

BUREAU OF INDIAN STANDARDS

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*Draft Indian Standard***PHENOL-CODE OF SAFETY***(First Revision)*

भारतीय मानक मसौदा

फिनॉल - सुरक्षा संहिता*(पहला पुनरीक्षण)*

ICS 71.080.90

Chemical Hazards Sectional Committee, CHD 07

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FOREWORD

(Formal clause may be added later)

Phenol, also commonly known as carbolic acid, is the trivial name of monohydroxybenzene (C₆H₅OH). Initially, Phenol was extracted by fractional distillation of coal tar, but now is manufactured from petroleum feedstock. Primarily phenol is used in manufacture of phenolic resins and plastics. It is also used to manufacture explosives, fertilizers, paints, rubber, textiles, adhesives, drugs, paper, soap, wood preservatives, and as photographic developers. When mixed with slaked lime and other reagents, phenol is an effective disinfectant for toilets, stables, cesspools, floors, and drains. A complete knowledge and understanding of the hazards of phenol is essential for its safe handling in industry and chemical laboratories.

This standard attempts to guide the users in the recognition of these hazards and in the recommended handling procedures. The information given should be utilized to the fullest extent and should be supplemented by additional information on aspects of design of plants and equipment. This standard describes properties of phenol, the nature of hazards associated with it and essential information on storage, handling, packing, labelling, waste disposal, cleaning and repair of tanks, selection and training of personnel, personal protective equipment and first-aid.

This standard was originally published in 1971. With a view to update the standard based on the experience of last five decades and on the currently available data, the Committee felt a need to revise the standard. In this revision general properties have been incorporated and modifications have been made to update safety measures for controlling hazards and essential information on symptoms of asphyxiation, first-aid, medical treatment, storage, handling, labelling and employee

safety based on the currently available data and last five decades experience. The title of this standard has been modified.

The various clauses of the standard have been aligned with the format being applied for all Indian Standards on code of safety of chemicals.

1 SCOPE

1.1 This standard describes properties of phenol, the nature of hazards associated with it and essential information on storage, handling, packing, labelling, disposal of waste, cleaning and repair of containers, selection and training of personnel, personal protective equipment and first-aid.

1.2 This code does not deal with specification for design of buildings, chemical engineering plants, storage vessels, equipment for operations control and waste disposal.

2 REFERENCE

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 1260 (Part 1) : 1973	Pictorial marking for handling and labelling of goods: Part 1 dangerous goods
IS 2925 : 1984	Specification for industrial safety helmets (<i>second revision</i>)
IS 4155: 2023	Glossary of Terms Relating to Chemical and Radiation Hazards and Hazardous Chemicals (<i>first revision</i>)
IS 8519 : 1977	Guide for selection of industrial safety equipment for body protection
IS 8520: 2023/ISO 19734:2021	Eye and face protection guidance on selection, use, and maintenance (<i>first revision</i>)
IS 10667 : 1983	Guide for selection of industrial safety equipment for protection of foot and leg
IS 10592 : 2018	Industrial emergency showers, eye and face fountains and combination units - Specification (<i>first revision</i>)
IS 15803: 2008	Respiratory protective devices -self contained closed circuit breathing apparatus chemical oxygen (ko ₂) type, self generating, self rescuers - specification

IS 10245 (Part 1): 1996	Breathing apparatus: Part 1 closed circuit breathing apparatus (Compressed Oxygen Cylinder) - Specification (<i>first revision</i>)
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3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 4155 shall apply.

4 PROPERTIES

4.1 General Information

At room temperature, phenol is translucent, clear, or light-pink crystalline mass; a white powder, or a clear liquid. It has a sweet, sharp odor. Phenol is more water soluble than other alcohols and have high boiling points. At room temperature it is extremely poisonous and toxic to health. **4.1.1** *Chemical Name* – Hydroxybenzene, oxybenzene, benzenol.

4.1.2 *Common Name & Synonyms* – Phenol..

4.1.3 *Uses*

It is a major manufacturing product because it is major precursor to many product and valuable compounds. Approximately 2/3rd of total commercial production of phenol is used in manufacturing of plastics and resins. It is also used in manufacturing of cosmetic, fertilizers, paints, photographic developers, and some medicines.

