AdvanSix Phenol

Product and Technical Information

AdvanSix

Table Of Contents

Introduction

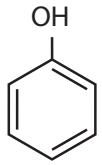
Phenol is produced by AdvanSix at Frankford, PA. The Frankford plant is strategically located along the Delaware River in Philadelphia. The Frankford plant receives feedstock and ships products by rail, truck, barge and ocean vessel.

AdvanSix's commitment to the merchant phenol market is evidenced by its major investments and acquisitions in phenol production capacity. AdvanSix's annual phenol capacity is over 1 billion pounds.

Phenol*, also referred to as carbolic acid, phenylic acid, benzophenol, hydrobenzene, and mono-hydroxy benzene, is an organic chemical used to produce a wide variety of chemical intermediates. The primary chemical intermediates include phenolic resins, bisphenol A, caprolactam, alkyl phenols and adipic acid.

** Chemical Abstracts Registry Number 108-95-2*

Typical Physical Properties

Structural Formula	
	C_6H_5OH
Empirical Formula	
Physical State	Liquid or solid
Flammable Limits	Lower limit approx. 1.7%
Flash Point	Upper limit 8.6%
Tag Open Cup	85°C (185°F)
Closed Cup	79°C (174°F)
Autoignition Temperature	715°C (1319°F)
Boiling Point (760 mm)	181.8°C (359°F)
Color	Colorless to light pink solid, or white molten liquid
Critical Pressure (Atmospheres)	60.5
Critical Temperature	419°C (786°F)
Deliquescent	Yes
Dielectric Constant (48°C)	9.9
Freezing Point	40.9°C (105.6°F).
Heat of Vaporization at Boiling Point (1 atmosphere)	
cal/g	114.3
BTU/lb	205.7
Hygroscopic	Yes
Light Sensitive	Yes, darkens slowly on exposure to light
Molecular Weight	94.11
Odor	Characteristically sweet
Reactivity	Not dangerously reactive
Solubility	
Water 16°C (61°F) 66°C (151°F) Alcohol Organic Solvents	6.7 gm/100m1 All proportions Soluble Soluble
Specific Gravity	
Solid at 25/4°C	1.071
Liquid at 41/4°C	1.058
Liquid at 50/4°C	1.049
Liquid at 60/4°C	1.041
Specific Heat (cal/g/°C)	
Solid at 4°C	0.306
Solid at 22.7°C	0.338
Liquid at 70-74°C	0.548

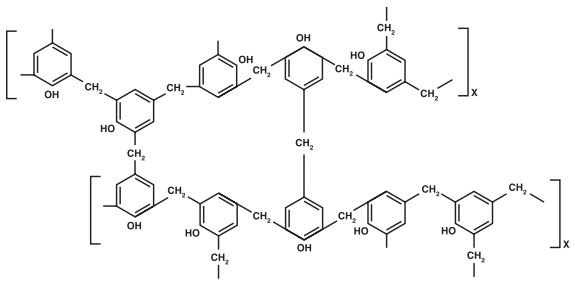
Surface Tension at Melting Point	
(Dynes/cm)	37.9
Threshold Limit value (8 hours)	5 ppm or 19mg/m3
Threshold (Odor	0.3 ppm)
Vapor Density (Air = I)	3.24
Viscosity (Centistokes)	
Liquid at 45°C	3.8
60°C	2.52
80°C	1.597
Weight per Gallon at 50°C (122°F) (lbs.)	8.75

Specifications for Phenol

Characteristics Test	Method Sales	Specifications
Solidification Pt., °C	ASTM D1493	40.7°C. minimum
Water, %	ASTM D1631	0.1% maximum
Appearance	Visual	White molten liquid or white crystalline solid; free of foreign material
Color, APHA	ASTM D1686	20, maximum LT<5

End Uses

Phenol is used as a basic feedstock for producing numerous derivatives. The major derivatives and uses are described briefly below.



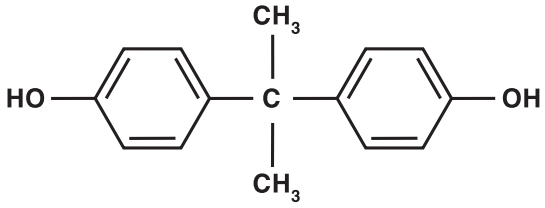
Phenolic Resins

Phenolic resins are the condensation product of phenol or substituted phenols with an aldehyde, such as formaldehyde. The largest use for phenolic resins is in adhesives (for plywood), followed by binders for insulation (fiberglass, mineral wool, etc.), impregnating and laminating agents (for plastic and wood laminates), and molding compounds and foundry resins.

End Uses *(continued)*

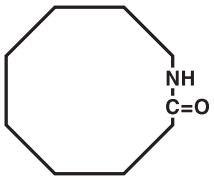
Bisphenol A

Bisphenol A (BPA) is produced by reacting phenol with acetone in the presence of an acid catalyst. There are two major uses for bisphenol A: epoxy resins and polycarbonate resins. Small amounts of bisphenol A are used to produce phenoxy resins, polysulfone resins, polyester resins, adhesives, and as stabilizers.



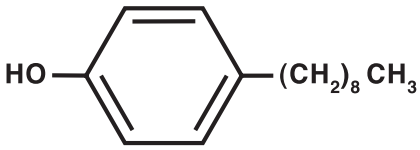
Caprolactam

Caprolactam is produced by hydrogenating phenol with a palladium catalyst to cyclohexanone, and then reacting with hydroxylamine sulfate to produce cyclohexanone oxime. The oxime is then reacted with sulfuric acid and neutralized with aqueous ammonia to produce caprolactam. Caprolactam is polymerized to nylon 6, a polyamide polymer used for fibers, films and engineering plastics.



