safety glasses and Silver Shield® gloves (but don't put on the gloves if you are treating yourself and your hands are contaminated with phenol).

3 Open up a few packages of gauze pads.

4 Pour polyethylene glycol liberally on to one of the gauze pads.

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5 Gently wipe off excessive phenol on the exposed area. Discard the gauze pad in the small plastic bag in the kit.

6 Take a new gauze pad, add polyethylene glycol, and continue to clean off exposed area. Discard the pad. Repeat with a new gauze pad and application of polyethylene glycol until all visible traces of phenol have been removed from the skin.

7 Continue to gently wipe skin (do not scrape or irritate the affected skin area) with polyethylene glycol soaked gauze pads until no odor of phenol remains, changing the gauze pad frequently.

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Even if you feel it is unnecessary call 112 (Europe) or 155 (Czechia) and get emergency help for evaluation to determine if follow-up treatment is necessary. Don't forget to fill out an accident report!

9 Seal all contaminated clothes in a double plastic bag. Label both the bag and the small zip-lock bag used to collect the used gauze wipes as **"Hazardous Waste – Phenol Contamination"**.

10 Replace the contents of the kit with new, unused items.

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