4.2 Identification

4.2.1 *Formula* – C₆H₆O.

4.2.2 *CAS Number* – 108-95-2.

4.2.3 *UN Number* – for solid, UN 1671.

for molten, UN 2312.

for solution, UN 2821.

4.2.4 *UN Class* – 6.1.

4.3 Physical Properties

At room temperature phenol is translucent, clear, or light-pink crystalline mass; a white powder, or a clear thick syrup liquid. It has a sweet, sharp odor.

4.3.2 *Molecular Mass* – 94.11 g/mol.

4.3.3 *Physical State* – Liquid or solid.

4.3.4 *Colour* – Colourless to light pink.

4.3.5 *Odour* – Characteristically sweet.

4.3.6 *Boiling Point* – 180 °C to 182 °C.

4.3.7 Melting Point – 40 °C to 43 °C.

4.3.8 Vapour Density – 3.24 gm/cm³.

4.3.9 Specific Gravity

a) *Solid (water = 1) at 20 °C* – No Data available.

b) *Liquid (water = 1)* – No Data available.

4.3.10 Viscosity – 3.437 Pas at 50.00 °C (Dynamic)

4.3.11 Vapour Pressure at 20 °C – 47.99 Pa

4.3.12 Heat of Combustion – No data available.

4.3.13 Refractive Index at 25°C – No data available.

4.3.14 Solubility in Water – In water, 8 g/100 ml at 16 °C, and soluble in all proportions at 66 °C.

4.3.15 Solubility in Other Solvents soluble in alcohol and other organic solvents.

4.3.16 Light Sensitivity – Darkens slowly on exposure to light due to oxidation.

4.4 Chemical Properties

4.4.1 Reactivity

Air and light sensitive. Prone to redden on exposure to light and air. Incompatible with aluminum chloride, peroxydisulfuric acid, acetaldehyde, sodium nitrite, boron trifluoride, nitrides, mineral oxidizing acids, calcium hypochlorite, halogens, formaldehyde, metals and alloys, lead, zinc, magnesium and their alloys, plastics, rubber, coatings. Phenol when reacted with isocyanates results in heat generation, and violent polymerization. When Phenol react with 1,3- butadiene and boron trifluoride diethyl ether complex results in intense exothermic reaction. **4.4.2 Polymerisation** – Not applicable.

4.4.3 Allotrope formation – No data available.

4.4.4 Corrosion properties – It has mildly corrosive effect on bronze, and severe effect on brass.

4.5 Fire and Explosion Hazard Properties

4.5.1 Ignition Temperature – 715 °C.

4.5.2 Auto Ignition Temperature – 715 °C.

4.5.3 Flash Point

a) Open-cup—85 °C-.

b) Closed-cup —79 °C.

4.5.4 Upper Explosive Limit – 8.6 volume percent (V)

4.5.5 Lower Explosive Limit – 1.7 volume percent (V)

4.5.6 Fire Risk

Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks, of oxidizing materials, of reducing materials, of combustible materials, of organic materials, of metals, of acids, of alkalis.

4.5.7 Hygroscopicity – Hygroscopic

4.5.8 Flammable limits – Lower limit approximately 1.5 percent

5 HEALTH HAZARDS & TOXICITY INFORMATION

5.1 General Information

Phenol is highly hazardous when not handled with care. In liquid, solid, vapour or droplet form or as a solution it exerts a local corrosive effect. It is readily absorbed through the skin, mucous membranes, gastrointestinal and respiratory tracts.

5.2 Routes of entry

5.2.1 Skin/Eye Phenol when comes in contact with skin or eye causes irritation and toxic effect. On prolonged exposure it may leads to skin burns. Phenol vapor and liquid penetrate the skin with an absorption efficiency approximately equal to the absorption efficiency by inhalation.

5.2.2 Ingestion

Accidental or intentional ingestion of phenol may cause damage to organs through prolonged or repeated exposure.

5.2.3 Inhalation

5.2.3.1 As phenol is heavier than air. Due to its low volatility phenol, when inhaled, is absorbed rapidly but poses limited inhalation hazard. It has a strong odor at concentrations much lower than the recommended safety limits, providing adequate warning.

