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GVST GENERAL VOLATILE SCREENING TEST FACT SHEET

INTRODUCTION

The aromatic and halogenated volatile organic compounds in the **GVST** are numbers of perhaps the most important and useful class of synthetic chemicals. They are routinely employed in hundreds of industrial processed and thousands of consumer products. In total, annual production and use in the U.S. is tens of billions of pounds. Primary uses for the class include employment as solvent systems, chemical production intermediates, and cleaning and degreasing agents. Exposure is predominantly by inhalation of vapor and fumes, and to a lesser degree through skin contact and ingestion, variable by compound. Recent concern has focused on environmental contamination of water supplies by solvent wastes from industrial use. Toxicity can be evident in numerous organ systems, but most share a predilection for the central nervous system and many are hepatotoxic and nephrotoxic as well. They are irritants to varying degrees and can cause injury to skin and sensitive ocular tissues. Benzene, in particular, has a severe toxic effect on the hematological system, and is a recognized human carcinogen. Chronic toxicity of the nervous system, and possible carcinogenic risks from exposures to other class members are a growing concern.

AROMATIC COMPOUNDS

Benzene has been used as an important industrial solvent for 80 years, although today the great bulk of its uses are as a chemical raw material in the synthesis of other organic compounds such as styrene and phenol and other products, such as detergent, polymers, pesticides, and pharmaceuticals. It has been widely used in the production of chlorinated solvents and printing inks. Benzene is present in amounts as great as 1 - 2 % in refined gasoline, and other environmental exposures may occur from trace amounts in processed foods and concentrations in cigarette smoke. Benzene exposure occurs primarily through inhalation of vapor, but it can be partially absorbed after skin contact as well. Acute exposures can cause central nervous system depression with end stage respiratory failure, as well as pulmonary edema, dermatitis, and gastrointestinal irritation. The primary toxic effect, particularly with long-term exposures, is on the hematological system. Benzene exposure can cause a variety of blood dyscrasias including aplastic anemia, hemolysis, and leukemia's of various cell types. Studies have shown that benzene induces chromosomal abnormalities in exposed workers, and reproductive damage in various animal experiments.

Toluene is an important organic solvent, closely related to benzene and often used as a replacement or in similar applications. Until relatively recently, commercial grades of toluene were frequently contaminated with benzene concentrations of as much as 10 - 15 %. About 1/4 of toluene production is converted to benzene for industrial use, and the remainder is used to produce solvents for gums, fats, and adhesives, as a paint

thinner and stripping agent, for varnishes, lacquers, and as a fuel additive. Toluene is absorbed by inhalation and through skin contact. Toluene is fat-soluble and accumulates in body fat with repeated exposures. The primary metabolic process occurs in the liver, and the conjugated waste products are excreted in the urine. The primary toxic action of toluene is on the central nervous system, with acute changes of CNS depression, and evidence of long-term impairment including cerebella impairment. Other recognized adverse health effects include a defatting dermatitis, conjunctivitis, keratitis, chemical bronchitis, hepatomegaly, paresthesias of the extremities, behavioral changes, and renal damage after acute exposures. Toluene does not have the potent hematological toxicity of benzene, but there are isolated reports of bone marrow damage after toluene exposure, even in situations where no benzene contamination is likely.

Ethylbenzene is used for industrial purposes in solvent applications, as a chemical intermediate, for paint and lacquer thinners. The primary route of exposure is through inhalation of vapors, with some secondary skin absorption. The toxicity profile is similar to other aromatic solvents, with a major action on the central nervous system causing depression acutely. Ethylbenzene can also cause skin irritation, conjunctivitis and corneal erosion, pulmonary edema after high levels of exposure, and toxic hepatitis.

Xylene. Commercial xylene is a mixture of three isomers and it is used in a variety of solvent applications for gums, synthetic resins, rubber, paints, inks, and photographic solutions. It is used in the production of insecticides, as a chemical intermediate in the production of plastics and synthetic fibers. Xylene is employed as a degreasing agent, cleaning agent, and as a gasoline additive. Exposure occurs by inhalation and skin absorption. Xylene is fat soluble and bioaccumulates after repeated exposures. Metabolism occurs in the liver with production of water-soluble degradation products. Xylene is a CNS irritant and narcotic, and causes performance impairment and cerebella dysfunction after acute exposures. Skin damage includes erythema, defatting, and blistering after severe exposures. Conjunctivitis and "polisher's keratitis" are recognized ocular effects. Reports of hematotoxicity may be due to benzene contamination of commercial xylene products, and there are cases of hepatotoxicity, renal damage, and paresthesias of the extremities.

Styrene is a major reactive solvent in a variety of uses for reinforced plastics manufacture, in production of polyesters and alkyds, and for products such as ABS synthetic rubbers. Exposure occurs by skin contact as well as inhalation of vapors and dusts. Styrene is a central nervous system depressant and mucous membrane irritant. Gastrointestinal symptoms can occur in addition to toxic hepatitis and peripheral neuropathy. Studies of styrene exposed workers have demonstrated an increased incidence of chromosomal aberrations, and there is some evidence from epidemiological investigations that occupational exposure is associated with an increased risk of leukemia.

