



Shell Chemicals

Phenol Product Information Bulletin

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Phenol
C₆H₅OH

Product

Phenol is a white crystalline (at room temperature), odorous and toxic chemical compound, which is used widely as a raw material in the manufacture of other chemical products (see "Applications"). It was originally isolated from coal tar streams, but through technological advances is now almost entirely produced synthetically. The dominant process in use today is the oxidation of cumene (a product of benzene and propylene reaction) and the subsequent cleavage of cumene hydroperoxide to form phenol and acetone. Shell began manufacturing phenol by this process in 1958 and was a pioneer in utilization of the new technology. Shell's original facility, however, was shut down in 1973 and has now been replaced with the world's largest integrated (cumene is manufactured on the same site), single train production facility. The plant utilizes the latest and most technologically advanced design characteristics possible for the efficient use of energy and feedstocks and protection of the environment. In addition the plant has been designed to produce very high quality materials.

This bulletin discusses briefly the safety, storage, handling, and shipping information, physical properties, specifications and uses of phenol.

Table 1

Phenol sales specifications

Freezing point, (dry)	40.8 degrees C minimum / 105 degrees F
Color, Pt-Co, as loaded at shipping origin	20 maximum
Water, %w, as loaded at shipping origin	0.1 maximum
Appearance	Clear
Non-volatile residue, %w	0.05 maximum

Phenol shipping information

Shell Chemical LP will ship phenol by all basic bulk modes: 45,000 lb minimum tank truck quantities, 23,500 gallon tank cars and barges. Shell's shipping equipment is designed to maintain product integrity and provide for safe, environmentally acceptable and efficient transportation. Due to the physical properties of phenol (solid below 106 degrees F) all equipment is insulated and equipped so that the product can be warmed prior to discharge into the customer's facilities.

Tank trucks

Stainless steel MC 307 tank trucks are utilized to ship phenol. They are insulated and equipped with low pressure (5-10 psig) steam or hot water coils to reheat the product in the event the phenol solidifies en route to the customer. Where customers choose to use their own equipment to pick up phenol at Shell's designated location(s), the equipment is inspected by Shell personnel for compliance with D.O.T. regulations prior to loading. Quantities loaded are determined by scale weight. Trucks are normally equipped with self-contained unloading equipment; however, individual customers having special requirements for unloading should note this when placing orders.

Tank cars

Shell's tank car fleet consists of 23,500 gallon lined tank cars which are insulated and equipped with low pressure steam external heating coils. Tank cars are equipped with facilities for top unloading only through a two inch line extending to the bottom of the car. A one inch inert gas connection is also included to allow unloading by pumping and/or pressurization.

The contents of the tank car should be warmed via the external heating coils using 5-10 psig low pressure steam until the contents at the top of the car are approximately 125 degrees F. The quantity of each delivery will be determined on the basis of a certified scale or weighmaster's certificate. If a customer chooses to use their own tank cars or if assistance is desired in establishing safe and effective unloading procedures, the local Shell Sales Representative should be contacted.

Marine

Shell has facilities to load phenol into ocean-going vessels and barges. Due to the specialized nature of equipment required to handle marine parcels of phenol, early discussions with your Shell Sales Representative are necessary to determine the availability and proper configuration of equipment.

Precautions

Shell recommends that several precautions be taken to help ensure safe handling of phenol.

- Personnel involved in the handling of phenol should be familiar with Shell's Product Stewardship Manual for phenol.
- Workers employing shipping equipment should be equipped with proper safety devices as described in the "Handling, storage, and environmental" portion of this bulletin.
- In case of accidental contact with phenol, the affected area(s) should be immediately and thoroughly washed with large amounts of water and immediate medical attention obtained.
- The unloading station should be equipped to allow containment and collection of phenol should a spill occur. Local regulations should be followed regarding disposal of phenol, or phenol contaminated wash water.
- The shipping container and unloading line should be electrically grounded.
- Check received quantity and storage availability prior to discharge.

Handling, storage, & environmental considerations for phenol handling

General Safety

Phenol storage areas should be labeled to identify the product, the hazards, and the appropriate personal protective equipment required to enter the area. The unloading station should be equipped to allow containment and collection of phenol should a spill occur. Local regulations should be followed regarding disposal of phenol, or phenol contaminated wash water.

Safety showers, eye wash fountains, supplied breathing air, and self-contained breathing apparatus (SCBA) should be readily available and properly maintained in the immediate area where phenol is stored. Safety showers and eye wash fountains should have alarms to alert workers of a possible exposure.

Phenol should not be handled without the use of suitable NIOSH and/or OSHA-approved full protective clothing and face shields. In case of accidental contact with phenol, the affected area(s) should be immediately and thoroughly washed with large amounts of water and immediate medical attention obtained.

All employees who have the potential for entering phenol storage areas should receive regular training regarding the hazards of phenol and the proper handling procedures. Phenol should be handled as a combustible liquid and stored in a cool, dry area, away from sparks and open flames. It is incompatible with strong oxidizing agents. Suitable extinguishing agents such as CO₂, dry chemical, foam or water fog should be readily available in the event of a fire.