5.2.3.2 Children are more at risk when exposed to phenol vapor due to their higher lung surface area relative to body weight and increased minute volumes. They could also face higher exposure levels due to their shorter stature, bringing them closer to ground-level phenol vapor concentrations.

5.2.4 Long Term Effects

On long term exposure to phenol may lead to genetic defects

5.3 Toxicity information

- a) Threshold Limit Value (TLV)— 5 ppm.
- b) Short Term Exposure Limit (STEL) —16 mg/m³.
- c) Immediately Dangerous to Life or Health (IDLH) — 250 ppm
- d) Lethal Dose (LD₅₀) (rabbit), Dermal —630 mg/kg.

e) Lethal Dose LD_{Lo} (rat) Oral —317 mg/kg.

f) Inhalation (Rat) Leathal Concentration (LC),8 h – 900 mg/m³.

5.4 Antidote

There is no antidote for phenol poisoning but rapid decontamination may greatly affect the odds of survival.

5.5 Health Effects

5.5.1 Signs and Symptoms

Phenol poisoning occur in different ways depending on route of entry. When inhaled may cause swelling of respiratory tract, itching and burning sensation when comes in contact with skin or eyes.

5.5.2 Acute Toxicity

5.5.2.1 Systemic effects

Generalized symptoms may develop rapidly after any route of exposure. These symptoms include weakness, mental confusion, rapid irregular pulse and breathing. Collapse and death may occur in a few minutes after massive exposure despite prompt emergency care.

5.5.2.2 Local effects

Phenol has a marked corrosive effects on any tissue. Since it is a skin anesthetic the first reaction is not pain, but a whitening of the exposed area accompanied by irritation. A serious burn or systemic poisoning may occur if the chemical is not removed promptly and thoroughly. Swallowing of the liquid results in severe corrosive injury to the mouth, throat and stomach.

5.5.3 Chronic Toxicity

5.5.3.1 Systemic effects

Chronic systemic poisoning has been reported but is probably extremely rare.

5.5.3.2 Local effects

Dermatitis may, result from repeated or prolonged skin contact with low concentrations of phenol in any form.

6 PERSONAL PROTECTIVE EQUIPMENTS

6.1 Availability and Use

6.1.1 While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct on the part of employees working with phenol. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area maybe exposed to danger.

6.1.2 The correct usage of personal protective equipment requires the education of the workers in proper employment of the equipment available to him. Under conditions which are sufficiently

hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazards.

6.2 Non- Respiratory Equipments

6.2.1 Eye and Face Protection

6.2.1.1 Chemical safety goggles

Plastic Safety goggles which fit snugly around the eyes should always be worn whenever there is danger of severe exposure to phenol, for example, when cleaning or repairing equipment, taking or handling samples, or cleaning up spills or leaks *see* IS 8250.

6.2.1.2 Face shields

Plastic shields (full length or 20 cm minimum) with forehead protection may be worn in addition to chemical safety goggles where complete face protection is desirable. Face shields should never be substituted for chemical safety goggles, but both should be worn when a face shield is desirable *see* IS 8250.

6.2.1.3 Safety spectacles

Metal or plastic rim safety spectacles with unperforated side shields may be used where continuous eye protection is desirable and where the danger of exposure is small, such as in laboratories, operating and loading areas. Such glasses may be fitted with prescription safety lenses if desired. Safety spectacles should never be substituted for chemical safety goggles when the latter are indicated by conditions *see* IS 8250.

6.2.1.4 Head protection

Suitable industrial safety helmets should be used *see* IS 2925.

6.2.1.5 Foot protection

Leather or rubber safety shoes with built-in steel toe caps are recommended for workers handling drums and cans of phenol. Rubbers may be worn over leather safety shoes to prevent their contamination. Rubbers should be thoroughly cleaned and ventilated to remove contamination. Do not use contaminated shoes *see* IS 10667.

6.2.1.6 Body skin and head protection

6.2.1.6.1 Intermittent skin contact with trace amounts of liquid phenol may produce dermatitis at the site of contact, Sustained skin contact may cause serious or fatal systemic illness.