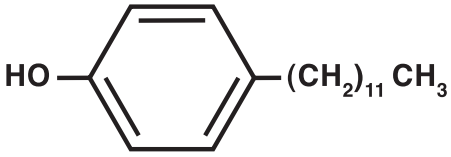
Nonylphenol

Nonylphenol is produced by adding phenol to a branched nonene isomer, or straight-chain nonene, in the presence of an acid catalyst, such as sulfuric acid or boron trifluoride, to produce mostly 4-substituted nonlyphenol. Nonylphenol is used as a surface-active agent, emulsifier, antioxidant, and lube oil additive.



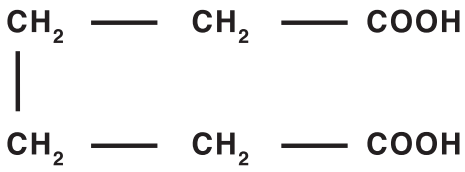
Dodeclyphenol

Dodeclyphenol is produced like nonylphenol: phenol is reacted with branched chain dodecenes in the presence of an acid catalyst, to produce mostly 4-alkylphenol isomers. Dodeclyphenol is used primarily in detergents, lube oil additives and surface-active agents.



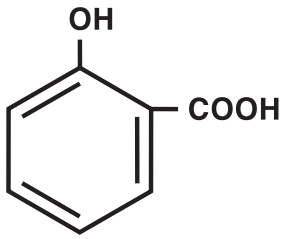
Adipic Acid

Adipic acid is produced by hydrogenating phenol to cyclohexanol, which is then oxidized with nitric acid to adipic acid. Adipic acid is used to produce plasticizers, polyester polyol-based urethane resins, food additives and synthetic lubricants.



Salicylic Acid

Salicylic acid is produced by reacting phenol with sodium hydroxide to produce sodium phenate, which is reacted with carbon dioxide to produce sodium salicylate and then acidified with hydrochloric acid or sulfuric acid to form salicylic acid. Salicylic acid is used primarily for drugs and drug intermediates, specialty chemical intermediates, dyes, and additives for resins, plastics, and rubbers.



Specialized Uses

Phenol is also found in numerous, small volume, applications, including:

- plasticizers (fire-retardant esters, such as cresyl diphenyl, triphenyl, dibutyl phenyl and diphenyl octyl phosphates),
- synthetic cresols and xylenols (o-cresol and 2, 6-xylenol, which are used for plastics and resins),
- other alkylphenols (such as p-t-butyl phenol, p-t-octyl phenol, and isopropylphenols, which have numerous applications, such as surfactant esters, and others),
- herbicides (2,4-dichlorophenoxyacetic acid),
- wood preservative (pentachlorophenol),
- aniline,
- pharmaceuticals,
- dyes.

Handling Information

DOT Regulatory Shipping Information

Phenol is classified by the U.S. Department of Transportation (DOT) as a Class 6.1 (poisonous) material. When shipping via all modes of transportation, shipments must be documented, packaged, labeled, marked, placarded, loaded and unloaded in accordance with the applicable DOT Regulations.

Title 49, Code of Federal Regulations contains the regulations for shipping hazardous materials via air, highway, rail, and water, except bulk water shipments, which are regulated by Titles 33 and 46, Code of Federal Regulations.

Storage

Molten phenol discolors quickly when in contact with iron or copper. The higher the temperature, the more rapid the discoloration. To minimize discoloration store phenol at temperatures below 60°C (140°F). The choice of construction materials for storing phenol depends on color requirements in conjunction with the end use. Preservation of color of high purity phenol is best accomplished in vessels constructed of stainless steel or lined carbon steel. Glass, nickel, baked phenolic resins and two part inorganic zinc silicate such as Plasite 1002/1010 are suitable materials for linings. When the color of phenol is not important, vessels of ordinary carbon steel serve satisfactorily, because phenol has no appreciable corrosive activity on mild steel at the temperatures usually encountered in transportation and storage. Hot phenol readily attacks metals such as copper, aluminum, magnesium, lead, and zinc. Therefore, these metals and their alloys are not recommended for use in molten phenol storage tanks where the metal is in direct contact with the phenol. Constant circulation through external steam-heat exchangers is the preferred method to maintain phenol in a liquid state while in storage. This minimizes the chance of moisture contamination due to leaks, facilitates tank cleaning, and avoids local overheating, which increases color degradation. All lines that are isolated after any transfer should be blown clear with nitrogen or an acceptable inert gas to prevent damage due to expansion. All transfer lines should be heat traced and insulated.

Sampling Phenol in Shipping Containers

Proper Personnel Protective Equipment (PPE) should be worn when sampling phenol. Samples of phenol may be taken through the manway opening of a shipping container by means of a bottle placed in a stainless steel holder and suspended by a light stainless steel chain. Before taking a sample for testing, the bottle should be rinsed with the phenol to be sampled, and quickly closed to minimize moisture pickup and other contamination. An ordinary three-gallon pail may be used to collect the sampling bottle, bottle holder and chain as they are withdrawn, dripping, from the tank.

Transfers from Shipping Containers and Storage Tanks

Phenol can be transferred by pumping, pressure, or gravity. Centrifugal and turbine-type pumps are used in transfer operations. Pipelines carrying phenol should be heat traced and insulated to keep the chemical in a liquid state to avoid plugging lines. Steam tracing is the most common means of heating; insulation is also recommended. Phenol should not remain stagnant in steam traced lines to avoid color formation.

