TRICHLOROETHYLENE - II

Health effects

Reproductive and Developmental Toxicity

Evidence from animal and epidemiologic studies suggests that several reproductive and developmental toxicity end points may be associated with trichloroethylene exposure, including infertility in males and females, impaired fetal growth, and cardiac teratogenesis. Multiple rodent studies
indicate that trichloroethylene affects spermatogenesis and the fertilizing capability of sperm in males and decreased fertilizability of oocytes in females. The effects appear to depend on metabolic activation of trichloroethylene by CYP2E1, but which oxidative metabolite is the proximate toxicant remains unknown. The relevance of these effects on rodent reproduction for predicting human outcomes also is not clear (#National Research Council, 2006).

Multiple animal studies have found decreased fetal growth after maternal exposure to trichloroethylene. Impaired fetal growth was also a consistent finding in different community studies of mothers exposed to drinking water contaminated with trichloroethylene or tetrachloroethylene, a compound that has some of the same metabolites as trichloroethylene. However, a mechanistic basis for this effect remains to be elucidated (#National Research Council, 2006).

Multiple studies in mammalian and avian models suggest that trichloroethylene or one or more of its metabolites (trichloroacetic acid and dichloroacetic acid) can cause cardiac teratogenesis. The avian studies are the most convincing. Rodent studies have had mixed results, suggesting either methodological or strain differences. The committee noted that the low-dose studies showing a positive correlation in trichloroethylene-induced cardiac teratogenesis showed unusually flat dose-response curves and came from a single laboratory. The results need to be replicated in another laboratory to clarify the dose-response relationship(#National Research Council, 2006).

Epidemiologic investigations of communities exposed to trichloroethylene have also reported mixed results. A 2- to 3-fold increase in risk of congenital heart defects was found in multiple studies, and the most frequently found defects were the same in animal and human studies (defects of the interventricular septae and the valves). In addition, mechanistic support is

provided by studies in animals demonstrating altered proliferation in the endocardial cushions at low dose or alterations in endothelial cell activation and decreased expression of two markers of epithelial mesenchymal cell transformation, a key process in valve and septum formation. Evidence that trichloroacetic acid and dichloroacetic acid are as potent as trichloroethylene suggests that CYP2E1 metabolic activation, as well as the fractional formation of trichloroacetic acid from chloral, is important in trichloroethylene cardiac teratogenesis(#National Research Council, 2006).

Neurotoxicity

Past evidence showed that inhalation of trichloroethylene causes neurotoxic effects in laboratory animals and humans that are similar in nature (e.g., massiter reflex latency, motor incoordination, changes in heart rate) and occur at comparable concentrations of exposure (7-16 parts per million [ppm]). New information has not added substantially to the understanding understanding the effects of chronic exposure to trichloroethylene. It is not yet possible to ascertain the extent of trichloroethylene-induced impairment of complex neurological functions such as learning, memory, and attention. Whether there is preferential vulnerability to trichloroethylene across these domains, what exposure parameters might be associated with the effects, the extent of their reversibility, and the impact of the developmental period of exposure on such effects remain to be elucidated. It has been suggested that exposure to trichloroethylene during early development could enhance its effects on the nervous system, but the available data are insufficient to draw firm conclusions. Aging appears to enhance susceptibility of the nervous system after exposure to trichloroethylene. Some studies suggest a contribution of trichloroethylene to Parkinson's disease. Multiple mechanisms appear to contribute to the neurotoxic action of trichloroethylene, and further study is needed to elucidate them more precisely (#National Research Council, 2006).

Immunotoxicity

Among the immunotoxicity end points the committee evaluated, evidence for an effect of trichloroethylene was strongest for autoimmune disease. Studies in genetically susceptible rodents have shown that trichloroethylene exacerbates underlying autoimmune disease, and supporting information comes from multiple human studies of scleroderma and exposures to organic solvents. The metabolites and the mode of action involved have not been elucidated, but a role for chloral has been implicated in mouse models. Some individuals might be genetically susceptible to developing autoimmune disease; alterations in the CYP2E1 gene are suspected to play a role (#National Research Council, 2006).

Precautions

The following is from the *Canadian Centre for Occupational Health and Safety (CCOHS) Profile for TCE*:
This material is a VERY TOXIC liquid (MUTAGEN, SKIN/EYE IRRITANT, SUSPECT CANCER HAZARD and POSSIBLE REPRODUCTIVE HAZARD). Before handling, it is extremely important that engineering controls are operating and that protective equipment requirements and personal hygiene measures are being followed. People working with this chemical should be properly trained regarding its hazards and its safe use. Maintenance and emergency personnel should be advised of potential hazards.

If trichloroethylene is released, immediately put on a suitable respirator and leave the area until the severity of the release is determined. In case of leaks or spills, escape-type respiratory protective equipment should be available in the work area.

Immediately report leaks, spills or ventilation failures.

Unprotected persons should avoid all contact with this chemical including contaminated equipment.

Closed handling systems for processes involving this material should be used. If a closed handling system is not possible, use in smallest possible amounts in well-ventilated area, separate from the storage area. Avoid generating vapours or mists. Prevent the release of vapours/mist into the workplace air. Do not use near welding operations, flames or hot surfaces because of the risk of formation of toxic hydrogen chloride or phosgene. Do not perform any welding, cutting, soldering, drilling or other hot work on an empty vessel, container or piping until all liquid and vapours have been cleared.

Follow the chemical supplier/manufacturer's advice regarding checking and maintaining appropriate levels of stabilizers.

Do not use with incompatible materials such as strong bases (e.g. sodium hydroxide) and alkali metals (e.g. sodium and its alloys). Never return contaminated material to its original container. Inspect containers for leaks before handling. Stand upwind of all opening, pouring and mixing operations. Prevent damage to containers. Label containers. Open containers on a stable surface. Keep containers tightly closed when not in use. Assume that empty containers contain residues which are hazardous. Never return contaminated material to its original container. Keeping work areas clean is essential. Use work surfaces that can be easily decontaminated. Follow handling

precautions on Material Safety Data Sheet. Have suitable emergency equipment for fires, spills and leaks readily available. Practice good housekeeping. Maintain handling equipment. Comply with applicable regulations.

Current Events

In 2001 the Environmental Protection Agency (EPA) issued a draft report on the known health effects of TCE and recommended stringent cleanup protocols to be executed at both public and private sites and to be included as a chemical covered by the Superfund act. This sparked a major debate between the Department of Defense and the Department of Energy on whether TCE had the risks the EPA claimed, largely due to the fact many of their sites were contaminated by TCE. President Bush interceded and called for a National Academies of Science (NAS) report before any actions would be taken regulating TCE (#Associated Press, 2006). The NAS completed their assessment and filed their report in July of 2006. This study helped to further boost awareness and created a guideline on how much TCE was safe exposure for humans through a cost benefit analysis (#Henderson, et al, 2006). Residents in the San Gabriel and San Fernando Valleys in California are perhaps the most populated areas affected by TCE contamination in public water supplies. Over two million residents were potentially exposed to carcinogenic levels of TCE from aquifers contaminated by surrounding military bases (#Vartabedian, 2007). In August of this year, Senator Clinton of New York introduced legislation to amend the safe drinking water act focusing on TCE contamination. That bill has yet to leave committee to be voted upon (#Grayson and Strong, 2007).

Source : http://www.toxipedia.org/display/toxipedia/Trichloroethylene