6.2.1.6.1 Clothing made of neoprene or other impervious material may be worn to protect the body against phenol splashes. It is imperative that contaminated clothing be removed promptly and laundered before re-use. Affected areas of the body should be washed thoroughly with copious amount of water before washing with soap. As a general hygienic measure, facilities for personal cleanliness should be provided and washing before lunch and at the end of the work day should be encouraged *see* IS 8519.

Caution: Protective creams do not afford adequate skin protection.

6.2.1.7 Personal hygiene

Emergency showers and eye baths see IS 10592 should be placed in convenient locations wherever phenol is being used. Employees should be instructed that direct contact with the chemical requires the immediate application of large amounts of water to the contaminated area.

6.3 Respiratory Protection

Severe exposure to phenol may occur in tanks during equipment cleaning and repairs, during decontamination of areas following spills, or in case of failure of piping or equipment. Employees who may be subject to such exposures should be provided with proper respiratory protection as described below:

6.3.1 Self-contained breathing apparatus.

This apparatus permit the wearer to carry a supply of oxygen or air compressed in the cylinder see IS 10245 (Part 1) and the self-generating type which produces oxygen chemically *see* IS 15803. These allow considerable mobility. The length of time, a self-contained breathing apparatus provides protection varies according to the amount of air, oxygen, or regenerating' material carried. Compressed oxygen should not be used where there is danger of contact with flammable liquids, vapours, or sources of ignition, especially in confined spaces, such as tanks or pits.

6.3.2 Positive pressure hose masks

This apparatus supplied by blowers requiring no internal lubrication. The wearer shall be able to use the same route for exit as for entrance and shall take precautions to keep the hose line free of entanglement. The air blower shall be placed in an area free of contaminants.

6.3.3 Air-line masks supplied with clean compressed air.

These are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. These masks are usually supplied with air pipes to the area from a compressor. It is extremely important that the air supply is taken from a safe source, and that it is not contaminated by oil decomposition from inadequate cooling at the compressor. The safer method is to use a separate compressor of the type not requiring internal lubrication. Pressure reducing and relief valves as well as suitable traps and filters, shall be installed at all mask stations.

Better control of air quality pressure breathing air may be ensured by the use of high rom standard cylinders, with demand type valve and face piece.

6.3.4 Industrial canister type gas masks

This apparatus equipped with full face pieces with the proper canister for absorbing phenol vapour. These will afford protection against concentrations not exceeding 2 percent by volume when used in accordance with manufacturers instructions. The oxygen content, of the air shall not be less than 16 percent by volume. The masks should be used for relatively short exposure periods only. They may not be suitable for use in an emergency since, at that time, the actual vapour concentration is unknown and an oxygen deficiency may exist. The wearer shall be warned to leave the contaminated area immediately on detecting the odour of a harmful vapour. This may indicate that

the mask is not functioning properly, that the vapour concentration is too high, that the canister is exhausted, or that the mask is not properly fitted.

7 STORAGE, HANDLING, LABELLING AND TRANSPORT

7.1 Storage

7.1.1 General

Each phenol container should be inspected frequently and maintained in good condition. Small quantities should be stored in tightly closed, well-labeled, approved containers to avoid leakage, spillage, and careless handling as a result of ignorance of the contents. It is recommended to store under inert gas and maintain the storage temperature at 2 °C to 8 °C.

7.1.2 Carboys

Carboys with threaded mouth should be used for packing phenol and these should be closed by a gasket and stopper. They should never be handled by neck. Protective clothing should be worn when emptying. After use they should be thorough drained, gaskets and stoppers replaced and wired. Phenol spilled on the outside of the carboys should be wiped off and the affected area flushed with hot water thoroughly.

7.1.3 Drum

7.1.3.1 Drums should be unloaded carefully to prevent damage. Do not drop or bump them.

7.1.3.2 Each shipment should be examined carefully for leaking drums. If any are found they should be handled with particular care by turning the leaking part up, and should be removed to a safe place where the leakage may be stopped or the contents transferred to a sound container.

7.1.3.3 Before emptying, substantially support the drums and block them to prevent movement.

7.1.3.4 To remove the body plug, place the bung up and use a bung or plug wrench. Stand to one side and face away during the operation. Operator shall wear adequate personal protective equipment. After the plug is loosened, give it one full turn. If internal pressure exists, allow it to vent to atmospheric pressure; only then should the plug be loosened further or removed.

