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<b>Fact Sheet</b>	
 The logo for the California Department of Health Services (dhs) features a green outline of the state of California. Overlaid on the map is a caduceus symbol in orange and yellow. Below the map, the letters 'dhs' are written in a large, bold, black font. Underneath 'dhs', the words 'DEPARTMENT OF HEALTH SERVICES' are written in a smaller, black, sans-serif font.	<p style="text-align: center;"><b>Hazard Evaluation System and Information Service</b></p> <p style="text-align: center;">850 Marina Bay Parkway Building P, 3rd Floor Richmond, CA 94804</p> <p style="text-align: center;">(866) 282-5516</p>

# Styrene

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**Health Hazard Summary:** *Styrene most commonly affects the nervous system, causing symptoms similar to drunkenness, such as headaches, nausea, dizziness, clumsiness, and drowsiness. Styrene can also irritate your eyes, nose, throat, lungs, and skin. Styrene has been found to damage genetic material (chromosomes) in workers exposed while working in the reinforced plastics industry.*

## **HOW TO FIND OUT IF YOU ARE WORKING WITH STYRENE**

**Odor and Appearance:** Styrene is a colorless, oily liquid. Most, but not all, people can smell styrene at levels below those which cause significant health effects. Its odor is sweet at very low

concentrations, but becomes sharp and disagreeable at higher concentrations which still may be well below the legal limits for exposure.

**Jobs Where Styrene is Used:** Styrene is used in the production of polystyrene plastics, fiberglassreinforced plastics, synthetic rubber, resins, styrenated polyesters, and protective coatings.

Some other names for styrene are:

vinylbenzene	cinnamene	phenylethene
vinylbenzol	cinnamol	phenylethylene
styrol	styrolene	ethenylbenzene

Under California's Hazard Communication Standard (Cal/OSHA regulation *GISO 5194*), your employer must tell you if you are working with any hazardous substances, including styrene, and must train you to use them safely.

If you think you may be exposed to hazardous chemicals at work, ask to see the Material Safety Data Sheets (MSDSs) for the products you are using. An MSDS lists the hazardous chemical contents of a product, describes its health and safety hazards, and gives methods for its safe use, storage, and disposal. An MSDS should also include information on fire and explosion hazards, chemical reactivity, first aid, and procedures for handling leaks and spills. Your employer must have an MSDS for any workplace product that contains a hazardous substance, and must make the MSDS available to employees on request.

This Fact Sheet is an aid for worker training programs. It does not take the place of a Material Safety Data Sheet.

## **HOW STYRENE ENTERS AND AFFECTS YOUR BODY**

Styrene enters your body when you breathe its vapors in the air. Also, the liquid can be absorbed through your skin, particularly if it is in contact with your skin for a long time. Overexposure to styrene most commonly affects your eyes, nose, throat, skin, and nervous system, as described below.

**Eyes, Nose, Throat, and Lungs:** Styrene in the air at levels above 100 parts of styrene per million parts of air (100 "parts per million," or 100 ppm) can irritate your eyes, nose, throat, and lungs. Liquid styrene splashed in the eye stings and may damage the surface of the eye, but the eye usually heals within a few days. Extreme overexposure (for example, in an enclosed space) could result in pulmonary edema, a potentially life-threatening condition in which the lungs fill with fluid. Styrene normally does not have substantial effects on the eyes, nose, throat, or lungs.

**Skin:** Skin contact with styrene can remove the natural protective oils from your skin. Frequent or prolonged skin contact can cause irritation and dermatitis (skin rash), with dryness, redness, flaking, and cracking of the skin. Skin that is affected by dermatitis can allow chemicals, including styrene, to enter the body more easily than healthy skin.

**Nervous System:** Like most organic solvents, styrene can affect your brain the same way drinking alcohol does. Drinking alcohol within a few hours of exposure increases these effects and makes them last longer, because the effects of styrene and alcohol on the brain add together. Effects occur more quickly and become more noticeable and serious as the exposure level and time increase. The effects listed below may start to occur at exposure levels of about 100 ppm. The symptoms of short-term overexposure usually clear up within hours after exposure stops. These effects may increase your chances of having accidents.

Some studies suggest that repeated, frequent overexposure to organic solvents over months or years can have long-lasting and possibly permanent effects on the nervous system. The symptoms of these long-term effects include fatigue, poor coordination, difficulty in concentrating, loss of short-term memory, and personality changes such as increased anxiety, nervousness, and irritability. Studies of these effects in workers exposed mainly to styrene have been inconclusive.

<b>Effects of Styrene on the Nervous System</b>		
feeling "high"	weakness	confusion
lightheadedness	headache	slurred speech
dizziness	nausea	loss of balance
tiredness	vomiting	and coordination

**Liver and Kidneys:** Styrene in high doses can affect liver and kidney function in animals, but these effects have not been confirmed in human studies. It is unlikely that the liver or kidney will be harmed at levels near the legal exposure limits.

**Cancer:** Limited evidence suggests that styrene causes cancer in laboratory animals when given orally. Styrene has not been tested by inhalation, the major route of occupational exposure. It is not known whether styrene can cause cancer in humans. However, it can damage the chromosomes (genetic material) of workers even at exposure levels below 50 ppm; this suggests that it may cause cancer and/or reproductive damage. Further studies in both animals and humans are needed to reach definite conclusions.

