

# Solvents:

## a threat to workers and their children

**Pregnant women exposed to organic solvents** on the job are 13 times more likely to deliver a baby with major birth defects. So warned scientists at the Hospital for Sick Children in a study published last spring. The researchers also found an increased risk of miscarriages, low birth weight, fetal distress and prematurity. Featured in the March 24-31 volume of the *Journal of the American Medical Association*, this new study has received much attention.

**But pregnant workers are not the only individuals at risk** of illness caused by exposure to organic solvents. Workers who handle adhesives, paints, resins, plastics, dyeing and printing materials are also at risk. Many solvents used in these types of jobs act as depressants of the central nervous system which can result in headaches, nausea, dizziness and drowsiness. Workers such as graphic designers, painters and factory workers may also experience memory impairment, muscular weakness and cancer from long-term exposure to solvents in the workplace.

### What is a solvent?

A solvent is a substance, usually a liquid, capable of dissolving other substances such as dirt, grease, fats, oils and other chemicals. The term solvent is used to describe a group of organic chemicals. Organic chemicals are carbon-based chemicals that possess the same physical structure as living organisms. These organic chemicals differ in chemical structure yet generally share important characteristics: they will evaporate (form vapour) quickly and easily at room temperature; and they dissolve the protective oil barrier of the skin, passing freely into the bloodstream.

Solvents can be classified by chemical groups or families. Generally, solvents from the same group have similar physical characteristics. In many cases they will produce similar health effects and flammability hazards. Chemical groups into which solvents can be categorized are:

- alcohols;
- glycols;
- esters;
- ethers;
- aromatic hydrocarbons;
- aliphatic hydrocarbons;
- chlorinated hydrocarbons;
- ketones; and others.

### What are the health effects?

#### Reproductive effects

Solvents may be absorbed through the skin and possibly inhaled. Absorption is increased with physical activity and during pregnancy when the blood flow is increased. Once solvents are absorbed, they are widely distributed throughout the body and concentrate in lipid-rich tissues. Most solvents can cross the placenta barrier and pose a threat to the baby pre-natally, as well as post-natally through breast milk.

Researchers involved in the Sick Kids study found the occurrence of 13 malformations among fetuses of the exposed group and one in the control group. Some of the defects discovered were congenital deafness, a tethered umbilical cord, congenital kidney disorder, ventricle defect of the heart and clubfoot requiring surgery. Also most of the fetal malformations occurred among women who had symptoms associated with their exposure to organic solvents — irritation of the eyes or respiratory system, breathing difficulties and headaches.

Scientists are also exploring the connection between solvents and more subtle, but equally serious negative reproductive outcomes, like mental deficiencies, learning disabilities and other neurodevelopment problems. To date, various animal studies have shown that maternal inhalation of solvents has resulted in neurodevelopment deficits, such as delayed learning and impaired neuromuscular activity in the baby.

### Cancer

Concern for the reproductive effects of organic solvents has emerged because of the various health risks identified in the literature, for adult workers exposed to solvents. Studies have shown that chlorinated solvents such as trichloroethylene and perchloroethylene (perc) used in dry cleaning facilities cause a variety of cancers. These include:

- pancreas;
- liver;
- bones;
- lymphatic tissues; and
- uterine cervix.

Further, solvents have been reported to cause leukemia, kidney and breast cancer.

### Other effects

Solvents are also known to contribute to many other adverse health effects. They include:

- contact dermatitis;
- upper and lower respiratory airway irritation;
- pulmonary edema;
- acute tubular necrosis;
- renal failure; and
- chemical hepatitis.

### Who is at risk?

Organic solvents are one of the most widely used groups of chemicals in the workplace. The National Institute for Occupational Safety and Health (NIOSH), a research institute funded by the U.S. federal government, has identified 335 different occupations, which have the potential to expose workers to solvents. They estimate in the U.S. three million women and six million men are occupationally exposed to solvents. Occupations with the greatest number of exposed workers are:

- registered nurses;
- janitors and cleaners;
- metal precision assemblers;
- textile sewing machine operators; and
- printing machine operators.