7.1.3.5 Before returnable drums are sent back to the supplier, they should be completely drained, and the plugs should be securely replaced. Phenol spilled on the outside of the drum body should be flushed well with water.

7.2 Handling

7.2.1 General

Tank and equipment cleaning should be under the direction of thoroughly trained personnel who are fully familiar with all of the hazards and the safeguards necessary for the safe performance of their work. The main hazards are exposure to phenol liquid and to toxic fumes.

7.2.1.1 Tanks and equipment, pumps, lines, and valves should always be drained and thoroughly flushed with water and steamed before being repaired. Workmen should never be allowed to attempt to repair equipment while it is in operation and the lines full. If pipe sections are to be

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removed and flanges opened, the lower bolts should be loosened first, and although the lines have been flushed care should be taken to avoid personal contact with the liquid draining or dripping from the equipment. All spillage from the lines or equipment should be removed immediately by flushing to the drain with large quantities of water.

7.2.1.2 The tank or equipment to be repaired should first be emptied of all liquid, and all pipes leading to and from the tank (except vents) should be disconnected or blanked off after draining.

7.2.1.3 The tank should be steamed to remove residual phenol and vapours.

7.2.1.4 The tank should be cooled, preferably by filling with water and draining once or twice.

7.2.1.5 The tank should then be purged with fresh air, and the atmosphere should be tested for phenol vapors and oxygen deficiency.

7.2.2 *Entering Tank*

7.2.2.1 No one should enter a tank or confined space until a work permit see has been signed by an authorized person indicating that the area has been tested and found to be safe. Furthermore, no workman should 'enter a tank or vessel that does not have a manhole opening (minimum 45 cm diameter) to admit a person wearing a safety harness, life line, and emergency respiratory equipment. It should be ascertained that the tank or vessel may be left by the original entrance.

7.2.2.2 One man on the outside of the tank should keep the men in the tank under observation and another man should be available nearby to aid rescue if any of the men in the tank are overcome.

7.2.2.3 A supplied-air respirator (hose mask) or self-contained breathing apparatus, together with rescue harness and life line should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank. Appropriate personal protective equipment shall be used.

7.2.2.4 Special ventilation is recommended during the entire time men are cleaning, repairing, or inspecting the tank. Ventilation can be accomplished by exhausting or removing vapours from the bottom of the tank, either through its bottom openings or by exhausting the vapours from the tank bottom by means of a large flexible duct where tanks have a top opening only.

7.2.2.5 On tanks having only a top opening, care shall be exercised to ensure complete removal of vapors from the entire tank. Care shall also be taken to avoid having exhaust gases recycled into the tank.

7.2.2.6 During the course of the work, frequent tests should be made to determine that the atmosphere in the tank is being maintained within the safe range. This precaution is necessary because residues not completely removed by washing may re-contaminate the tank atmosphere.

7.2.2.7 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work permit issued before resumption of work.

7.2.3 Emergency Escape

Under no circumstances should a rescuer enter a tank to remove a victim of over exposure without proper respiratory protection, a safety harness, and an attached life line. The free end of life line should be manned by an attendant located outside the tank. Another attendant should be immediately available to assist in the rescue if needed. The rescuer should be in view of the outside attendant at all times or in constant communication with him.

7.2.4 Exterior Repair Work

7.2.4.1 Exterior tank repairs, including repairs to steam coils, cutting, riveting, and welding, should be permitted only after thorough cleaning and testing of the tank to make sure it is free of vapour and after a work permit has been issued by an authorized person.

7.2.4.2 All outside welding, or burning on tanks or equipment which have contained phenol should be done only after such containers have been completely purged with steam. Purging should be continued while repair work is in progress. Filling empty tanks with inert gas is another method which may be used in outside welding or burning.

7.2.4.3 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work permit issued before resumption of work.

7.3 Labelling

7.3.1 Packaging

7.3.1.1 Solid phenol in metal containers may be packed in high density polyethylene or wooden barrels, kegs or boxes. Aluminium drums may also be used.

