



SPECIAL EDITION

# Expanding Encyclopedia Of Mortuary Practices

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## PHENOL EXPOSURE IN EMBALMING ROOMS

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### Part 1

*ABSTRACT: The historical and technical facts relating to phenol and its derivatives are discussed. Phenol's disinfection ability and embalming uses are summarized. A phenol vapor exposure study in embalming rooms was conducted. Simulated embalmings under high concentrations of phenol and worst case scenarios which included no precautions or ventilation in conjunction with the use of volatile alcohols as solvents were monitored and analyzed. Results indicate that phenol vapor exposures are moderate or marginal in the worst case scenarios tested and no significant hazard with exposure values well below limits when ventilation is used. Exposure values would have been low to insignificant if typical concentrations of phenol found in most embalming fluids were used along with the elimination of volatile alcohols as solvents. Ventilation reduced phenol exposures an average of 30-35% overall and 10-45% during individual phases of the monitoring. The use of phenol products in embalming rooms with proper safety techniques and exposure controls such as ventilation is well within accepted safety standards and limits of exposure.*

**INTRODUCTION:** Phenol, or carbolic acid, as it is sometimes referred to, is a colorless or white crystalline solid with a relatively low melting point. Concentrated phenol is usually encountered as a liquid with 8% water present as a solvent additive. It has a characteristic pungent odor and is weakly acidic in reactions with other chemicals, hence the name carbolic acid. Phenol is derived from wood decomposition products by destructive distillation of coal tar derivatives by separation from oil or coal tar deposits. It also is synthetically produced from various aromatic hydrocarbons (typically benzene and cumenes). The majority of phenol and phenol derivatives are ultimately used in resins and resin based products such as formaldehyde and bisphenol resins from acetones.

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Phenol is widely used as a general disinfectant for cesspools, chemical toilets and animal barns. Occasionally phenol is mixed with slaked lime (a hydrolyzed version of quicklime or mixture of carbonates) to increase the disinfecting and cleaning ability. It also finds extensive use in the manufacture of industrial organic dyes and is widely used as a reagent chemical in organic and inorganic analysis.

Medical usage in humans was much more extensive in the past than now, but phenol and its derivatives are still found in topical anesthetics and disinfectants such as sore throat sprays and lozenges or as drying agents for various minor skin lesions. Phenol still has a wide usage in veterinary practice as antipruritic ointments for inflamed and itching areas and cauterizing agents for sores and lesions and in the general treatment of mange.

The disinfection properties of phenol have been known throughout most of history. The first documented and widely publicized use of phenol as a disinfectant in the medical field was by Lister in 1867. It had been used only sporadically up to 2 years before by other surgeons. Lister proved the effectiveness of phenol solutions in preventing postoperative wound infections following surgery. The standardized use of phenol as a wound cleanser just missed the Civil War and it is interesting to speculate on the effect that phenol would have had on the battlefield casualties.

Phenol is bacteriostatic in as small a concentration as .2% by virtue of its ability to deactivate enzymes within the cell and affect cell permeability allowing an ionic imbalance to occur with the cessation of cell division. It becomes bactericidal/fungicidal at concentrations of 1-1.5% and actually destroys cell walls and allows leaching of the cell contents to the environment and ultimate destruction of the organism. There is a marked increase in bactericidal activity with halogenation or alkylation of the basic phenol molecule. This fact has resulted in the discovery of substituted phenols that are much more effective disinfectants than phenol itself. Examples of such phenols would include chlorophene, hexachlorophene and t-amyl phenol which are anywhere from 4 to 100 times more effective in disinfection than phenol. This is the basis of the phenol coefficient concept in the rating of disinfectants. Any disinfectant can be compared and rated to phenols disinfecting ability by the assigning of a phenol coefficient. For example, t-amyl phenol, a widely used and effective disinfectant, has 100 times the activity of phenol under test conditions and is assigned a phenol coefficient of 100.

The mode of action of phenol and its derivatives against various bacteria, fungi and viruses is due to its ability to denature and precipitate protein and proteinaceous products and its ability to effectively attack and destroy the cell wall due to its lipophilic character. Cresols are actually more effective than phenol in this regard with most cresols having phenol coefficient values of 2-3.

Phenols have broad spectrum activity against most gram positive and gram negative bacteria and fungi. In addition, phenol is particularly effective against *Mycobacterium tuberculosis* and is generally virucidal and very effective against the lipid viruses. Most general purpose hospital disinfectants that are tuberculocidal invariably have phenol as the base formulation. Phenol based disinfectants are capable of tolerating a high organic load and are relatively unaffected by hard water. Phenols also exhibit good residual activity, especially if allowed to dry on the surface to be disinfected. Phenol disinfectants are, in general, superior to quaternary ammonium compounds and especially hypochlorites for uses requiring thorough and lasting disinfection under heavily challenged conditions. Phenols are also, fortunately, readily biodegradable. They are effectively neutralized and degraded by sewage sludge, bacteria-laden soils and composts.

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Phenol is used in embalming as a medium to lower strength preservative. Phenol forms a softer protein coagulate and is therefore used only as a supplementary preservative and never as a primary preservative. Phenol does have superior penetration ability due to its lipophilicity and its slower reaction rate with tissues and weaker endpoint rigidity. This fact allows its use in embalming as a supplementary penetrating and fixative chemical.

In addition, the use of phenol in embalming fluids results in superior disinfecting and sanitizing during the embalming operation. In fact, some of the most effective HLD's (High Level Disinfectants) available are based upon glutaraldehyde in synergistic combination with various substituted phenols such as t-amyl phenol or o-phenyl phenol. Consequently, an embalming fluid based on glutaraldehyde/phenol would exhibit a maximum of sanitizing ability during embalming. This sanitizing ability takes on heightened importance during the embalming of decomposed or highly infectious cases.

Phenol is a very effective anti-fungal agent and is successfully used in various embalming formulation as a fungicide and mold inhibitor. Phenol is a superior bleaching agent (mostly topically) and will actually reverse the graying effects of formaldehyde embalming. It is used hypodermically and by surface pack to eliminate post-mortem bruising and staining (IV bruises, black eyes, etc.) prior to cosmetizing. Phenol is also used as a cauterant and drying/shrinking agent to control seepage from wounds and other traumatized areas and to create a dry firm base for further treatment of necrotic or damaged areas. Finally, phenol is used for odor control of noxious exudates and gases from decomposed bodies or other serious situations requiring powerful odor control.

As an exposure hazard, phenol is a powerful cellular poison. The typical fatal dose of concentrated phenol is only 2-15 gm., which is less than 1/2 ounce. Acute poisoning is corrosive to the throat and stomach causing nausea, vomiting, cyanosis, loss of blood pressure, convulsion, pulmonary edema, coma and ultimately death. Phenol is also capable of being absorbed through the skin. First aid for acute poisoning is to delay absorption with the administration of milk or activated charcoal followed by gastric lavage at a medical facility. In addition to ingestion and skin absorption, phenol vapors can be inhaled. The threshold limit value (TLV) for an 8 hour exposure is set at 5ppm. There is no STEL or short term exposure limit.

What are the exposures to embalmers of phenol during the embalming operation? To answer this question we undertook a vapor exposure study of phenol in the embalming room.

CONTINUED: Phenol Exposure In Embalming Rooms  
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