Shipments

AdvanSix ships phenol in tank trucks and tank cars. The following procedures apply to unloading tank cars and tank trucks. The safety guidelines also apply to barges. AdvanSix ships high-quality phenol in various capacity tank cars. All tank cars in AdvanSix's fleet are equipped with external steam heater coils. In order to maintain a high-quality product, AdvanSix's tank cars are internally lined and all loading arrangements and valves are made of stainless steel.

Type of Container	Net Weight (Approx. Lbs.)
Rail	
23,500 Gal. Lined Carbon Steel Tank Cars	186,000
22,000 Gal. Lined Carbon Steel Tank Cars	183,900
21,000 Gal. Lined Carbon Steel Tank Cars	173,000
20,000 Gal. Lined Carbon Steel Tank Cars	167,200
Truck	
5,200 Gallon Stainless Steel	45,500

Unloading Phenol Tank Cars

Proper Personnel Protective Equipment must be worn whenever personnel are on or under the phenol tank car during the unloading operation. Phenol tank cars can be unloaded by the use of inert gas or by the use of a pump. Although some of the tank cars are equipped to be bottom unloaded as well as top unloaded, AdvanSix strongly recommends that phenol be unloaded from the top. Bottom unloading is extremely hazardous and, therefore, not recommended. Failure of an unloading line would allow the remaining phenol within the car to escape until one of the tank car valves is completely closed. In the case of top unloading, the closing of the pump or inert gas will stop the flow of phenol up through the siphon pipe.

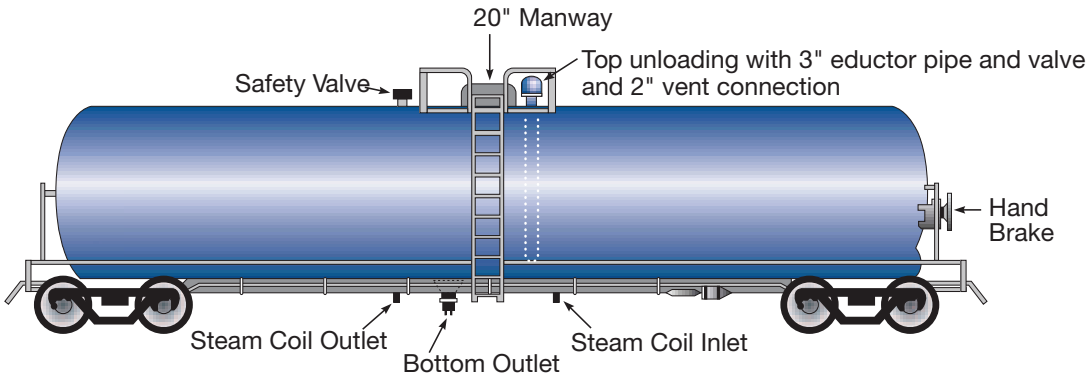
Car Thawing

When necessary to thaw phenol tank cars, they should be spotted on a level section of the unloading rack and isolated from moving cars. Brakes must be applied, chocks must be in place, the tank car must be grounded and caution signs in place. It is then safe to vent the car by means of the vent valve, as shown on the diagram. Before starting to thaw the tank car, a proper vent must be established on the phenol tank car to avoid any pressure build up inside the tank car. If the dome is open, the dome opening must be free of phenol. This can be accomplished by briefly heating the outside of the dome ring. The manway cover may now be opened to permit inspection of the contents of the tank car. Low pressure steam should be connected to the steam inlet or inlets on the bottom of the tank car. (See illustration on page 9). Gradually admit steam to the coils until a trickling of condensate appears at the steam coil outlet pipe (a steam trap is not recommended to avoid overheating and discoloration). Heat the phenol in the tank car to 50 to 60°C (122 to 140°F). During the thawing process, the temperature of the car should be continuously monitored and recorded. Either the temperature of the phenol can be directly measured by inserting a thermocouple in to the phenol or thermowell, or the condensate outlet temperature can be monitored. An automatic steam supply shut off valve linked to a temperature measurement should be considered to avoid overheating. Phenol expands as it is heated and occupies approximately 5% more volume at 100°C than it does at 41°C; overheating also raises the temperature above its flash point (79°C).

CAUTION: Do not overheat phenol as you may overflow the container as it expands and/or it may exceed its flashpoint (79°C) and create an extremely hazardous situation.

Top Unloading Procedures By Pumping

Strategically place all signs and placards before operations begin. Tank cars should be spotted on a level section of the unloading track and isolated from moving cars. Brakes must be applied, chocks must be in place, the tank car must be grounded and caution signs put in place. Before unloading operations begin, make certain all personnel are wearing appropriate personal protective equipment.



Note: Most of our older cars have 2" eductors and 1" vent valves.
Our newer cars have no bottom outlets. Bottom unloading is not recommended.

