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METHANOL AND ISOPROPANOL EXPOSURES IN EMBALMING ROOMS

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Part 1

ABSTRACT: The properties and uses of methanol and isopropanol in modern chemical industry are discussed. Both methanol and isopropanol's value in embalming and disinfection/sanitation are overviewed. The hazards involved in the use of both chemicals is summarized. A vapor exposure study of both alcohols in embalming rooms was undertaken. Simulated embalmings using extremely high concentrations of both alcohols and worst case scenarios which included no precautions or the use of ventilation were monitored and analyzed. Exposure values for both methanol and isopropanol were found to be well below exposure limits during all monitorings and exposures were insignificant in the majority of monitorings. Ventilation was found to have relatively little or no impact on the exposure readings-with exposure values being only slightly lower when ventilation was utilized. Methanol and isopropanol exposure during embalming is well within accepted safety standards and established limits of exposure.

INTRODUCTION: Methanol and isopropanol are two readily available alcohols that see extensive use in embalming formulations. Methanol, or wood alcohol or wood spirits, as it is sometimes referred to, is the simplest alcohol of the series and is found as a clear alcoholic liquid with a mild odor and high volatility. Methanol is obtained from the destructive distillation of wood products or by modern synthesis by pressurized catalysis with hydrogen gas, carbon monoxide and carbon dioxides in metal catalytic reactors. The raw materials used are ultimately obtained from natural gas, petroleum crude, naptha and coal tar residues.

Most of the methanol produced worldwide is used for conversion to formaldehyde, acetic acid, various fuels and additives for other chemical manufacture.

Consumer and factory uses for methanol include general industrial solvents, antifreezes, small stove fuels, an additive to denature ethanol, a polymer solvent and as a solvent for pharmaceutical manufacture.

Isopropanol or isopropyl alcohol is a colorless, volatile (though slightly less so than methanol) flammable (as is methanol) alcoholic liquid with an odor resembling ethanol or acetone. Isopropanol's physical properties are most similar to ethanol (ethyl alcohol). Isopropanol is manufactured from propylene by the sulfuric acid method or catalytic high pressure steam method.

Isopropanol is used extensively in the manufacture of acetone, various coatings, general solvents and agricultural and pharmaceutical chemicals.

Final products utilizing isopropyl alcohol include antifreezes, window cleaners, shellacs and varnish solvents, rubbing alcohol, ink solvents, pharmaceutical solvents, after-shave lotions and as an agent to denature ethanol. In addition, it has some usage in the veterinarian field as an antiseptic rub and rubefacient (localized vasodilator producing a warming and reddening effect).

Methanol and isopropanol are used as a diluent and solvent for numerous embalming fluids. Methanol is probably the second most common ingredient (next to formaldehyde) found in embalming formulations. Both alcohols exhibit a mild disinfectant and sanitizing action and have had extensive use as low level disinfectants or solvents for other disinfectants in the past. In fact, isopropanol is superior to both methanol and ethanol in disinfection and sanitation. When used in embalming formulations, they exhibit a mild bleaching property which supplements the bleaching action by more effective chemicals. Both methanol and isopropanol are mild protein fixative agents and readily penetrate tissues during injection. The level of fixation, however, is very low and they do not contribute significantly to overall tissue fixation or endpoint rigidity. They are never to be relied on for substantial or primary preservation. The other purpose of these alcohols is to act as a water substitute so as to create a more anhydrous-type embalming fluid. Reducing the water content by the substitution of methanol or isopropanol increases the reactivity and penetrability of the embalming formulation with faster and more certain embalming results. Isopropanol is the preferred alcohol in this case due to its lesser volatility than methanol.

Methanol is highly toxic if ingested or the concentrated fumes are inhaled. The fatal dose is from 2-8 ounces. It is not unusual to have reports of over 100 deaths in a year that are attributed to acute methanol poisoning. The toxicity of methanol is due to its conversion in the body to formaldehyde and formic acid with a resultant life-threatening acidosis. Methanol is metabolized slowly by the human body at only one-fifth the rate that ethanol is eliminated. Methanol poisoning results in liver damage, kidney damage, edema and congestion of the lungs, brain edema and hemorrhaging.

Symptoms of methanol poisoning include dizziness, nausea, vomiting, blindness followed by extreme acidosis, rapid blood pressure drop and coma resulting in death. Blindness is a relatively common symptom of methanol intoxication and sometimes is irreversible. In fact, 6% of blindness in World War 2 was caused by willful methanol ingestion. The treatment for methanol poisoning is gastric lavage with bicarbonate and the treatment of the systemic acidosis by intravenous bicarbonate or lactate. In addition, paradoxically, forced ethanol ingestion is an effective antidote as ethanol competes very successfully with the intermediary metabolism of methanol.

Despite the fact that methanol is a definite poison, the threshold limit values for airborne exposure are set relatively high. The eight hour exposure limit is established at 200 ppm and the STEL (short term exposure limit) or 15 minute exposure limit is set at 250 ppm.

Isopropanol is also highly toxic if ingested but less so than methanol. It is however, twice as toxic as ethanol. The typical fatal dose of isopropanol is 8 ounces. The human body slowly metabolizes isopropanol to acetone and then eliminates it by excretion.

Symptoms of acute isopropanol poisoning include nausea, vomiting, depressed respiration, narcosis and coma with death resulting if no treatment is administered. Cases of isopropanol overexposure have occurred in infants that were given numerous rubbing alcohol spongings to reduce fevers with treatment for isopropanol poisoning being necessary. Treatment in general is to give oxygen followed by gastric lavage. Gastric lavage has been found to be effective only if administered quickly after ingestion. Standard electrolyte treatment intravenously is also recommended and the patient is then stabilized and allowed to slowly recover. The prognosis for recovery is usually good.

The exposure limits for isopropanol are set considerably higher than are the limits for methanol. The TLV (threshold limit value) for an 8 hour exposure to isopropanol is set at 400 ppm and the STEL (short term exposure limit) for a 15 minute exposure is established at 500 ppm.

What are the exposure risks involved in the use of these two alcohols by embalmers in embalming rooms? To answer these questions a vapor exposure study of methanol and isopropanol in embalming rooms was undertaken.

METHOD AND FINDINGS: In this investigation, numerous samplings for both methanol and isopropanol were taken during simulated embalmings that utilized both alcohols in extreme concentrations of 50% in solution with each other. Consequently, methanol was present in 50% concentration in isopropanol and isopropanol was present in 50% concentration in methanol. The purpose of this study was to monitor under absolute worst case scenarios for exposure when extremely high concentrations and quantities of methanol and isopropanol are utilized during embalming operations. In addition, we attempted to maximize the exposures to both chemicals by not using ventilation or any other safety precautions that might have reduced our exposures, such as table irrigation, prompt cleanup of spills, keeping lids on all bottles and the lid tightly sealed on the embalming machine.

CONTINUED: Methanol and Isopropanol Exposures in Embalming Rooms
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