

---

---

**CHAMPION® Expanding Encyclopedia  
Of Mortuary Practices**

---

---

Number 643, 2001

**TCE (TRICHLOROETHYLENE) AND PERCHLOROETHYLENE:  
NEW AND UNNECESSARY EXPOSURE  
PROBLEMS IN EMBALMING ROOMS.**

**Part 1**

**By: James H. Bedino, Chemist/Dir. Research  
The Champion Company**

*ABSTRACT: A review of TCE and its exposure dangers and disposal problems in embalming rooms is discussed. The reasons for TCE's appearance and the replacement of the old traditional solvents is explained. The dangers of TCE including carcinogenicity and other exposure related health effects along with groundwater contamination problems and liabilities is delineated. Perchloroethylene (PERC) is found to have all the disadvantages and dangers of TCE as a drywash/cleaning solvent. Recommendations to minimize or eliminate the use of TCE and perchloroethylene in embalming rooms and discussion of acceptable and safer alternative solvents are offered and explained.*

INTRODUCTION. A new solvent is being used in the embalming profession that is not necessary and creates exposure dangers and disposal problems above and beyond what already exists in embalming rooms. The new solvent is TCE (Trichloroethylene) and it's use carries with it additional burdens of exposure and disposal problems when used. Perchloroethylene (PERC) is also being used as a new solvent and it's health effects, exposure dangers and disposal problems is as bad or worse than TCE. This is unfortunate because, for embalmer's purposes, it is a logical choice and an overall excellent solvent for embalming operations. TCE is the number one groundwater contaminant in the United States in addition to being listed as a potential carcinogen by several agencies. In an already chemically exposure-rich environment, the embalming profession does not need another exposure hazard that carries all these problems and dangers unless compelling reasons for it's use override these concerns. This is not the case with TCE or PERC, the new replacement drywash/cleaning solvents. With these facts let us discuss the disappearance of the traditional solvents and the reasons to not implement TCE or PERC as the replacement.

---

---

**THE TRADITIONAL SOLVENTS:** The traditional drywash/cleaning solvent in the embalming room was chloroethene (1,1,1-trichloroethane) which was a very effective and volatile non-flammable cleaning solvent that was used for many purposes including cleaning of hair and skin surfaces in addition to normal spot cleaning uses on fabrics. It was also used as a remover and softener for oil and grease based cosmetics. All the embalming suppliers had the solvent and Champion was no exception. Chlorinated hydrocarbons such as chloroethene and many of the refrigerants and other CFC's were phased out of production and eventually banned from manufacture and distribution. These types of solvents were excellent for the purposes they were used for but seriously depleted the ozone layer and were considered environmentally unacceptable. Most all of these solvents is now out of the pipeline —only a small amount of reclaimed product is still available in certain circumstances. The professional embalmer had lost a very effective solvent due to this situation and the unfortunate choice for replacement was TCE or it's cousin PERC (perchloroethylene).

**TRICHLOROETHYLENE:** TCE is a manmade chemical that does not occur naturally in the environment. It was created in the 1920's from the chlorination of ethylene and acetylene. It's main use has been as a vapor degreasing chemical. It was used extensively in drycleaning starting in the 1930's but fell out of use by the late 1950's when better and more effective cleaning agents were found. Today it is primarily used as a degreaser of metal and metal parts prior to electroplating or painting. It has been used as a paint stripper, glue solvent and as a solvent for latex manufacture. In addition, there is some use as a de-inker in paper/pulp manufacture and recycling. You will find it occasionally in certain consumer products such as : aerosol paints, spot cleaners, paint and varnish removers and rubber and resin additives. At one time it was even used as a coffee decaffeinator extracting chemical, but this use is now banned. It was also used as an anesthetic gas during surgery but has been replaced mostly by safer and more effective anesthetic gas agents. TCE is very volatile and is essentially non-flammable and exhibits a sweet chloroform-like odor. Moisture and light will cause a slow autooxidation and decomposition of the product. TCE's solvent characteristics are excellent for the requirements of the embalming profession. Perchloroethylene is very similar to TCE in characteristics, properties and uses and would be very acceptable as a drywash/cleaning solvent for the embalming industry.

**THE PROBLEMS WITH TCE.** Unfortunately, the exposure dangers and health risks associated with TCE are substantial. Current epidemiological studies show an increased risk of liver and biliary tract cancers in exposed workers and a 2X increased risk of cervical cancers. There is also an increased risk of non-hodgkins lymphomas in exposed workers. Animal studies show significant benign and malignant tumors in mice and inhalation studies in mice with lymphomas, liver tumors and lung tumors evident in experimental animals. Rats do not exhibit these effects due to a divergent metabolic pathway for TCE in that species. In-vivo and in-vitro studies give indications of genotoxicity with evidence of micronuclei induction and DNA single-strand breaks and sister-chromatid exchanges noted. IARC (International Agency for Research on Cancer) rates TCE as a class 2A carcinogen.

In addition, metabolites of TCE, particularly trichloroacetic acid have shown induction of cardiac teratogenic (birth defects) effects in fetuses of pregnant rats. TCAA (trichloroacetic acid) can, in fact, be measured in the urine of exposed humans up to a week after exposures. Other metabolites of TCE in humans include: chloral hydrate, dichloroacetic acid and dichloroethanol — all with their own exposure problems and related health risks.