Trimethylbenzenes are used as solvents, as intermediates for chemical synthesis, for paint thinners, in perfumes, dyes, and as a motor fuel additive. Inhalation is the major route of exposure, though skin contact can contribute. Toxic effects include irritation, CNS depression, conjunctivitis, dermatitis, asthmatic bronchitis, headache, and behavioral changes. Thrombocytopenia and hypochromic anemia can result from hematotoxicity of trimethylbenzenes.

CHLORINATED COMPOUNDS

Chloroform Industrial uses include solvent properties, as a chemical intermediate for dyes and drugs, in the manufacture of fluorocarbons as refrigerants, plastics, and propellants. It is used to make artificial silk insecticides, floor polishes, lacquers, and as a cleaning fluid. Chloroform is no

longer used as an anesthetic in medicine. The major routes of exposure are ingestion and inhalation. Primary toxic effects occur in the liver with hepatitis and necrosis and renal damage associated with tubular degeneration. CNS symptoms of lassitude, confusion, and nervousness occur, along with gastrointestinal distress, cardiac depression, and frequent urination. Chloroform acts as an irritant on the eyes, nose, and respiratory tract, and can cause dermatitis.

Dichloromethane, or more commonly methylene chloride, is a highly volatile solvent and extracting agent whose primary use is as the major component of paint strippers. Exposure is by means of inhalation and ingestion. Methylene chloride accumulates in fat tissue, in proportion to body habitus. Toxic effects are evident in CNS impairment, causing headache, stumbling, impaired coordination, and irritability, in both acute and chronic exposure circumstances. Gastrointestinal symptoms, eye irritation, and dermatitis can also occur. Instances of carbon monoxide intoxication have resulted from methylene chloride exposure, as it is metabolized with an increase in blood carboxyhemoglobin.

1,1,1-Trichloroethane, or methyl chloroform, is widely used as a solvent, chemical intermediate, dry cleaning fluid, and vapor degreaser. Commercial mixtures usually contain various stabilizers or inhibitors which may be ketones, alcohols, or esters. The primary exposure route is inhalation, but ingestion may also contribute. Methyl chloroform is a narcotic and central nervous system depressant, and can cause serious cardiac arrhythmia. Severe overexposure may result in pulmonary edema. Altered liver function and renal damage can occur after exposure, as well as eye irritation and dermatitis.

Trichloroethylene is commonly used as a metal degreaser and dry cleaning agent. Other uses include service as an extracting solvent, in lacquers, printing inks, paints, and use as a refrigerant. Previous use as a surgical anesthetic has been largely abandoned. Exposure may occur by inhalation, ingestion, and secondarily through skin absorption. Recently, large quantities of trichloroethylene have been found in drinking water supplies from contamination by nearby industrial users, for example in California's Silicon Valley. Metabolism occurs in the liver as well as excretion unchanged through expired air, and trichloroethylene is a relatively mild irritant of the eyes and respiratory tract, and can cause both primary irritation and skin sensitization. Cardiac arrhythmia and toxic myocarditis following exposure have been reported, and renal and hepatic damage can also occur. Concurrent alcohol use may potentiate adverse exposure-related health effects.

Tetrachloroethylene, or perchloroethylene, is primarily used as a dry cleaning agent, but has some use as a metal degreaser, and grain fumigant. Environmental contamination of ground water from discharges by nearby dry-cleaning establishments has recently been documented. Exposure is by inhalation with a minor contribution from skin contact. Perchloroethylene is an irritant and direct skin contact can result in erythema and vesiculation. Cardiac irregularities have been reported. Hepatic damage in the form of elevated liver function enzymes, particularly SGOT and SGPT, are recognized.

Dichlorobenzene. The dichlorobenzene isomers are used as chemical intermediates, in deodorants, disinfectants, insecticides, fumigants, in metal polishes, for mothproofing, as a component of paints and lacquers, and for solvent purposes. Exposures are by means of inhalation, ingestion, and skin absorption. Dichlorobenzenes are irritants, skin sensitizers, and CNS depressants. A variety of toxic effects on the hematological system are known, including anemia, allergic purpura, and methemoglobinemia. Hepatic and renal dysfunction can occur as well.

REFERENCES

Arlie-Soborg, Solvent Neurotoxicity, CRC Press, Boca Raton, FL, 1992.

Clayton, GD and FE Clayton, Patty's Industrial Hygiene and Toxicology, vol 2B, 3rd edition, Wiley-Interscience, New York, 1981.

Doull, J., et al., Casarett and Doull's Toxicology, 2nd edition, Macmillan, New York, 1980.

Last, JM, Maxcy-Rosenau Public Health and Preventive Medicine, 11th edition, Appleton-Century-Crofts, New York, 1980.

Plunkett, ER, Handbook of Industrial Toxicology, Chemical Publishing Co., New York, 1976.