1. Vent pressure in tank car by opening the vent valve and ensure the vent is free and clear throughout the entire unloading process.
2. Open the manway cover and inspect the phenol. Refer to the paragraphs on steam heating phenol tank cars, if necessary.
3. Phenol is ready to be unloaded when the temperature in the tank is 50 to 60°C (122 to 140°F). Confirm receiving storage tank will contain the entire contents of car and is properly vented.
4. Connect the pump discharge to the receiving storage tank. Make sure all fittings are tight. Leak check fittings.
5. Open the eductor outlet valve.
6. Blow backward through the eductor with nitrogen to confirm the eductor is open.
7. Connect the pump suction to the eductor pipe valve as shown in the appropriate diagram of the tank car.
8. Start the pump and empty the tank car. Be sure car is properly vented or that the contents are being displaced with nitrogen or another acceptable inert gas.
9. Stop the pump after making certain the car is empty.
10. Blow the transfer lines clear of phenol with nitrogen or inert gas.
11. Disconnect all hoses, nozzles, and associated fittings connected to the car. Collect and properly dispose of any dripped phenol.
12. Close all openings on the car except coil inlet and outlet caps, if so equipped.
13. Carefully blow out the steam coils. Do not replace steam inlet and outlet caps, if so equipped. Let them hang by their safety chains to permit drainage.
14. Remove chocks, safety signs, and ground wire.

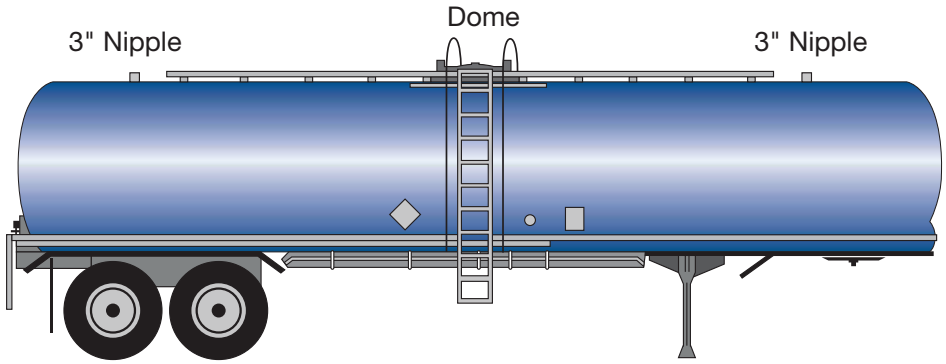
Top unloading procedure by inert gas

Strategically place all signs and placards before operations begin. Tank cars should be spotted on a level section of the unloading track and isolated from moving cars. Wheels should be chocked, brake set, the car must be grounded and caution signs put in place. Before unloading operations begin, make certain all personnel are wearing proper personal protective equipment.

1. Vent pressure in tank car by opening the vent valve.
2. Open the manway cover and inspect the phenol. Refer to the paragraphs on steam heating phenol tank cars, if necessary.
3. Phenol is ready to be unloaded when the temperature in the tank is 50 to 60 C (122 to 140°F). Make sure the receiving tank is vented and will receive the entire contents of the car.
4. Open the eductor pipe valve.
5. Make sure the eductor pipe is open by blowing nitrogen or another inert gas backwards through the eductor.
6. Connect the discharge line to the eductor pipe valve.
7. Connect the inert gas line to the vent valve. A suitable relief valve must be included in the line. Pressure must be regulated to a maximum of 80% of the relief device setting.
8. Close the manway cover and secure it. Make sure all fittings are tight. Leak check fittings.
9. Check to see that all valves in the discharge line are open; slowly turn on the inert gas.
10. Empty the car. When the pressure falls, or when gas begins to rush through the discharge line, turn off the inert gas.
11. Slowly vent the pressure from the tank car preferably through the unloading line to the tank.
12. Close the eductor pipe valve.
13. Blow transfer lines clear of phenol with inert gas.
14. Remove all hoses, nozzles, and fittings from the car and replace all caps or plugs tool tight except coil inlet and outlet caps, if so equipped. Collect and properly dispose of any dripped phenol.
15. Carefully blow out the heater coils. Do not replace steam inlet and outlet caps, if so equipped. Let them hang by their safety chains to permit drainage.
16. Remove chocks, safety signs, and ground wire.

Unloading Phenol Tank Trucks

The methods for unloading tank trucks are similar to those used for tank cars. The tank truck must conform to DOT specifications. DOT Regulations (49CFR177.834) require that the tank truck be attended by a qualified person at all times during unloading. This person must have an unobstructed view of the cargo tank and be within 25 feet of the tank truck. The truck engine should be shut off, unless it is required to power the off-loading pump; the handbrake must be set; the wheels chocked and tank truck grounded before unloading. Before unloading operations begin, make certain all personnel are wearing proper personal protective equipment. It is recommended that the tank truck be spotted on an impervious surface, and ideally within an impervious bermed containment area.