7.3.1.2 Phenol solutions may be packed in metal drums or boxed glass or high density polyethylene carboys.

7.3.2 Labelling

7.3.2.1 Each container including tank cars shall be securely closed and shall bear legibly and indelibly the following information:

- a) Name and grade of the material;
- b) Lot or batch number and date of manufacture;
- c) Tare, gross and net mass; and
- d) Indication of the source of manufacture.
- e) Physical, chemical and toxicological data as per the criteria given in the relevant schedule of the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989. While referring to the statutes, the stipulations given in the subsequent amendments of those statutes shall be taken into account.

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Manufacturers name with label warnings required by regulations or ordinances form part of the label or placard.

7.3.2.2 Each container shall also be marked with Fig. 7 of IS 1260 (Part 1) along with the following information printed in the space provided. The lower half of the label shall have the following text printed in addition to or in combination with any other statements required by statutes, regulations or ordinances.

<p style="text-align: center;">PHENOL</p> <p style="text-align: center;">DANGER! POISON! LIQUID OR SOLID RAPIDLY ABSORBED THROUGH SKIN, CAUSES SEVERE BURNS</p> <p>Do not get in eyes, on skin, on clothing.</p> <p>Avoid breathing vapors.</p> <p>Do not take internally.</p> <p>In case of contact immediately remove all contaminated clothing involving shoes, and flush skin or eyes with plenty of water at least 15 min, for eyes get medical attention.</p>

7.4 Transport

Only driver trained in phenol handling should be employed for transportation of phenol. Driver should carry TREM card when vehicle is on road.

NOTE — If transport of the hazardous chemical is involved it shall be carried out in accordance with the Central Motor Vehicles Rules, 1989. While referring to the statutes, the stipulations given in the subsequent amendments of those statutes shall be taken into account

8 SPILLAGE, LEAKAGE AND WASTE DISPOSAL

8.1 Spill and Leaks

8.1.1 Frequent equipment inspections should be made to detect or prevent leaks.

8.1.2 If leaks or spills occur and vapour becomes strong enough to be noticeable, only properly protected personnel should remain in the area.

8.1.3 Spilled phenol should never be left unattended. Immediately flush with large quantities of water until ail hazards from phenol have been removed and all traces of odour have disappeared. Freely ventilate the area to remove the vapour. A two to five percent solution of-caustic soda be used as a neutralizer. may Care shall be exercised in the use of caustic soda as it is corrosive and will burn the skin and eyes.

8.1.4 If leakage of a container occurs, remove the container to the outdoors or to isolated, well-ventilated area, and transfer contents to ~ suitable containers_

8.2 Waste Disposal

8.2.1 General

All local water pollution regulations should be determined and complied with. Phenol may be recovered, and possible pollutioncausing discharges avoided, by charcoal absorption, solvent extraction or steam stripping. Minimum concentrations of one percent by weight are generally necessary for economical recovery.

8.2.2 Phenol is water soluble and is amenable to biological or chemical oxidation. Larger amounts of phenol may be more economically removed by biological oxidation. It is generally necessary to acclimate the microorganisms to phenol, so care should be taken to avoid shock loadings on biological treatment plants. Discharge to municipal sewers may offer a satisfactory solution provided approval of the sewerage authority is obtained. Aqueous phenol solutions may be chemically oxidized by chlorine, chlorine dioxide or other oxidants. Disposal may also be accomplished by burning contaminated wastes if proper burning methods are practised so as not to create an air pollution problem.

8.2.3 If phenol bearing wastes are to be treated in oxidation ponds or disposed of in impounding basins, or otherwise discharged to the ground, necessary precautions shall be taken to prevent ground water contamination. Care shall also be taken to keep unprotected workers and the general public away from such disposal areas.

8.2.4 Phenol is classed as a taste and odour producing compound in water supplies, especially those which are chlorinated. The phenol content of a water supply should not be in excess of 0.01 mg/l, where other more suitable supplies are or may be made available.

8.3 Tank Cleaning and Repair

8.3.1 General

Tank and equipment cleaning should be under the direction of thoroughly trained personnel who are fully familiar with all of the hazards and the safeguards necessary for the safe performance of their work. The main hazards are exposure to phenol liquid and to toxic fumes.

