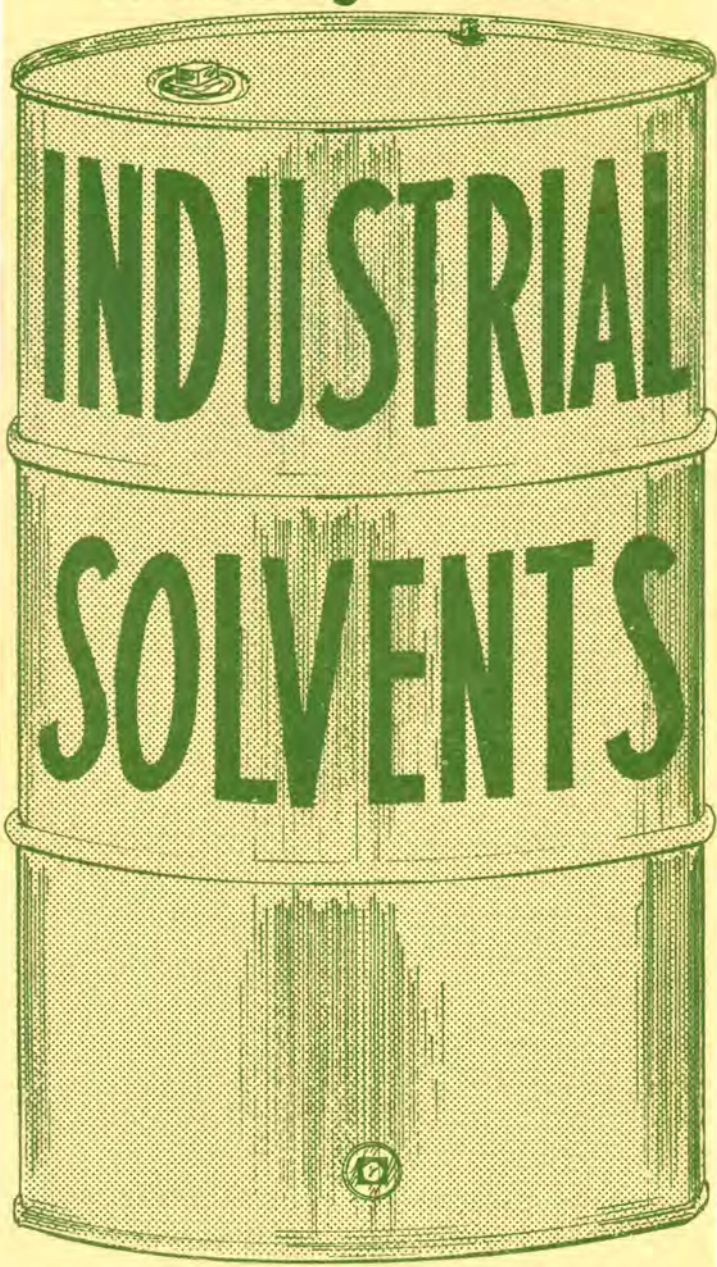
Working with



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
HEALTH SERVICES AND MENTAL HEALTH ADMINISTRATION
National Institute for Occupational
Safety and Health

Working with INDUSTRIAL SOLVENTS

In most occupations, exposure to organic industrial solvents presents a constant threat to the health, productivity, and efficiency of workers. Solvents have found widespread industrial application and are incorporated in a variety of products including paint, varnishes, lacquers, paint removers, adhesives, plastics, textiles, polishes, and waxes. They are used as cleaning agents, thinners, degreasers, chemical reagents, and drying agents. Since organic solvents can be toxic at some level of exposure, they can do damage to the health of workers who use them without proper precautions and adequate controls.

What Solvents Are

Organic solvents, also called thinners, organic liquids, or vehicles, are derived from hydrocarbons and used to dissolve other organic materials. The organic solvents can be classified into various family groups having similar solvent and chemical characteristics. Principally, these include aliphatic, aromatic, and halogenated hydrocarbons, the alcohols, ketones, esters, and ethers. The aliphatic hydrocarbons include petroleum products such as gasoline, kerosene, turpentine, hexane, and heptane. The aromatic hydrocarbons include benzene, toluene, xylene, and

carbon disulfide. The halogenated hydrocarbons include carbon tetrachloride, trichloroethene, ethylene dichloride, and trifluorotrichloroethane. The alcohols include methanol, ethanol, and propanol. The esters, ketones and ethers include ethyl acetate, amyl acetate, methyl ethyl ketone, acetone, ethyl ether and isopropyl ether.

Health Problems With Use

All organic solvents have some effect on the central nervous system and the skin. The principal modes of exposure causing health problems from industrial use of solvents are skin contact and inhalation of vapors. Ingestion is regarded as an accidental rather than a normal exposure hazard. Excessive solvent vapor inhalation may cause impairments which have no discernible effects on health such as lack of coordination and drowsiness but which may result in increased risk of accidents. In other cases, exposure may result in serious damage to the blood, lungs, liver, kidney, and gastrointestinal system. The effects range from mild to narcosis and death from respiratory arrest, depending upon the degree of exposure and the solvents involved.