Bottom Unloading By Pump

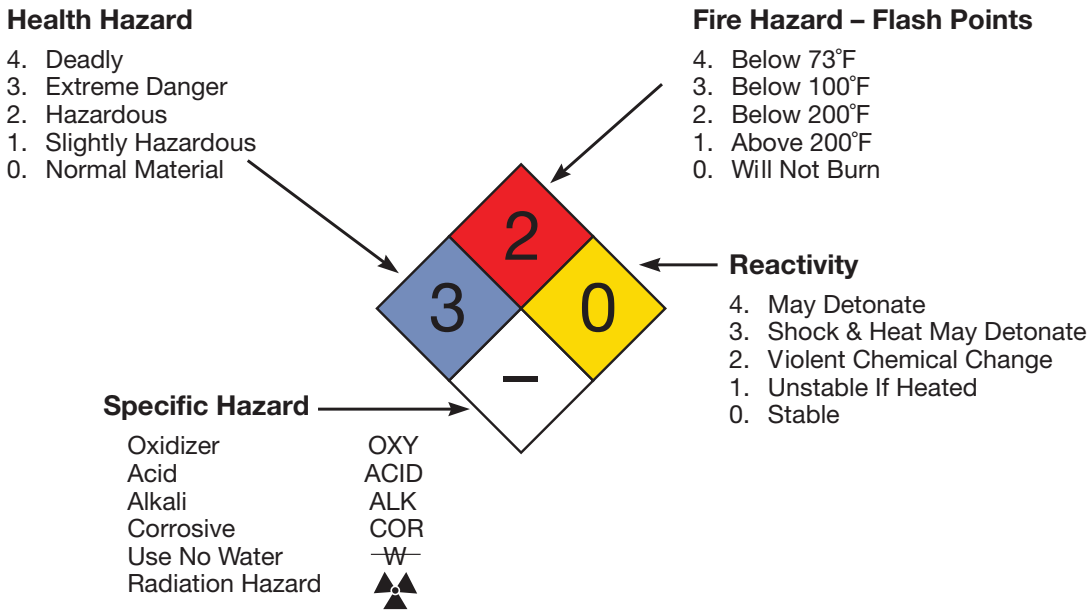
1. In this method, the phenol is unloaded through the valves on the bottom of the tank truck and pumped to the receiving tank.
2. Internal and external valves in the bottom of the tank truck must be in good working order and leak-free to help prevent spillage or the potential for personnel exposure.
3. The emergency cut off handles can be used to close the internal bottom valve in the event of a leak in the fittings on the bottom of the tank truck.
4. Monitor all lines for leaks.
5. Tank truck must be vented or product displaced by nitrogen or other suitable inert gas to prevent pulling a vacuum on the tank truck.

Bottom Unloading By Pressure

1. Connect a non-reactive gas to the top of the tank truck to pressurize it. This will push the phenol out the bottom unloading valve into the receiving vessel.
2. Be certain to keep the pressure below the rating of the safety valve on the trailer.
3. The dome on the tank truck is kept closed to hold pressure in the tank truck.
4. Pressure is maintained until the loading procedure is complete.
5. Monitor all lines for leaks.
6. Once the non-reactive gas is shut-off and disconnected and transfer line closed, the tank truck should be depressurized using the 1” vapor valve.

Health Hazard & Toxicity Information

Typical Physical Properties



National Fire Protection Association Ratings

Health: 3
Flammability: 2
Reactivity: 0

Acute Effects

The consequences of exposure to phenol can be severe. Phenol is highly toxic and corrosive by all routes of exposure, and overexposure can cause severe injuries and death. However, it can be handled safely by knowledgeable, trained personnel using appropriate equipment.

Skin

Phenol exposure occurs most often through skin contact. It can cause second or third degree chemical burns while being rapidly absorbed through the skin. Overexposure can lead to central nervous system effects such as excitability, dizziness, loss of balance and coordination, confusion, unconsciousness, shock, convulsion and death. Respiratory problems as well as kidney and liver damage, are also signs of overexposure. Overexposure can be fatal if contact is long enough and occurs over a large enough area of the body. Liquid exposure to 15 to 20% of the body can lead to death. It is important to know that phenol acts as an anesthetic. This means that skin contact may be very painful at first, but shortly the skin will become numb and the pain will subside. Just because the pain goes away, it does not mean the phenol has been completely removed.

Please review the MSDS for additional information.

Inhalation

Inhalation of vapors or mists can be severely irritating to the upper respiratory tract, and can result in damage to the respiratory tract and the lungs. Signs and symptoms of overexposure can include coughing, choking, runny nose, pain or burning sensation, difficulty breathing and sore throat. Similar to the effects resulting from skin contact, overexposure can cause kidney and liver damage, central nervous system effects, shock, convulsions and possibly even death, if exposure is long enough and the airborne concentrations are high enough.

Eyes

Phenol vapors or mists can be severely irritating to the eyes. Direct contact of phenol with the eyes can cause severe burns and permanent corneal damage which could result in blindness. Symptoms of overexposure include, severe pain, redness, swelling and photophobia (*intolerance of light*).

Ingestion

Phenol is highly toxic when swallowed. It is absorbed rapidly into the system and can cause the effects mentioned above, such as kidney and liver damage, shock, convulsions and possibly even death, if the amount swallowed is large enough. As little as one (1) gram of phenol swallowed by an adult has resulted in death.

Chronic Effects

Chronic phenol poisoning in industry is rare. Symptoms include vomiting, difficulty swallowing, loss of appetite, dermatitis, dark urine, discolored skin, general weakness, loss of body weight, enlarged liver and kidney damage.

Cancer

Phenol was tested by the National Cancer Institute (NCI) in a 2 year cancer bioassay and found not to be a carcinogen. No organization or regulatory agency classifies phenol as a carcinogen.

First Aid

Employees working in an area where contact with phenol is possible must be trained and knowledgeable in appropriate first aid procedures. Immediate first aid treatment is critical to minimize effects.

Deluge-type safety showers with quick-opening valves should be immediately accessible in all working areas, and all personnel should be familiar with their location and operation. Safety showers should be supplied with tempered water. If the safety shower is in a remote area, it is suggested that the shower be alarmed and tied into a central monitoring facility. Moderate pressure water hoses and eye wash fountains should also be located strategically within work areas.

Skin Contact

Immediately flush with large volumes of water while removing contaminated clothing. Continue to thoroughly wash with water for at least 20 minutes after clothing is removed. If phenol has contaminated the face or head, the victim should wear goggles in the shower to prevent phenol from entering the eyes. Phenol acts as an anesthetic. Just because the pain following initial contact subsides, it does not mean that all of the phenol has been removed. It is important to continue to flush the exposed area for the full 20 minutes.