8.3.1.1 Tanks and equipment, pumps, lines, and valves should always be drained and thoroughly flushed with water and steamed before being repaired. Workmen should never be allowed to attempt to repair equipment while it is in operation and the lines full. If pipe sections are to be removed and flanges opened, the lower bolts should be loosened first, and, although the lines have been flushed, care should be taken to avoid personal contact with the liquid draining or dripping from the equipment. All spillage from the lines or equipment should be removed immediately by flushing to the drain with large quantities of water.

8.3.1.2 The tank or equipment to be repaired should first be emptied of all liquid, and all pipes leading to and from the tank (except vents) should be disconnected or blanked off after draining.

8.3.1.3 The tank should be steamed to remove residual phenol and vapours.

8.3.1.4 The tank should be cooled, preferably by filling with water and draining once or twice.

8.3.1.5 The tank should then be purged with fresh air, and the atmosphere should be tested for phenol vapours and oxygen deficiency.

8.3.2 Entering Tank

8.3.2.1 No one should enter a tank or confined space until a work permit has been signed by an authorized person indicating that the area has been tested and found to be safe. Furthermore, no workman should 'enter a tank or vessel that does not have a manhole opening (minimum 45 cm diameter) to admit a person wearing a safety harness, life line, and emergency respiratory equipment. It should be ascertained that the tank or vessel may be left by the original entrance.

8.3.2.2 One man on the outside of the tank should keep the men in the tank under observation and another man should be available nearby to aid in rescue if any of the men in the tank are overcome.

8.3.2.3 A supplied-air respirator (hose mask) or self-contained breathing apparatus, together with rescue harness and life line should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank. Appropriate personal protective equipment shall be used.

8.3.2.4 Special ventilation is recommended during the entire time men are cleaning, repairing, or inspecting the tank. Ventilation can be accomplished by exhausting or removing vapours from the bottom of the tank, either through its bottom openings or by exhausting the vapours from the tank bottom by means of a large flexible duct where tanks have a top opening only.

8.3.2.5 On tanks having only a top opening, care shall be exercised to ensure complete removal of vapours from the entire tank. Care shall also be taken to avoid having exhaust gases recycled into the tank.

8.3.2.6 During the course of the work, frequent tests should be made to determine that the atmosphere in the tank is being maintained within the - safe range. This precaution is necessary because residues not completely removed by washing may re-contaminate the tank atmosphere.

8.3.2.7 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work permit issued before resumption of work.

8.3.3 *Emergency Escape*

Under no circumstances should a rescuer enter a tank to remove a victim of over exposure without proper protection, a safety harness, and an attached life line. The free end of the life line should be manned by an attendant located outside the tank. Another attendant should be immediately available to assist in the rescue if needed. The rescuer should be in view of the outside attendant at all times or in constant communication with him.

8.3.4 *Exterior Repair Work*

8.3.4.1 Exterior tank repairs, including repairs to steam coils, cutting, riveting, and welding, should be permitted only after thorough cleaning and testing of the tank to make sure it is free of vapour and after a work permit has been issued by an authorized person.

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8.3.4.2 All outside welding, or burning on tanks or equipment which have contained phenol should be done only after such containers have been completely purged with steam. Purging should be continued while the repair work is in progress. Filling empty tanks with inert gas is another method which may be used in outside welding or burning.

8.3.4.3 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work permit issued before resumption of work

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 General

Phenol, having a flash point of 85 °C is safe to handle at ambient temperatures but will burn if ignited or if involved in a fire. Flammable toxic vapour will be given off: at elevated temperatures, should the material become involved in fire.

9.2 Fire fighting

9.2.1 Suitable extinguishing media

This material is combustible. Use extinguishing media appropriate for surrounding fire. If tank, rail car or tank truck is involved in fire, consider for isolation and initial evacuation in all directions. For small fire use dry chemical powder as extinguishing media. For large Water foam Carbon dioxide (CO₂), Dry powder and water, foam, alcohol resistant foam, dry extinguishing powder, ABC-powder as suitable extinguishing media to put out the fire. If it can be done safely, move undamaged containers away from the area around the fire. Dike runoff from fire control for later disposal.

