

Phenol

108-95-2

Hazard Summary

Exposure to phenol may occur from the use of some medicinal products (including throat lozenges and ointments). Phenol is highly irritating to the skin, eyes, and mucous membranes in humans after acute (short-term) inhalation or dermal exposures. Phenol is considered to be quite toxic to humans via oral exposure. Anorexia, progressive weight loss, diarrhea, vertigo, salivation, a dark coloration of the urine, and blood and liver effects have been reported in chronically (long-term) exposed humans. Animal studies have reported reduced fetal body weights, growth retardation, and abnormal development in the offspring of animals exposed to phenol by the oral route. EPA has classified phenol as a Group D, not classifiable as to human carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (5), which contains information on oral chronic toxicity and the RfD and the carcinogenic effects of phenol, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Phenol. (1)

Uses

- The primary use of phenol is in the production of phenolic resins, which are used in the plywood, construction, automotive, and appliance industries. (1)
- Phenol is also used in the production of caprolactam and bisphenol A, which are intermediates in the manufacture of nylon and epoxy resins, respectively. (1)
- Other uses of phenol include as a slimicide, as a disinfectant, and in medicinal products such as ear and nose drops, throat lozenges, and mouthwashes. (1)

Sources and Potential Exposure

- Individuals may be exposed to phenol through breathing contaminated air or through skin contact in the workplace. (1)
- Other exposures to phenol may occur through the use of phenol-containing medicinal products (including mouthwashes, toothache drops, throat lozenges, analgesic rubs, and antiseptic lotions) or smoking tobacco. (1)

Assessing Personal Exposure

- Phenol can be detected in urine; this test can be used to determine whether a person has recently been exposed to phenol or to substances that are changed to phenol in the body. However, no test will tell whether a person has been exposed only to phenol, because many substances are changed to phenol in the body. (1)

Health Hazard Information

Acute Effects:

- Inhalation and dermal exposure to phenol is highly irritating to the skin, eyes, and mucous membranes in humans. (1-3)

- Symptoms of acute toxicity in humans include irregular breathing, muscle weakness and tremors, loss of coordination, convulsions, coma, and respiratory arrest at lethal doses. (1–3)
- Acute animal tests in rats, mice, and rabbits have shown phenol to have high acute toxicity from oral exposure. (4)

Chronic Effects (Noncancer):

- Anorexia, progressive weight loss, diarrhea, vertigo, salivation, and a dark coloration of the urine have been reported in chronically exposed humans. Gastrointestinal irritation and blood and liver effects have also been reported. (1)
- In one study, muscle pain, weakness, enlarged liver and elevated levels of liver enzymes were found in an individual after inhalation and dermal exposure to phenol and a few other chemicals. (1)
- Application of phenol to the skin results in dermal inflammation and necrosis. Cardiac arrhythmias have also been reported in humans exposed to high concentrations of phenol. (1)
- Chronic inhalation exposure of animals to phenol has shown central nervous systems (CNS), kidney, liver, respiratory, and cardiovascular effects. (1)
- The Reference Dose (RfD) for phenol is 0.6 milligrams per kilogram body weight per day (mg/kg/d) based on reduced fetal body weights in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (5)
- EPA has low confidence in the study on which the RfD was based because the dose was administered by gavage; medium confidence in the database because it contains several supporting studies (subchronic, chronic, and reproductive/ developmental); and, consequently, low-to-medium confidence in the RfD. (5)
- EPA has established a provisional Reference Concentration (RfC) for phenol of 0.006 milligrams per cubic meter (mg/m³) based on no effects in rats, mice, or monkeys. The provisional RfC is a value that has had some form of Agency review, but it does not appear on IRIS. (13)

Reproductive/ Developmental Effects:

- No studies were located concerning the developmental or reproductive effects of phenol in humans.
- Animal studies have reported reduced fetal body weights, growth retardation, and abnormal development in the offspring of animals exposed to phenol by the oral route. Decreased maternal weight gain and increased maternal mortality were also observed. (1,3,5)

Cancer Risk:

- Small, non-significant excesses in certain types of cancers were reported in occupationally exposed workers; however, these effects were not clearly related to phenol exposure. (1)
- Animal studies have not seen tumors resulting from oral exposure to phenol, while dermal studies have reported that phenol applied to the skin may be a tumor promotor and/or a weak skin carcinogen in mice. (1,2,5)
- EPA has classified phenol as a Group D, not classifiable as to human carcinogenicity, based on a lack of data concerning carcinogenic effects in humans and animals. (5)