---

---

TCE is classified, in various lists, as a carcinogen, cardiovascular or blood toxicant, developmental toxicant, gastrointestinal or liver toxicant, kidney toxicant, neurotoxicant, reproductive toxicant, respiratory toxicant and a skin or sense organ toxicant. It ranks worse than most chemicals in 5 out of 12 ranking systems. It is manufactured in high volume in the U.S. and is a documented contributor to indoor air pollution. It is on 7 Federal and State regulatory lists. Its use in general has been decreasing due to its toxicity and health risks and is banned as a solvent in some states in the U.S. Symptoms of exposure include dizziness, drowsiness, headache, and unconsciousness. Skin and eye splash exposures result in dryness, redness, irritation, swelling and pain. The typically fatal oral dose is 7-8 ounces.

Numerous agencies classify TCE as carcinogenic or potentially carcinogenic. NTP (National Toxicology Program) in their 9th report on carcinogens rated TCE as an R classification (reasonably anticipated to be a human carcinogen), when the 10th report is published — TCE will be upgraded to a K classification (known human carcinogen). EPA (Environmental Protection Agency) classifies TCE as a B/C classification. As stated above, IARC classifies TCE as a 2A carcinogen. NIOSH (National Institute of Safety and Health) classifies TCE as a carcinogen and the Federal Republic of Germany gives it a carcinogenic classification of 1.

The limits for exposure to TCE vary from agency to agency. ACGIH sets an 8 hr./15 min. limit of 50/100 ppm while OSHA (very typically) has higher limits of 100 ppm/200 ppm and an unusual requirement of 300 ppm for any 5 minute peak over a total exposure scenario of 2 hours. NIOSH has lower limits of 25 ppm for a 10 hour TWA and a 2 ppm ceiling for 15 minute exposures. Compared to the traditional chloroethene based solvents — TCE has much lower limits. In fact, exposure limits to chloroethene are set at 350 ppm/ 450 ppm by OSHA which is 4-7 times higher than for TCE. The odor threshold which is 28 ppm is above the NIOSH limits for TCE. TCE is a volatile chemical — it exhibits a vapor pressure of 60 mmHg at room temperature and increase to over 100 mmHg at 90 degrees Fahrenheit.

TCE is the number one groundwater contaminant in the United States. EPA has set a MCL (maximum contaminant level) of 5 ppb (parts per billion) for drinking water systems in the U.S. Over 38% of groundwater sourced municipal water supplies are over this limit at any given time. TCE is a severe and persistent soil and water contaminant. In soil, it slowly evaporates or leaches into groundwater systems. When present in surface water it will evaporate but is trapped in underground water and accumulates in sediment beds. Fortunately, it does not appear to bioaccumulate in plants or animals. EPA ranks TCE in the worst 10% of all chemical for overall damage to human health and the environment. Underground water supplies that test above the 5 ppb limits must remediate their water by pumping from the underground aquifer and aerating the water in evaporation ponds and/or activated charcoal filtration prior to delivery to the municipal water supply. TCE has been proven to persist in surface water for up to several weeks and ground water for months to years. Microbial oxidation yields vinyl chloride and vinylidene chloride, both of which are probable human carcinogens. Current research efforts into control of TCE in groundwater is focusing on phytoremediation — the use of poplar trees to detoxify underground aquifers. Poplar trees very effectively bioremediate and breakdown TCE through their root systems and testing is underway to verify the efficacy of this methodology. Suffice it to say that TCE is a serious exposure problem in general and an unacceptable choice for a drywash/ cleaning solvent in the embalming room.

---

---

Is PERC (perchloroethylene) any better? Unfortunately it has all the disadvantages and danger involved in TCE and is even worse in most respects from a health and safety standpoint. It is a common soil and groundwater contaminant and is as unacceptable as TCE is for embalming room use. I will not delineate the subtle differences between TCE and PERC in this discussion as they do not change the impact on the embalming profession or the decision to use or not use these solvents. PERC and TCE are closely related chlorinated chemicals and share all the hazards involved in their use and both are serious soil and groundwater contaminants, neither is acceptable for use in embalming rooms.

As can be seen from the above discussion, the choice of TCE or PERC as a drywash/cleaning solvent in embalming rooms is an extremely poor one. The additional exposure and health hazards along with the documentation as a serious groundwater contaminant should dissuade embalmers from the use of TCE and to seek an alternative. The liabilities of stocking and using substantial quantities of TCE in a regulated work environment where records and MSDS files must be kept and requirements of OSHA in regards training and disposal are mandatory and significant. Using a small amount of TCE in your own home as an occasional spot remover is one thing, while stocking gallon quantities and regular use of significant quantities as the standard in the embalming room is quite another scenario. It is difficult to use drywash/cleaning solvents without some chemical ending up down the drain in one way or another. In my opinion, a funeral home would have little defense against an accusation of contamination of the groundwater or municipal water supply, if it ever came up. I think it unadvisable to be a documented user of this type of chemical on a regular basis.

CONTINUED: TCE (Trichloroethylene) and Perchloroethylene:  
New and Unnecessary Exposure Problems in Embalming Rooms  
Champion Expanding Encyclopedia of Mortuary Practices  
Number 644, 2001