Skin contact may cause dermatitis, ranging in severity from a simple irritation to systemic damage to the skin. Even the most inert solvent can dissolve the natural protective barriers of fats and oils, leaving the skin unprotected. When this natural lubricant is removed from the skin, it becomes subject to disabling and possibly disfiguring dermatitis and opens the way to serious infection.

The principal health problem associated with the use of ***aliphatic hydrocarbons*** is dermatitis. The unsaturated cyclic aliphatics generally are more irritating than the saturated forms. Although they can act as depressants to the central nervous system, the aliphatics are among the least toxic organic solvents.

The principal health problems associated with the ***aromatic hydrocarbons*** other than benzene are dermatitis and central nervous system reactions. Benzene is well known for its effect on the blood-forming tissue of the bone marrow, and it should not be used for cleaning processes or any process where the concentration in the air is in excess of safe levels.

The effects of the ***halogenated hydrocarbons*** vary considerably with the number and type of halogen atoms present in the molecule. Carbon tetrachloride is highly toxic, and can cause injury to the kidneys, liver, central nervous system, and the gastrointestinal tract. Continued exposures to carbon tetrachloride result primarily in damage to the liver and kidneys. The most common health problems associated with the halogenated hydrocarbons of moderate toxicity involve the central nervous system, dermatitis, and liver damage. Certain solvents in this group have a low relative toxicity and are good substitutes for more hazardous solvents. The fluorinated hydrocarbons are generally less toxic than the chlorinated hydrocarbons. The chlorinated hydrocarbon solvents are particularly hazardous when used around industrial processes involving open flame, hot metal surfaces, high temperature, and ultra-

violet energy sources because of the toxic and corrosive decomposition products.

The *alcohols* are known for their effect on the central nervous system and the liver; however, they vary widely in their degree of toxicity. For example, methanol being noted for its impairment to vision is more toxic than ethanol. Similarly, other organic solvents differ in toxic action and potential for injurious health effects. In general, the worker's reaction to a solvent is influenced by his degree of exposure, the concentration of solvent vapor in the air, the type of solvent used, the degree of contact with the body, and the individual's work habits.

Control of Exposures

Measures to control industrial exposures to solvents include the substitution of a less toxic solvent, local exhaust ventilation, and the use of respirators and protective clothing.

Substitution of a less toxic or less volatile solvent has been effective in controlling solvent exposure and in reducing the hazard potential. For example, the substitution of methyl chloroform for carbon tetrachloride has worked efficiently and effectively in many cleaning and degreasing operations. Often the so-called safety solvents can be substituted for more toxic solvents if water or aqueous solutions are not possible. These include such solvents as methylene chloride, methyl chloroform, the aliphatic hydrocarbons with high flash points and the fluorinated hydrocarbons. However, the substitution of a less toxic solvent does not imply that a health hazard has been

eliminated; it only means that a worker is less likely to suffer ill effects.

The use of closed systems and local exhaust ventilation is an effective way of preventing solvent vapors from entering the breathing zone of the worker. Solvent containers should be covered when not in use. Possible leaks and spills should be considered in system design and operating procedures. Ventilation systems should be considered in solvent use as well as in its storage requirements. Local exhaust ventilation can remove vapors at their point of origin and thus prevent toxic concentrations in the breathing zone of the worker. Respirators can be used for short duration or emergency exposures; however, they should not be used as a regular means of protection against solvent vapors. Too often respirators give the wearer a false sense of security.

Good personal hygiene is essential whenever solvents are used. The skin should always be protected from contact with solvents. Gloves, face shields, or goggles, and other prescribed protective clothing may be used. Similarly, barrier creams may offer some degree of protection. The skin should never be washed with any raw organic solvent. Whenever possible, cleaning operations should use mechanical or manual devices to carry the parts being cleaned into and from the solvent container. Although some solvents are less toxic than others, good safety practices dictate that care be exercised in the use of any or all organic industrial solvents.

Management Responsibilities

Industrial management should realize that use of organic solvents can be a threat to the health and safety of workers and should provide necessary controls and measures to prevent injuries. Management operating guidelines should be established for the selection, use, and handling of solvents and provide the mechanism for worker training and education. Each supervisor should provide and enforce the use of protective safety devices and protective clothing when indicated. Any erratic behavior on the part of the employee which may be the result of exposure to solvents should be quickly investigated. Good housekeeping practices should be maintained throughout all storage and handling areas.

Employees' Responsibilities

Each employee should be aware of the health and safety problems associated with the use of organic industrial solvents and should follow these general rules as well as other safety rules issued to protect him on the job:

1. Avoid skin contact.
2. Use available protective devices and equipment.
3. Avoid using solvents around hot metal surfaces and metal flames.
4. Do not smoke or light matches in areas where solvents are used and stored.
5. Report and clean up spills immediately.

6. Avoid working with solvents in confined, unventilated areas.
7. Avoid drinking alcoholic beverages or medication before or during work.
8. Report all ill effects and skin disorders.
9. Develop good personal hygiene habits.

OH SERIES No. 004

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HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and
Mental Health Administration

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
Rockville, Md. 20852

1972
REPRINTED 1973
HSM 72-10263

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

☆ U.S. Government Printing Office:1973-756-384/119