

### Introduction

Phenol was first isolated from coal tar by distillation in 1834, and was named carbolic acid. In 1865, Sir Joseph Lister discovered that a dilute carbolic acid solution had germ killing properties, and pioneered its use as an antiseptic in surgery.

In those days, even the most minor surgery inevitably lead to infection and up to 50% of all surgery cases died. Lister's findings were so spectacular that the history of surgery is divided into two periods: pre- and post-Lister.

The use of carbolic acid was soon discontinued after the discovery of much gentler, safer antiseptics. However carbolic acid, or phenol as it is now known, is still used a biological standard for disinfectants. Any new disinfectant formulation is always compared with phenol in its effectiveness to kill germs.

### Properties

Pure phenol is a white solid which quickly discolours on exposure to air, becoming pink, even red. It is combustible with a flash point of 79 deg C, so while it will not catch fire readily, it will burn in a fire. It can be converted to a liquid by the addition of 8% water and warming gently.

It has a characteristic strong, sweet, tarry smell which can be detected down to 0.04 ppm. The vapour pressure can support a saturated air concentration of 460 ppm, while the safety limit as expressed by the current Exposure Standard is 1 ppm (TWA) (skin) (4 mg/m<sup>3</sup>). While phenol can be detected by smell at levels far below the safety limit, it can also support vapour concentrations considerably above that limit.

Formula	C <sub>6</sub> H <sub>5</sub> OH
MW	94.1
CAS	108-95-2
Melting Point	42.5 deg C
Boiling Point	182.0 degC
Vapour Pressure (20 C)	0.048 kPa
Vapour Density	3.24 (air = 1.00)
Specific Gravity	1.06 (water = 1)
Flash Point	79 deg C
Flammability Limits	1.5 to 8.6 vol %
Autoignition	715 deg C

**Properties of Phenol**

### Transport

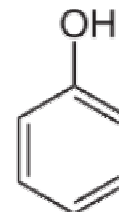
Phenol can be transported under three different UN numbers as a Class 6.1a poison: the solid form under UN 1671, the molten form at temperatures greater than 43 degrees C under UN 2312, and the liquid form under UN 2812.

As far as Western Australia is concerned, very little phenol is stored or transported and it is only under UN 1671.

**PHENOL, SOLID** 1671 6.1 II 2X

**PHENOL SOLUTIONS** 2821 6.1 II or III 2X

**PHENOL, MOLTEN** 2312 6.1 II ●3X



### Uses

In 1985, phenol was the 34th chemical manufactured by volume in the US. It is used mainly as a raw material in the manufacture of plastics, other chemicals and drugs.

One of the most common uses is the manufacture of phenol-formaldehyde resins. This material was first prepared in 1907, and was trademarked as "Bakelite" in 1911. It is a dark coloured, inert and insulating material which is used in the manufacture of a wide variety of items such as handles, knobs, switches, electrical appliance parts including automotive distributors, coils and rotor buttons, automotive transmission and braking components, washing machine components, jug lids, even toilet seats and lawn bowls. Other phenol-formaldehyde resins have been developed as adhesives for bonding plywood and particle board, for bonding glass or rock wool fibres for thermal and acoustic insulation materials, and for manufacture of decorative laminates for kitchen work benches.

Phenol is also used to prepare bisphenol A, which in turn is used to manufacture epoxy resins and polycarbonate plastics, and another chemical called caprolactam, which is one of the starting materials in nylon manufacture.

## Toxicity

Skin absorption is the primary route of entry of phenol into the body. Even the vapour can penetrate the skin with an efficiency approximating that of breathing it in through the lungs. Small amounts once taken into the body can be quickly broken down and eliminated, however once the body's detoxification systems are overwhelmed, symptoms will quickly appear to the extent of being rapidly fatal.

Even exposures by skin absorption may be fatal; for example, a 32 year old man who spilled a solution of phenol onto his scalp, face, neck, shoulders and back, died within 10 minutes. A lethal dose by swallowing is about 10 grams for adult humans, although a case as low as 1 gram has been reported, and approximately half of reported cases of acute poisonings have died.

Phenol is highly corrosive and contact with the skin can cause dangerous and painful burns, while contact with the eyes will cause an almost immediate white opacification of the outer corneal layer. It has a local anaesthetic action which prevents any immediate burning sensation until it is too late, by which time it will have deeply penetrated the skin. Sometimes even then no pain will be experienced with the destruction of nerve endings. In such cases the skin will be dead, turning white, then yellowish-brown becoming deeply eroded and scarred, with the possibility of gangrene.

## Environment

Phenol is only slightly toxic to fish with LC<sub>50</sub>(96hr)<sup>1</sup> concentrations ranging from 10 to 100 ppm in water, however it has the unique property of imparting a taint to the taste of fish at concentrations down to 0.1 to 1.0 ppm.

It does not bioaccumulate in the environment, rather it breaks down quite quickly, so that after 5 days 70% will be gone and after 20 days it is completely gone.

## Incidents

Chemical incidents involving phenol have covered the whole range of possibilities as far as emergency service response is concerned.

Fires have included runaway chemical reactions in which clouds of phenol vapours have been released over populated areas. Transport incidents have included a tanker rupture and spillage of up to 68,000 litres of liquid phenol, of another carrying 91,000 litres of hot liquid phenol, and a road tanker with "a faulty connection" spilling small quantities of phenol onto a road for many miles.

As for the environment and populated areas, reports have included a leakage from a bulk storage tank with a hole corroded in the bottom allowing an estimated 120,000 litres to leak into the soil underneath: of spillages into rivers causing either massive fish kills and affecting drinking water of populated areas leading to widespread gastric disorders, and with water supplies shut off in some cases for up to 2 weeks.

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<sup>1</sup> The LC<sub>50</sub>(96hr) is the concentration of the chemical which is lethal to 50% of the fish population that has been exposed continuously for 96 hours or 3 days

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