Physical Properties

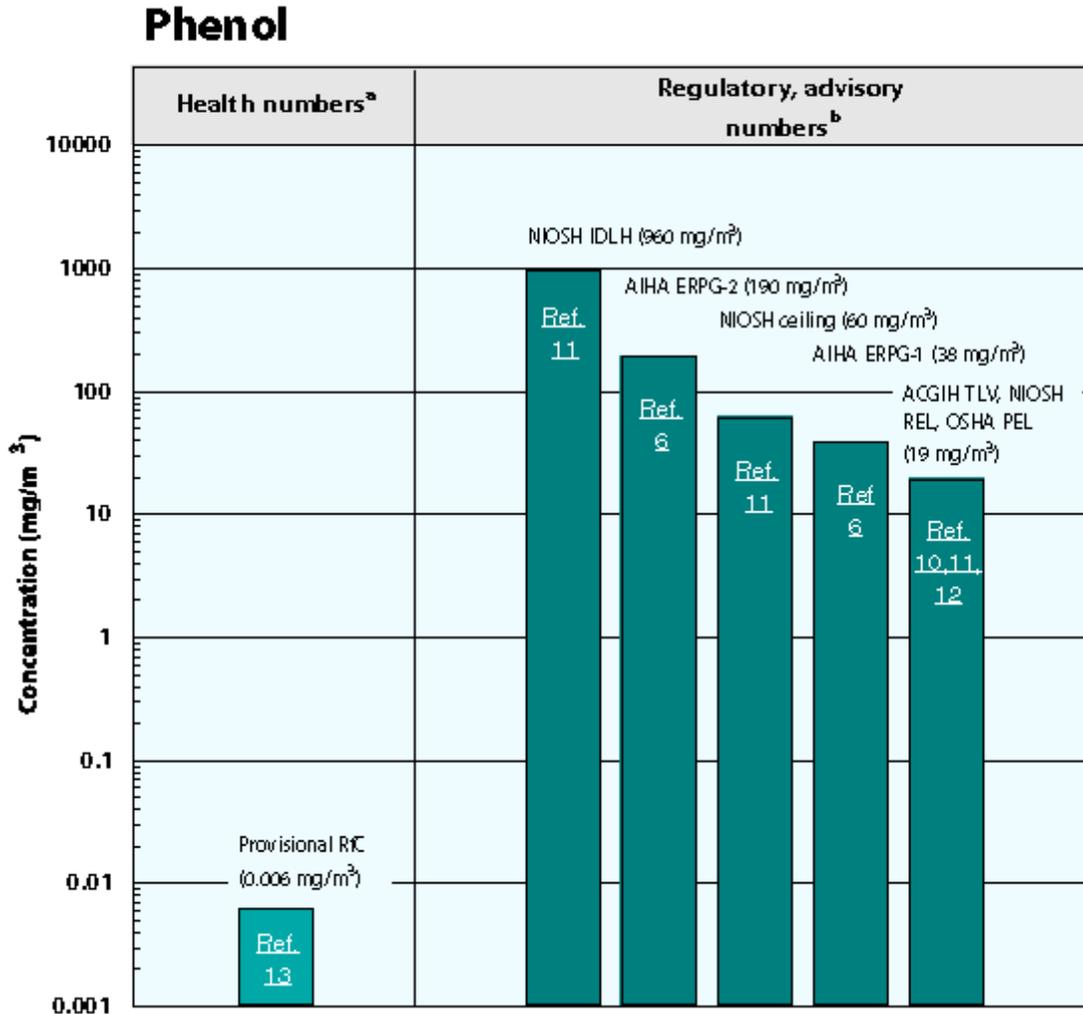
- Phenol is a colorless or white solid when it is pure; however, it is usually sold and used as a liquid. (1)
- The odor threshold for phenol is 0.04 parts per million (ppm), with a strong very sweet odor reported. (1,7)
- Phenol is very soluble in water and is quite flammable. (2)
- The chemical formula for phenol is C₆H₆O and the molecular weight is 94.1 g/mol. (8,9)

- The vapor pressure for phenol is 0.3513 mm Hg at 25 °C, and it has a log octanol/water partition coefficient ($\log K_{ow}$) of 1.46. (1)

Conversion Factors (only for the gaseous form):

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For phenol: $1 \text{ ppm} = 3.85 \text{ mg}/\text{m}^3$.

Health Data from Inhalation Exposure



AIHA ERPG --American Industrial Hygiene Association's emergency response planning guidelines. ERPG 1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor; ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.

ACGIH TLV --American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

NIOSH ceiling --National Institute of Occupational Safety and Health's recommended exposure limit ceiling; the concentration that should not be exceeded at any time.

NIOSH IDLH -- NIOSH's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or

delayed permanent adverse health effects or prevent escape from the environment.

NIOSH REL--NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.

References

Summary created in April 1992, updated in January 2000

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