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General Facts About Formaldehyde

1. Formaldehyde (HCHO) is an *naturally existing organic compound*. It is naturally found in the cells of every animal on Earth and is a necessary component in human cells to complete the biochemical processes that produce DNA and amino acids.

2. The word *organic* simply means that formaldehyde is *carbon based* in its molecular structure. The natural structure of formaldehyde means that it is easily and quickly broken down when exposed to the natural elements such as water, atmosphere, and soil. Specifically, the formaldehyde molecule breaks down into carbon dioxide and 2 other compounds: urotropin, which is non harmful and formic acid, which is also naturally occurring and is commonly found in ants and other small insects that sting.

3. Only about 1% of all commercially manufactured formaldehyde in North America is used by the funeral industry. The other 99% is used by much larger professions such as lumber, paint, tobacco, and cleaning products.

Addressing the Common Misconception that Formaldehyde Used in Embalming Contaminates Soil and Water Near Cemeteries.

A common fallacy associated with the embalming industry is that as human remains break down after disposition, the approximate 3 gallons of formaldehyde solution that was injected into the remains then leaches into the soil and water. This is not true and is scientifically not possible. The reason embalmers use formaldehyde specifically is because it has the unique molecular ability to move between proteins of the body, bind to them, and bend their unique shape. This bending of the proteins shape then makes the protein unrecognizable by enzymes that decompose the body. This is how formaldehyde preserves. However, when formaldehyde binds to protein, it bends their shape by destroying itself and sacrificing its hydrogen ions. Formaldehyde is only formaldehyde if it is HCHO; the preservation process destroys this molecule by default. This means that once formaldehyde is introduced into a human body and it reacts with proteins to preserve the remains, formaldehyde ceases to exist, making it impossible for formaldehyde to be present after the remains eventually break down.

Formaldehyde As A Sanitation Chemical

According to the World Health Association approximately 30% of worldwide deaths per year are caused by communicable infectious diseases. Formaldehyde is not only an excellent preservative but is also extremely effective as a chemical agent that destroys causative agents of disease such as bacteria.

Interpretation of Studies & Data Related to Formaldehyde

1. OSHA metabolic (ceiling) and exposure limits

OSHA recognized that just because formaldehyde is organic and natural it can still be harmful to human beings in excess amounts, just like anything else. OSHA scientists studied the **maximum** amount of formaldehyde humans can metabolize (break down without negative consequences) between the years of 1976-1983. Since formaldehyde naturally exists as a gas, its amounts are measured in PPM (parts per million). OSHA discovered that the **maximum amount** of formaldehyde that humans can withstand is **3 PPM** if exposed continually over an 8 hour averaged period of time of **10 PPM** if exposed over a one time 15 minute burst.

Because OSHA serves to protect worker safety, it needed to establish **workplace exposure limits**. These limits are different than the maximum limits; workplace exposure limits are substantially lower than the maximum limit and are what employers are required to abide by. The reason these limits are lower than maximum limits is because OSHA doesn't want any worker to be close to the maximum exposure limit. It was thus decided in 1983 that the OSHA **exposure limits** would be 80% lower than the maximum exposure limits. The 8 hour exposure limit, known as the PEL (permissible exposure limit) in the workplace is .**75 PPM** and the 15 minute exposure limit, known as the STEL (short term exposure limit) is **2 PPM.**

Of particular note in **Canada** is that the according to the Ontario standards you emailed me, **Ontario has no PEL (8 hour standard) in place at all, but has a slightly lower STEL (15 minute exposure standard) than OSHA.** The Ontario STEL is set at 1.5 PPM as opposed to OSHA STEL which is slightly higher at 2 PPM.

In addition to making the workplace exposure limit substantially lower than the maximum limit, OSHA also instituted workplace controls to further limit formaldehyde exposure. These include the use of PPE and the mandate that air ventilation systems are present and are exchanging air a minimum of 15 - 20 times per hour.

2. Formaldehyde Classified As Potential Carcinogen by the United States EPA

In 1979 the United State EPA classified formaldehyde as a potential carcinogen based on an experiment done by the Chemical Industry Institute of Technology in Ontario, Canada. This experiment exposed lab mice to formaldehyde of varying PPM levels without any ventilation continuously for 6 hours a day, 5 days a week, for 18 months. At the end of the experiment the rodents were examined for signs of nasopharyngeal or lung cancer. 720 rodents were broken into 3 groups of 240 and placed in isolation. The first group was exposed to 2 PPM formaldehyde (note: this is **6 times** the OSHA workplace exposure limit); the second group was exposed to 6 PPM, and the third group exposed to 15 PPM (20 times the OSHA workplace limit!). None of the rodents in the first 2 groups showed any sign of cancer. 3/240 (1.2%) showed signs of nasopharygeal cancer in the third group that was exposed to 20 times the exposure limit. This study demonstrates what OSHA already suspected— that formaldehyde is able to be metabolized with no incident as long as it kept to a reasonable amount. It is interesting to note that in 2017 this experiment was repeated by the Toxicology Branch of the National Institute of Environmental Health Sciences and yielded results of 0% cancer from all 3 groups.