After the emergency shower, the affected area(s) of the patient should be swabbed with cotton soaked in polyethylene glycol (PEG) 400 for a minimum of 10 to 20 minutes. After treatment with PEG, the patient should be transported to an emergency medical facility for further treatment. Dispose of all contaminated clothing, particularly leather items, because it can retain phenol and potentially cause re-exposure if worn again.

Note: PEG 400 solution should be available in work areas in case of emergencies. This mixture is available commercially.

Eye Contact

Flush with large amounts of water for at least 20 minutes, separating and lifting the upper and lower eyelids occasionally. Get medical attention immediately.

Inhalation

If phenol vapors are inhaled, remove the person from the area immediately and get to fresh air. If a person has difficulty breathing, or if breathing has stopped, administer artificial respiration (mouth-to-mouth) or oxygen as appropriate. Obtain assistance and call for medical help.

Ingestion

If phenol is swallowed, immediately call a physician. Wipe excessive material from mouth and lip area. Transport person to hospital emergency facility immediately. DO NOT induce vomiting. Give 1-2 glasses of milk or water if person is conscious and alert. Never give anything by mouth to an unconscious person.

Engineering Controls/Personal Protective Equipment

Engineering Controls

Local exhaust ventilation should be used to capture and remove phenol vapors. Good ventilation should be provided in all working areas.

Personal Protective Equipment

A comprehensive industrial hygiene plan reduces the likelihood of unnecessary exposure to phenol and other chemicals in the industrial environment. This includes a ready supply of gloves and other protective wear for employees working with phenol and atmospheric monitoring in areas where exposure is possible.

Personal protective equipment must be used to prevent direct skin and eye contact and to reduce the potential for inhalation exposure. Employees can be protected against skin contact by using gloves and other garments made from polyvinyl chloride (PVC), neoprene or natural rubber. The eyes and face should be protected with splash goggles, a full face shield or a full face respirator.

The need for a respirator and respirator selection depends upon the airborne concentrations of phenol in the workplace. When concentrations of phenol are greater than 5 ppm, but less than 50 ppm, a half-mask organic vapor cartridge respirator should be worn. When dust and/or mists are present, a particulate prefilter must also be used. A full-face respirator with the same cartridge is suitable for concentrations up to 250 ppm phenol. For concentrations greater than 250 ppm, an air supplied respirator must be worn. Firefighters should wear a self-contained breathing apparatus (SCBA). When respirators are used at a facility, the employer is responsible for implementing a respiratory protection program (OSHA 1910.134).

As with any type of personal protective device an employee may use, safe practices and habits are crucial to successful implementation. Therefore, a thorough education program should be in place to properly train employees in the safe use of personal protective equipment. A personal protective device used incorrectly will not afford the protection for which it was designed.

Engineering Limits/Exposure Monitoring

Exposure limits or exposure guidelines have been established by various regulatory agencies or professional organizations regarding allowable concentrations of phenol in the work environment. Exposure guidelines are reviewed regularly by occupational health professionals and are changed when new information dictates. Operators working with phenol must keep themselves informed of the most current guidelines and regulations governing exposure.

The American Conference of Government Industrial Hygienists (ACGIH), a voluntary standards setting organization, has adopted a Threshold Limit Value (LTV), and the Occupational Safety and Health Administration (OSHA) has set a Permissible Exposure Limit (PEL) for phenol.

ACGIH and OSHA have set an exposure limit for the entire work shift. A Time Weighted Average (TWA) is a concentration to which it is believed nearly all workers may be repeatedly exposed for 8 hours a day, 40 hours a week, without adverse effect. The “skin” designation refers to the potential significant contribution to overall exposure by absorption of phenol through the skin. If significant quantities of phenol are being absorbed by the skin, air sampling alone may not be sufficient to accurately quantify exposures.

Phenol exposure limits are:

OSHA PEL:	8 hour TWA:	5 ppm (skin)
ACGIH TLV:	8 hour TWA:	5 ppm (skin)

Exposure Monitoring

Airborne exposure monitoring for phenol must be conducted in order to properly assess personal exposures and effectiveness of engineering controls. Initial exposure monitoring should be conducted by an industrial hygienist or person specifically trained and experienced in sampling techniques. OSHA method 32 is recommended for exposure monitoring.

Fire Fighting

Carbon dioxide and dry chemical extinguishers should be used for small fires. For larger fires, universal or PSL foams are most effective. If water is used, run-off should be contained to prevent the entrance of phenolic water into sewers and waterways. The run-off water should be collected for proper disposal. Any escape of phenol or phenolic water must be reported promptly to local authorities so that drinking water intakes can be closed and intakes to sewage plants can be blocked or bypassed. Be careful not to splash personnel with water containing phenol because it can cause chemical burns and toxic effects. Firefighters should wear a self-contained breathing apparatus (SCBA).