When styrene is absorbed into the body, it is changed into other chemicals called "breakdown products" or metabolites. Styrene oxide, one of these breakdown products, causes cancer and

chromosome damage in laboratory animals. We do not know whether styrene oxide causes these effects in humans.

**Reproductive System:** In limited studies, exposure of pregnant animals to styrene at levels (250-300 ppm) moderately above the legal workplace limit did not cause birth defects, but did result in the death of some of the developing fetuses early in pregnancy.

We do not know whether styrene can affect human reproduction; studies conducted so far have produced unclear results. However, styrene inhaled by a pregnant woman can reach her developing fetus. Styrene may also enter breast milk. Whether it can affect the fetus or the nursing infant is uncertain. Pregnant and nursing women should avoid overexposure to styrene, just as they should minimize their exposure to alcohol, tobacco, and other drugs.

## TESTS FOR EXPOSURE AND MEDICAL EFFECTS

Air monitoring is usually the best measure of an individual's exposure to styrene. However, when there is also substantial skin exposure, air sampling will underestimate the total exposure level.

Mandelic acid, a breakdown product of styrene, can be measured in urine at the end of a workday to determine the total amount of styrene you have absorbed. However, because individuals differ in the way in which their bodies break down styrene, it is not currently possible to accurately determine an individual's exposure level based only on the analysis of urine samples. Urine mandelic acid measurement can be used to evaluate styrene exposure only if other information regarding exposure is available. HESIS physicians can provide assistance for such evaluations. Routine testing is not recommended or required.

## LEGAL EXPOSURE LIMITS

California's Division of Occupational Safety and Health (Cal/OSHA) sets and enforces standards for chemical exposure in the workplace. Cal/OSHA establishes Permissible Exposure Limits (PELs) for the amounts of certain chemicals in workplace air. The PELs are intended to protect the health of a person who is exposed every day for a working lifetime.

Cal/OSHA's PEL for styrene is 50 ppm. This is equal to 210 milligrams of styrene per cubic meter of air (210 mg/m<sup>3</sup>). Legally, your exposure may be above the PEL at times, but only if it is *below* the PEL at other times, so that your *average* exposure for any 8-hour workshift is no more than 50 ppm.

There is also an "excursion" limit of 100 ppm, which must not be exceeded during any 15-minute averaging period. Excursion limits are very important because spray application of styrene

products often exposes workers to hazardous amounts of styrene for short periods of time without exceeding the 8-hour time-weighted average.

You should not rely on your sense of smell to warn you that you are being overexposed to styrene. Most people can smell styrene when the concentration in the air is much lower than 1 ppm. Thus, smelling a strong odor of styrene does not mean that you are being overexposed to it. On the other hand, you may become less sensitive to the odor after being around it for awhile. Measuring the amount of a substance in the air is the only reliable way to determine the exposure level.

If you work with styrene and think you may be overexposed, talk to your supervisor and your union representative, or other people listed under "Resources" on page 4. If any worker might be exposed to a substance at more than the legal exposure limit, the employer must measure the amount of the chemical in the air in the work area (Cal/OSHA regulation *GISO 5155*). You have the right to see the results of such monitoring relevant to your work (*GISO 3204*).

You also have the right to see and copy your own medical records and records of your exposure to toxic substances. These records are important in determining whether your health has been affected by your work. Employers who have such records must keep them and make them available to you for at least 30 years after the end of your employment.

## REDUCING YOUR EXPOSURE

Your employer must protect you from being exposed to chemicals at levels above the PELs. For information about how Cal/OSHA and Cal/OSHA Consultation Service can help you and your employer, see the "Resources" section on page 4.

**Substitution:** The most effective way to prevent overexposure is to use a safer chemical, if one is available. However, the health and safety hazards of substitutes must also be carefully considered, to ensure that they are actually safer.

**Engineering Controls:** When possible, employers must use engineering control methods rather than personal protective equipment to prevent overexposure. Engineering control methods include installing ventilation, changing the work process, and changing work practices. Containers and vats should be tightly covered to prevent evaporation. Some work processes can be isolated, enclosed or automated to reduce exposures.

Local exhaust ventilation systems (such as "hoods") are the most effective type of ventilation control. These systems capture contaminated air at its source before it spreads into the air in your breathing zone. If you are spraying a styrene product, local exhaust ventilation should reduce your exposure and also minimize exposure of workers in adjacent areas.

**Personal Protective Equipment:** When engineering controls cannot sufficiently reduce exposures, a respirator must be worn and a respiratory protection program must be developed by the employer, as outlined in Cal/OSHA regulations (*GISO 5144*). An industrial hygienist or other knowledgeable person should be consulted to ensure that the equipment is appropriate and is used correctly.

If frequent or prolonged skin contact with styrene is unavoidable, or if splashing may occur, other protective equipment such as gloves, goggles, or faceshields should be worn. Gloves and other protective clothing should be made of a material which is resistant to styrene, such as polyvinyl alcohol. Even the most resistant materials will be penetrated quickly and should be replaced often.