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Also at risk of exposure, are obviously any workers who handle solvent-containing products. These products can include:

- cleaning products;
- degreasers;
- paints and paint thinners;
- enamels and lacquers;
- adhesives;
- resins;
- marking fluids and inks; and
- typewriter correction fluid.

### **How do you control exposures?**

Workers and all workplace representatives can minimize the risk of solvent exposure in the workplace by taking steps to control the hazard at its source, along the path between the hazard and the worker, or at the worker.

#### **Elimination/substitution**

The first priority is to eliminate the hazard altogether. This is often achieved by substituting the toxic solvent with something less harmful. For example, cleaning solvents can often be replaced with simple water and detergent solutions. In many cases, water-based paints can be used in place of solvent-based paints and vegetable-based inks in place of their solvent-based counterparts.

#### **Isolation/enclosure**

Isolating or enclosing the source of the solvent controls exposure. In the automobile industry, for example, some paint spraying operations have been enclosed in order to isolate the hazard from the general work environment.

#### **Ventilation**

A local exhaust ventilation (LEV) system draws solvent vapours or mists away from the worker's breathing zone and into a hood and ducts using fans or turbines. LEV is essential in confined spaces such as tanks, pits or trenches. Without it, solvents and other contaminants can quickly reach hazardous concentrations. An effective LEV system also helps control fire and explosion hazards associated with solvent vapours. To be effective, LEV must be situated as close as possible to the source of the solvent. LEV systems that control exposure to solvents include:

- fixed hood;
- moveable hood with flexible ducting; and
- rim ventilation (on vapour degreasers).

In each of these systems, contaminated air is drawn into the ducts by exhaust fans. Capture velocity of the exhaust fans should be sufficient enough to ensure that solvent vapours or mists are captured and drawn up the hood. The hood should be located so that

it pulls solvent vapours or mists away from a worker's breathing zone. LEV should also be used in areas where metal components are stored after being removed from all degreasers (i.e., vapour or cold). Solvent vapour will emanate from components that are not completely dry.

#### **Ignition control**

Where flammable solvents are involved, all sources of ignition such as static electricity must be removed from the work area. This is controlled through conductive floors preventing the accumulation of static electricity and by maintaining a high relative humidity in affected workplaces, which helps prevent static build-up. However, static electricity is mainly controlled or dissipated through bonding and grounding.

#### **Housekeeping**

General housekeeping practices such as procedures to handle solvent spills will also prevent a fire hazard. Spills should be cleaned up according to established procedures by properly trained staff. For example, to remove the substance completely from the workplace and to prevent sparks from developing, vacuuming of spills is preferred to sweeping or mopping. This will be effective provided the vacuum and its filter are properly maintained and wastes are disposed of properly.

#### **Other controls**

Bins, tanks or process lines which are used to store or transport solvents must be cleaned and purged before maintenance or repair work is performed in or around them. After this has been completed, air in and around the equipment to be worked on should be tested to ensure that the worker will not be exposed to solvents or a fire and explosion hazard. All bins, tanks, and other containers containing solvents should be closed with tight fitting lids when not in use. This will eliminate or reduce worker exposure to solvent fumes or liquids.

#### **Personal protective equipment (PPE)**

As a last resort work exposures to solvents can be reduced with the use of proper PPE such as eye protection plus respirators, gloves, coveralls and boots made of appropriate material to protect against the specific solvent being used. For example, workers exposed to alcohols should wear butyl rubber or polyethylene gloves; those exposed to esters should wear neoprene gloves; and those working with chlorinated hydrocarbons should wear gloves made of polyvinyl alcohol.

**NOTE:** For more detailed information and training on solvents and related issues like reproductive hazards and occupational cancer contact a Workers Health & Safety Centre near you.



## **RESOURCE LINES**

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