Spill Control

A number of factors will determine the proper course of action in the event of a spill or leak of phenol. The most important factor to consider is whether available personnel have the ability to properly handle the spill based on the size and location of the spill. A responsible individual should determine if materials and information are available to enable them to safely and effectively deal with a spill situation. In preparation for accidental spills, it is advisable to have written procedures and personnel trained to deal with such emergencies. There are a few important things to remember when dealing with a phenol spill:

- Because of phenol's hazard classification, preventing environmental releases is of the utmost importance. The reportable quantity for phenol is 1,000 pounds. This means that if 1,000 pounds or more of phenol are released to the environment in any 24 hour period, it must be reported to the National Response Center immediately (phone 1-800-424-8802). Additional notification of state and local agencies may be necessary; see "Regulatory Issues: Emergency Release Notification" section.
- When faced with a phenol spill, first ensure the safety of personnel. If it is determined that an environmental release is taking place, spill control procedures should be implemented.
- Determine if phenol is still leaking and if it can safely be prevented from leaking further, i.e., by closing a valve or shutting off a pump. Since phenol freezes at about 106°F, some leaks may be stopped by freezing the area of the leak. Once it has been determined that either the leak has been stopped or it is impossible to do so, action must be taken to prevent the spill from spreading any further. Spills should be contained with booms or earthen dikes and allowed to solidify.
- To avoid water pollution, water should not be used to flush or clean the area. Any release of phenol or phenolic water to a waterway or to a storm sewer must be reported promptly to local authorities so that downstream drinking water intakes can be closed. If phenolic water enters a process sewer notification should be made to the associated wastewater treatment operations so that protective measures can be implemented such as bypassing to storage or blocking intakes to the treatment plant. Phenol is miscible in water to a concentration of 8% by weight, at which point undissolved phenol will sink.

- Personnel responding to a spill should be trained in spill control and emergency response procedures and have available adequate personal protective equipment, materials and tools necessary to stop the flow of product. Defensive control actions can be taken by people with a minimum amount of training including building dams and dikes to control the flow of product and plugging sewer drops and drains. Materials such as oil dry, sand, vermiculite or absorbent pads can be used to control or absorb.
- Phenol contaminated soil and contaminated materials (such as clothing or absorbent materials) should be collected and placed into lA2 open drop lidded steel drums for disposal at a licensed incinerator or secured hazardous waste landfill upon fulfillment of the land disposal restriction treatment standards required. It may be possible to treat phenol contaminated water in biological water treatment plants. However, high concentrations are toxic to the biological population, and the facility must ensure that such treatment is authorized by any permits held by the treatment plant and any applicable laws.

The above recommendations are important points to take into consideration when determining the proper course of action when a phenol spill takes place, particularly in the event of a minor spill that can be handled by available personnel.

In some situations, where medical assistance is needed, contact:

PROSAR@800-498-5701 or +1-651-523-3887

In the event of a transportation emergency contact:

CHEMTREC (in the USA) 1-800-424-9300

CANUTEC (in Canada) 613-996-6666

These 24 hour services will provide instructions on handling emergency situations involving spills.

Additional Spill Control / Response Information can be found in Section 6 (Accidental Release Measures) of the AdvanSix, Inc. Material Safety Data Sheet, as well as the following publications:

1. Department of Transportation 2000 Emergency Response Guidebook (Guide # 153)
2. Association of American Railroads / Bureau of Explosives Emergency Action Guide (1995 Guide for Carbolic Acid or Phenol)
3. Association of American Railroads / Bureau of Explosives Emergency Handling of Hazardous Materials in Surface Transportation

Pollution Prevention

AdvanSix encourages users of phenol to implement aggressive pollution prevention programs to reduce the quantity of phenol and other hazardous materials in their wastes, as well as to minimize the potential for release of phenol to the environment via spills and other mechanisms. AdvanSix endorses the application of the pollution prevention hierarchy in such programs, stressing source reduction through process efficiency, internal recycling and other means. In the absence of feasible source reduction alternatives, recovery, recycling and reuse should be considered. Disposal should be the final option considered.

Most state environmental agencies now have pollution prevention experts who can provide technical assistance or refer inquiries to industry experts. The American Chemistry Council also is a valuable source of information regarding pollution prevention programs.

Waste Handling & Disposal

The Resource Conservation and Recovery Act of 1976 (RCRA) was passed to promote safe management of hazardous wastes. Discarded phenol, spilled phenol, and materials contaminated with commercial chemical product phenol are considered hazardous waste (EPA Waste Code U188) and are banned from land disposal unless treated to meet the Land Disposal restrictions levels of 40 CFR § 268.40. The treatment level for U188 wastewaters (<1% TOC and <1% TSS) is 0.039 mg/l, and the treatment standard for nonwastewaters (>1% TOC and >1% TSS) is 6.2 mg/kg. Contaminated materials would include, for example, filters, rags or other materials contaminated with spilled phenol.

Drums should be empty as defined by RCRA before they leave the user's facility. Empty drums can be reconditioned by a reputable licensed reconditioner, or incinerated. Drums destined for incineration should be punctured or crushed to prevent reuse.

CAUTION: *Under no circumstances should empty drums be burned or cut open with a gas or electric torch as hazardous decomposition products may be generated. Drums should be cut or destroyed only by mechanical means after complete rinsing.*

RCRA and its implementing regulations are complex and may vary from state to state. Some state regulations may be more stringent than federal regulations. Therefore, check with the regional USEPA office and/or state environmental regulatory office before managing and disposing of waste phenol.

Regulatory Issues

The following is a brief compilation of noteworthy regulatory issues related to phenol. The user is responsible for understanding and complying with applicable statutes and regulations. The user may also want to consult legal counsel to discuss their specific applicability.