3. Formaldehyde Classified as A Known Carcinogen

The United States National Institute for Occupational Safety and Health (NIOSH), the British Health and Safety Executive, and the National Cancer Institute all classify formaldehyde as a known carcinogen based on results of a correlative study all 3 groups completed independently. This study took certified death certificates of those whose occupation caused them to be regularly exposed to formaldehyde (embalmers, paint factory workers, lumber yard employees, etc) and examined those DCs for causes of death related to cancer. The National Cancer Institute surveyed 25,619 such death certificates and found 8 cases of nasopharyngeal cancer death (.03%). NIOSH surveyed 11,039 DCs and found 1 case of nasopharyngeal cancer (.009%). The British HSE surveyed 14,014 PCs and found 0 cases of nasopharyngeal cancer death.

It is important to note that even in the very low numbers of cancer related deaths, there is no substantive proof that formaldehyde exposure caused the cancer, it is only a correlation.

4. Correlation of Male Embalmers to ALS (Lou Gehrig's Disease)

It is worth mentioning that in 2015 the *Journal of Neurology, Neurosurgery, and Psychiatry* published an article that some in the media interpreted to mean that male embalmers were 4 times more likely to die of ALS than everyone else. These claims were made by people who didn't read the full study, which states"

"…we did not find a dose-response association between formaldehyde exposure and ALS."

"We found no overall association between estimated occupational formaldehyde exposure and ALS…"

5. Amount of Formaldehyde Exposure to Embalmers

In 1984, Williams et al.published a study in the American Industrial Hygiene Association Journal that specifically studied the Short Term Exposure (15 minute) of embalmers. The study compared straight case and autopsy embalming and was done in rural and urban areas with prep rooms of various sizes. Keeping in mind that the OSHA STEL in the work place is 2 ppm—— the study revealed that on average an embalmer is exposed to only .4 PPM formaldehyde during a straight case embalming and 1.2 PPM during an autopsy embalming, with the average exposure being .9 PPM, which is less than half the STEL of 2 PPM and drastically lower than the maximum exposure of 10PPM.

In 1986, The University of Pennsylvania and the Pittsburgh Institute of Mortuary Science studied the PEL (8 hour exposure) of embalmers. The variable in this study was square footage (size) of the prep rooms, with the smallest being only 735 square feet and the largest 5000. Of interesting note is that this study inadvertently revealed that only 17% of surveyed prep rooms even had a ventilation system, and of those that did, the average air exchange per hour was only 7.5; this is half the OSHA minimum requirement of 15-20 exchanges per hour. Despite the poor ventilation, the study revealed that the average 8 hour exposure to formaldehyde of embalmers was only .16 PPM. The OSHA workplace limit is .75PPM and the maximum limit is 2 PPM.

6. Amount of Formaldehyde in Cemetery Soil

In 2018 researchers at the University of Pretoria in South Africa designed an experiment to test how much formaldehyde remained in soil after direct exposure. Pure formalin (liquid formaldehyde) was soaked into cloth strips and deposited directly into different types of soil (gravel, dirt, sand, clay, etc). These soils were then exposed to various moisture and pH conditions over 6 months. At the end of the study it was discovered that greater than 97% of the pure formaldehyde had been broken down by the soil. It is important to note that this was formaldehyde directly exposed to the soil; remember that in the funeral setting even this would not be possible since formaldehyde ceases to exist once it enters the body.

7. Current NFDA Study of Embalmer Formaldehyde Exposure

Recognizing that relevant studies on formaldehyde exposure to embalmers were nearly 40 years old, NFDA commissioned an independent study of exposure in June of 2022.

The study was published in the Journal of Occupational and Environmental Hygiene. The pretense of the study was that embalming and PPE has improved over the last 40 years and a current capture of data was deemed valuable. The NFDA study surveyed the 8 hour average exposure (PEL) in 13 different funeral homes of various sizes and call volumes. The findings were that the average exposure to embalmers was only .037 PPM. Furthermore, approximately 94% of the tests revealed exposure of less than .1PPM. This was seen as a huge victory for personal safety and for the funeral industry as the OSHA PEL standard for workplaces is .75PPM. This data also supported the hypothesis that exposure controls and PPE have drastically improved in the funeral industry over the last 40 years.