9.2.2 Unsuitable Extinguishing Media

Water jet to be avoided to put out the fire due to phenol. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire.

9.3 Preventive Measures

9.3.1 Ventilation

Except where an operation gives off hot phenol vapour, special ventilation is not required. Adequate ventilation should, however, be provided so that the threshold limit value is not exceeded.

9.3.1.1 Under all normal conditions the atmospheric concentration of phenol vapour shall be kept low enough to prevent irritation of the mucous membranes and discomfort to the workers.

9.3.1.1.1 Under abnormal conditions, such as leaks or spills, special emergency ventilating equipment may be necessary. The discharge from any ventilating system shall be so located as to prevent atmospheric contamination.

9.3.2 Grounding

Process equipment should be electrically grounded and bonded to prevent possible ignition from static sparks.

10 TRAINING

10.1 Employee Education and Training

10.1.1 Safety in handling phenol depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision, and the use of safe equipment.

10.1.2 The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervision. Training classes for both new and old employees should be conducted periodically to maintain a high degree of safety in handling procedures. Workers should be thoroughly informed of the hazards that may result from improper handling of phenol. They should, be cautioned to prevent spills and thoroughly instructed regarding proper action to be taken in case they occur. Each employee should know what to do in an emergency and should be fully informed as to first-aid measures.

10.2 Pre placement Physical Examination

10.2.1 Most employees may be assigned to processes in which the handling of phenol is carefully controlled. Individuals with evidence of liver or kidney disease and those who are unusually sensitive to phenol should not be assigned to processes that may involve-exposure to phenol.

10.2.2 Employees should undergo periodical medical check-up including urine examination to find out effects of phenol exposure on skin, liver or kidney.

11 FIRST-AID

11.1 General

After severe exposure to phenol vapours or air droplets, it is important to remove the patient from the contaminated area. In case of skin or eye exposure the chemical shall be removed immediately or severe injury may result. A physician shall be called.

11.2 Contact with Skin and Mucous Membranes

11.2.1 The most important part of the treatment is removing the chemical by large amounts of water immediately after the accident. If skin contact is extensive, the employee should get under the shower immediately. Clothing including shoes and socks may be removed while under the shower. Continue washing until all odour of phenol has disappeared. Rub contaminated skin with swabs soaked in glycerol, polyethylene glycol (PEG) or 70 : 30 mixture of PEG and methylated spirit for at least 10 min. Medical advice should be sought immediately.

11.2.2 Rinse our rinse out with polyethylene glycol 400 or a mixture of polyethylene glycol 300/ethanol 2:1 and wash with plenty of water. If neither is available wash with plenty of water. Immediately take off contaminated clothing. Call a physician immediately.

11.3 Contact with Eyes

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If phenol in either the solid, liquid or vapour form enters the eyes, they should be irrigated immediately and copiously with water for at least 15 min. The eye lids should be held apart during the irrigation to insure the removal of the chemical from all the tissues of the eye surfaces and lids. A physician, preferably an eye specialist, should be called at the first possible moment. If a physician is not immediately available, the irrigation should be continued for a further 15 min interval. After the first 15 min period of irrigation and if pain is still present, it is permissible as a first-aid measure to instill two or three drops of a 0.5 percent pontocaine solution or an equally effective aqueous topical anesthetic. No oils or oily ointments should be instilled unless ordered by a physician.

11.4 Ingestion

If a person has swallowed phenol the injury that occurs will be due to the corrosive action on the mouth, esophagus and stomach and to its systemic toxicity. The patient should instantly drink large quantities of water in order to reduce the concentration of the chemical. If vomiting does not occur spontaneously induce vomiting by giving a warm salt solution (2 table-spoons to a glass of water) or tickling the back of the throat. If the patient is in shock, has severe pain or is unconscious, vomiting should not be induced. Call a physician immediately. Keep the patient warm but not hot.

11.5 Inhalation

Exposed persons should be removed immediately from the contaminated atmosphere and a physician called. If breathing has ceased, effective artificial respiration should be initiated at once. If oxygen inhalation apparatus is available, oxygen should be administered but only by a person authorized for such duty by a physician. If the patient is conscious the irritation to the throat may be relieved by washing the throat with water.