Emergency Planning and Community Right to Know Act [EPCRA])

Section 302: Extremely Hazardous Substances - Emergency Planning

Phenol is identified by USEPA as an extremely hazardous substance (EHS). Under section 302, a facility which has an EHS in excess of its threshold planning quantity (TPQ) must notify its state emergency response commission (SERC) and participate, as necessary, with the local emergency planning committee (LEPC) in the local emergency planning process. Substances such as phenol that are solid at room temperature are subject to either of two TPQs. These TPQs are 500 pounds for molten phenol, phenol in solution, and for solid phenol with particle sizes less than 100 microns, and 10,000 pounds for all other form of phenol. [See 42 USC § 11002 and 40 CFR Pt. 355]

Section 304: Emergency Release Notification

If more than 1,000 pounds of phenol are released to the environment in any 24 hour period, the facility owner/operator must notify the SERC, the LEPC and the National Response Center (NRC). Onsite releases to the environment that do not migrate offsite must be reported to the NRC, but may not require reporting to the SERC and LEPC. See "Spill Control" section for additional information. [See 42 USC § 11004 and 40 CFR Pt. 355]

Sections 311 and 312: MSDS Submission and Inventory

If phenol is present in the facility in quantities equal to or greater than 10,000 pounds, facilities may have to submit MSDSs to the SERC, LEPC and the local fire department. In addition, facilities may also have to submit an annual inventory form (Tier I or Tier II report) detailing the maximum amount of each chemical present at any one time, estimating the average daily amount at the facility, and identifying the location of these substances at the facility. The annual inventory form must be submitted by March 1 for chemicals at the facility the previous year. A variety of exemptions from reporting are noted. [See 42 USC 40 § 11021 and CFR Pt. 370]

Section 313: Annual Reporting Obligations

Phenol is regulated under Title III of the Superfund Amendments and Reauthorization Act (SARA Title III), otherwise known as the Emergency Planning and Community Right to Know Act (EPCRA), which requires annual reporting of releases to the environment of listed substances. If a facility has 10 or more full time employees (or a total of 20,000 hours worked for all full and part time employees), is in Standard Industrial Classification (SIC) Codes 20 through 39, 10 (except 1011, 1081, and 1084), 12 (except 1241) 4911, 4931, 4939, 4953, 5169, 5171, or 7389, and that manufactures or processes (including repackage) 25,000 pounds or more of phenol in a year, or if the facility otherwise uses 10,000 pounds or more a year, the facility must submit annual reports (Form R) to USEPA or other regulatory agencies regarding the quantities of phenol released from the facility. Persons who sell or distribute mixtures or trade name products containing phenol must notify their customers of the presence and concentration of phenol in their product if it is present in concentrations greater than 1.0%. The annual reporting deadline is July 1 of each year. [See 42 USC § 11023 and 40 CFR Pt. 372]

Regulatory Issues

Clean Air Act

Phenol is identified by the USEPA as a hazardous air pollutant (HAP) under the Clean Air Act Amendments (CAAA) of 1990. USEPA develops emission standards based on the maximum available control technology (MACT) for facilities that emit ten tons per year of phenol or 25 tons per year of several HAPs. MACT standards are currently being developed. Facilities may also be subject to state air permitting processes under Title V of the CAAA. In addition, phenol is regulated as a volatile organic compound (VOC). [See 42 USC § 7412]

Toxic Substances Control Act

Section 4: Testing

Inhalation, neurotoxic, and reproductive effects of phenol were investigated under the terms of an enforceable consent agreement (ECA) among U.S. phenol manufacturers and importers and USEPA. Information learned from these tests regarding the health effects of phenol were communicated on our material safety data sheets. [See 15 USC §§ 2603 and 40 CFR stet 790]

Section 12(b): Export Regulations

Substances being tested under Section 4 of the TSCA are usually subject to export notification requirements under TSCA Section 12(b). These reporting requirements are usually effective at the same time the Section 4 testing agreement becomes effective. However, for phenol, USEPA announced an intent to issue this rulemaking separately. As of the date of this writing, no such rulemaking has been issued. Be aware that such a requirement may be implemented in the future. [See 15 USC § 2611 and 40 CFR § 707, Subpart D]

Clean Water Act

USEPA developed ambient water quality criteria for phenol and other substances for the protection of aquatic life, human health, aesthetics and recreation. For each listed substance, states are required to adopt water quality standards based on USEPA's criteria. The standards then drive calculation of National Pollutant Discharge Elimination System (NPDES) permit criteria for facility effluent. [See 40 CFR § 131]

In addition, phenol is also named as a priority pollutant under the CWA. USEPA set effluent standards for priority pollutants for a number of specified industries. [See 40 CFR § 401.15 and 40 CFR Pt. 414 Sub Pt. F]

Appendix of Abbreviations

ACC	American Chemistry Council
ACGIH	American Conference of Governmental Industrial Hygienists
ASTM	American Society of Testing and Materials
CAA	Clean Air Act Amendments of 1990
CAS	Chemical Abstract Services
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOT	Department of Transportation
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act (also known as SARA Title III)
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
HAP	Hazardous Air Pollutant
LEPC	Local Emergency Planning Committee
LOEL	Lowest Observed Effect Levels
MACT	Maximum Available Control Technology
MCL	Maximum Contaminant Level
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NIOSH	National Institute of Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NRC	National Response Center
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PELs	Permissible Exposure Limits
RCRA	Resource Conservation and Recovery Act of 1976
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
TLV	Threshold Limit Value
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
USC	United States Code
VOC	Volatile Organic Compound

Contact AdvanSix
To learn more visit
Advan6.com or call:
1-844-890-8949 (toll free, U.S./Can.)
+1-973-455-3000 (international)

AdvanSix
115 Tabor Road
Morris Plains, NJ 07950

RESPONSIBLE CARE®
OUR COMMITMENT TO SUSTAINABILITY

September 2016, Printed in U.S.A.

ADVANSIX