

## Phenol

Synonym: carbolic acid

CAS: 108-95-2

MF: C<sub>6</sub>H<sub>5</sub>OH

MW: 94.11

Solubility: very well soluble in water.

### Major uses

The major use of phenol is in manufacture of phenolic resins and other chemicals, such as bisphenol A, caprolactam, alkyl phenols etc. It is also used as a disinfectant, a reagent in chemical analysis, and a preservative for pharmaceuticals [1].

### Human toxicity

Phenol is considered to be very toxic to humans through oral exposure, with symptoms including muscle weakness and tremors, loss of coordination, paralysis, convulsions, coma, and respiratory arrest. Among systemic symptoms of toxicity, e.g. nausea, diarrhea, hypotension, dysrhythmia, pulmonary edema, lethargy, and seizures are described. The central nervous system (CNS), liver, lung and renal injury may also occur, as well as a severe acidosis, and myocardial depression [1, 2].

Phenol vapors and liquid phenol are highly irritating to the skin, eyes, and mucous membranes. Concentrated phenol is extremely corrosive and may cause oral, esophageal, and gastric burns following ingestion [1, 2].

The minimum lethal dose was estimated to be 140 mg/kg [3]. Ingestion of 1 to 1.5 g of phenol has been reported to be lethal [1]. An average oral acute single lethal dose was calculated to be 11 g [4].

The minimum lethal serum concentration of phenol, based on the data from several handbooks, is 46 mg/l (range 42-50 mg/l) [4]. According to Winek, lethal plasma/serum blood concentration level is 90 mg/l [5].

TLW/TWA\*: 5 ppm (19 mg/m<sup>3</sup>) (EPA, 2004) [1].

*Carcinogenicity*: Not classified as human carcinogen (EPA, 2004) [1].

### Kinetic data

*Absorption*: Phenol is rapidly absorbed in the gut by ingestion and by inhalation. It is also rapidly absorbed by the skin: 70% of phenol may be absorbed in 30 min [1].

*Kinetics* is possibly biphasic? [4].

*Time to peak blood concentration*: 0.5 h (for the overdose situation) [4].

*Elimination half-life*: 2.8 h [4].

*Passage of blood-brain barrier*: free [4].

### Metabolism and excretion

Phenol is metabolically converted in the liver into water-soluble glucosiduronide by reaction with uridine diphosphate (UDP)-glucuronic acid, in the presence of UDP-glucuronate transferase [6]. Small amounts of phenol are oxidized to catechol and quinol, which are mainly conjugated [1].

*Excretion:* Phenol is rapidly secreted through the kidney, primarily conjugated with glucosiduronide, but also as free phenol.

### **Toxicological mechanisms**

Phenol is a cellular poison, which is toxic to all cells. At the concentrations over 5%, it denaturates proteins and therefore exerts necrosis upon tissues with which it comes to contact. The toxic effect of phenol is related to the amount of free phenol in the blood [7, 8].

Phenol can have a stimulatory effect on the CNS due to increased acetylcholine release at the neuromuscular junction. Low doses of phenol cause a transient electrophysiological block, whereas higher doses cause an irreversible block of impulse conduction [8].

**Target organs:** CNS, liver, kidney, gastrointestinal tract (histopathological lesions) [4].

### **References**

1. Poisindex, Thomson Micromedex (2005).
2. Calabrese, E.J., Kenyon, E.M. (1991) *Air Toxics and Risk Assessment*. Lewis Publishers, Chelsea, MI.
3. HSDB (2003).
4. Ekwall, B., Clemenson, C., Crafoord, B., Ekwall, Ba., Hallander, S., Walum, E., Bondesson, I. (1998) MEIC evaluation of acute systemic toxicity. Part V. Rodent and human toxicity data for the 50 reference chemicals. *ATLA* 26, 571-616.
5. Winek, C.L. (1994) Drug and chemical blood-level data. *Winek's Toxicological Annual*, Pittsburgh. Allegheny County Department Laboratories.
6. Lehninger, A.L. (1975) *Biochemistry*. Worth Publishers, Inc., New York.
7. Haddad, L.M., Winchester, J.F. (1990) *Clinical Management of Poisoning and Drug Overdose*. 2<sup>nd</sup> ed., pp. 1290-1292. W.B. Saunders Company.
8. Liao, J.T.F., Oehme, F.W. (1980) Literature reviews of phenolic compounds. I. Phenol. *Vet Human Toxicol* 22, 160-164.

\*Threshold Limit Value/Time Weighted Average. The average concentration under which people can work consistently for 8 h.

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