Storage

All Phenol storage containers should have adequate secondary containment (dikes) to contain the product in the event of a release. Pumps and other equipment in Phenol service should be on a concrete containment system to capture drips and prevent soil contamination. Storage tanks should be equipped with high level and high-high level alarms to prevent overfills.

Phenol may be discolored by contact with carbon steel. Therefore, phenol storage tanks and transfer piping are normally constructed of stainless steel or lined carbon steel. A typical lining used is Carbozinc II. Generally, smaller fittings will be stainless steel due to the difficulty of lining them. Hot phenol is corrosive to carbon steel.

Phenol storage tanks are insulated and equipped with either internal (bayonet type) or external heaters or external heating pads. The heat medium used in heaters should be low pressure steam or another low temperature heat medium to prevent discoloration. A temperature control system should be in place to maintain the tank contents between 115 and 130 degrees F. Bulk skin temperatures of heating coils above 150 degrees F can cause discoloration. Tanks can be nitrogen-blanketed to minimize color and keep atmospheric moisture out.

Environmental Issues

For the US, under EPA CERCLA and EPCRA regulatory requirements, releases to air, land, or water which exceed the reportable quantity (RQ) for Phenol of 1,000 pounds must be reported to the National Response Center (1 800 424 8802), the Local Emergency Planning Committee (LEPC), and the State Emergency Response Commission (SERC). State and local laws may require additional notifications.

Spills

It is extremely important to prevent all bodily contact with spilled material. Personal protective equipment recommendations described above for safe handling of phenol should be followed by cleanup personnel.

For large spills, eliminate ignition sources and:

- If phenol is leaking from storage vessel, shut off the source of the leak if safe to do so.
- If phenol is spilled on the ground, dike and contain to prevent entry in drains.
- If phenol solidifies on the ground, shovel or scoop up and place in appropriate containers for recovery or disposal.
- If phenol solution is spilled on the ground, remove with vacuum truck or pump to storage/salvage vessels.
- If phenol residue remains, soak up with absorbent such as clay, sand, or other suitable material and place in non-leaking containers.
- If phenol traces and odors remain, flush the spill area with water and dispose of the flush solution properly.
- For small spills, phenol should be taken up with an absorbent material and placed in non-leaking containers for proper disposal.

Waste phenol is a Resource Conservation and Recovery Act (RCRA) hazardous waste (U188) in the US and must be disposed of in accordance with federal and local laws governing hazardous waste.

Table 2

Phenol typical properties	
Appearance	At ambient temperatures it is a hygroscopic crystal, white when pure, pink or red with impurities present. When in a molten state it is a colorless mobile liquid. Phenol darkens on exposure to light.
Odor	Strong, persistent, sweet odor.
Odor threshold	0.05 ppm to 0.5 ppm
Density	
25 degrees C	1.071 kg/liter
50 degrees C	1.050 kg/liter
Flash point (TCC)	79 degrees C (175 degrees F)
Autoignition temperature	716 degrees C (1321 degrees F)
Boiling point	182 degreesC (359 degrees F)
Melting point	40.9 degrees C (105.6 degrees F)
Coefficient of expansion	0.00085 per degrees C (approximate)
Viscosity, cSt	
41 degrees C	4.2
50 degrees C	3.4
60 degrees C	2.6
100 degrees C	1.05
Miscibility with water	Crystals are hygroscopic but not very soluble. Liquid is miscible above 67 degrees C. Below that temperature two phases exist: 10% phenol in water and 35% water in phenol.
Solubility, water in phenol	28% w at 20 degrees C (68 degrees F)
Solubility, phenol in water	8% w at 20 degrees C (68 degrees F)
Conductivity (picosiemens/meter) approximately	35 x 10 ⁵ at 50 degrees C
Explosive limit in air, lower	1.5% v/v
Vapor density (air=1)	3.24
Vapor pressure (millibar)	

25 degrees C	0.29
50 degrees C	3.5
100 degrees C	54
160 degrees C	530
Vapor pressure (Reid) 100 degrees F (lb)	0.2
Threshold limit value (TLV/MAC)* for eight hour day	5 ppm, 19 mg/cubic meter (ACGIH 1975)
Alternative names for phenol	Monohydroxybenzene, hydroxybenzene, benzenol, carboic acid, phenylic acid

* The TLV is valid only if appropriate measures are taken to prevent absorption through the skin and mucous membranes.

Applications

Phenol is a reactive organic chemical which is used in a wide variety of chemical products vital to the economy of the world. It is reacted in various ways with aldehydes, e.g., formaldehyde, to form what are commonly known as "phenolic resins", materials which are strong, water resistant and have good dielectric properties. They, in turn, are widely used as adhesives (plywood binders, brake linings, counter tops, insulation), structural shapes (automotive parts, electrical fixtures) and electrical laminates (circuit boards). Other uses for phenol include the manufacture of caprolactam (an intermediate in the manufacture of nylon), bispheno-A (an intermediate in the manufacture of epoxy resins and polycarbonate engineering thermoplastics), herbicides, wood preservatives, hydraulic fluids, heavy duty surfactants, lube oil additives and extraction aids, pharmaceuticals, disinfectant materials, tank linings and coating materials, and as intermediates for plasticizers and other specialty chemicals.

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