## ONLINE FACTS
# Inhalants

**by John Brick, Ph.D., M.A., F.A.P.A.**
(John Brick is a Biological Psychologist and Executive Director of Intoxikon International, an education and consulting firm located at 1006 Floral Vale, Yardley, Pennsylvania 19067.)

**What Are Inhalants?**
The term inhalant refers to a wide range of chemicals that can easily enter the body via inhalation and subsequent circulation. Breathing inhalants produces psychoactive and physiological effects that range from the relatively benign to the suddenly fatal. There are many different types of inhalants. Each has unique properties and is often derived from different products. The more commonly abused inhalants are listed in Table 1. Most of these chemicals interfere with the conduction of ions across the membranes and interfere with intracellular communication of nerve cells in the brain and elsewhere in the body (e.g., the heart).

**TABLE 1**
**COMMONLY ABUSED INHALANTS***

| Chemical** | Abused Product |
|---|---|
| Toluene | Acrylic paints, contact adhesives |
| Fluorocarbons | Aerosol propellants |
| Chloroform, nitrous oxide | Anesthetics |
| Propane, butane | Fuel, lighter fluids |
| Halogenated hydrocarbons | Gasoline |
| Benzene, carbon tetrachloride, n-hexane, toluene, trichloroethylene, xylene | Glues, plastic and rubber cements |
| Toluene, xylene | Inks |
| Methlene chloride | Paint removers |
| Trichloroethylene, toluene | Paints, varnishes, lacquer |
| Chlorinated hydrocarbons, toluene | Freon, shoe polish |
| Trichloroethane, trichlorethylene, carbon tetrachloride | Spot removers |
| Tetrachloroethylene, trichloroethane, trichloroethylene | Typewriter correction fluid, dry cleaning fluid |

* Based on Kolecki and Shih (2003)
** There is some overlap and redundancy of chemical categories to more clearly illustrate abused products.

**Patterns of Inhalant Abuse**
Inhalation of volatile substances (e.g., gasoline) to obtain a high was first reported in the United States before World War II, and by the 1960s "glue sniffing" had become popular in many states. Typical abusers are young boys, ages 12-15, who cannot afford or obtain other psychoactive drugs. Younger and older abusers have certainly been reported. Some studies suggest that the majority of adolescents abuse inhalants with friends and at home.

**Methods and Symptoms of Abuse**
Although the methods of inhalant abuse are very similar, the two most common methods of abuse are termed "huffing" and "sniffing." "Huffing" involves saturating a rag with the solvent (glue, gasoline, etc.), cupping the rag over the nose and inhaling the fumes. "Sniffing" involves the act of directly sniffing the fumes from the container, or squeezing the toxic substance onto a rag and nasally sniffing the fumes from the rag. Another method, "bagging", involves putting the toxic substance into a paper bag, placing this bag over the nose and mouth, and inhaling deeply. Some inhalants, such as nitrous oxide, are transferred to a balloon, placing the pinched-off end of the balloon into the mouth and allowing the escaping gas to be inhaled from the collapsing balloon.

As with other drugs (e.g., marijuana smoking, alcohol consumption), the odor of chemical solvents on the breath, hands or clothing, are indicative of recent use. Discoloration of the skin is a secondary effect of paint sniffing.

**Acute Intoxication**
Because inhalants enter through the pulmonary system, they immediately enter into the blood supply and within seconds produce intoxication. The acute effects of inhalants include dizziness, hypertension (increased blood pressure), tachycardia (increased heart rate), impaired coordination, disorientation, temporal distortion, confusion, thick slurred speech, delirium, hallucinations, assaults and suicide attempts. Depending upon the inhalant, recovery may take minutes to hours or may not occur at all. Single episode use can be fatal because of oxygen displacement from red blood cells, hypoxia and asphyxiation. Victims of pulmonary effects are often found with a paper bag over the head.

Profound relaxation and deep sleep usually follow the initial euphoric phase. Unpleasant symptoms reported after the use of inhalants include agitation, seizures, ataxia, headache, and dizziness.

**Chronic Effects**
Chronic inhalant abuse destroys motor neurons that send commands from the brain to the hands and feet. As these motor neurons fail, varying degrees of motor impairment result, including a decreased ability to perform manual and mental tasks. For example, toluene vapors produce high levels of this lipid soluble chemical, particularly in the brain. Toluene abusers present symptoms of motor uncoordination, fatigue, mental impairment, and increasingly greater degrees of permanent central nervous system damage. Most inhalants produce some degree of hepatotoxicity (liver damage). Halogenated hydrocarbons, such as freon, cause severe hepatotoxicity.

Some inhalants change cardiac physiology and increase the risk for cardiac failure. For example, butane (from cigarette lighters), freon (from aerosol propellants) and toluene (from glues) hypersensitize cardiac cells to norepinephrine, the neurotransmitter that stimulates cardiac contractions. Inhalants interfere with the transport of oxygen by interfering with the binding or release of oxygen by red blood cells. The resulting hypoxia also causes cardiac cell hypersensitivity to norepinephrine. Norepinephrine sensitivity and hypoxia can cause cardiac muscles to defibrillate or begin contracting randomly. A syndrome called Sudden Sniffing Death (SSD) occurs without warning, and discontinuation of breathing the inhalant does not reverse the sequence of events. Victims of SSD often appear to sense that something is wrong, and run away from the source or site where they were inhaling, before collapsing and dying.

**Neurotoxic Effects**
Permanent cerebral and cerebellar neurological disability is the most well known toxic effect of chronic inhalant abuse. Long-term abusers are at significant risk for a

neurological syndrome consisting of memory loss, cognitive impairment, sleep disturbance, depression, anxiety, and personality changes. Permanent cognitive disorders are also well described in patients who chronically sniff gasoline. Long term occupational chemical exposure (e.g., painters) may result in the development of cerebral atrophy and abnormal EEGs.

Chronic abuse of n-hexane and nitrous oxide are well known to cause peripheral neurological deficits including profound sensorimotor polyneuropathy (n-hexane) and a demyelinating polyneuropathy and extremity weakness (nitrous oxide), which appears to be related to the inactivation of vitamin B12, an important cofactor in many necessary biochemical reactions.

Inhalation of leaded gasoline increases the risk for neurological complications from organic lead poisoning. These include mental confusion, poor short-term memory, psychosis, and encephalopathy. Symptoms of inorganic lead poisoning (headache, abdominal pain, hepatic injury, renal damage) have also been reported in patients who chronically inhale gasoline.

**References**

Brick, J. (1998). *Inhalants*, Technical Document No. 3. Yardley, PA: Intoxikon International.

Broussard, L. (1999). Inhalants. In B. Levine (Ed.). *Principles of forensic toxicology* (pp 345-353). Washington: American Association for Clinical Chemistry.

Kolecki, P and Shih, R. (2003). Inhalant abuse. In J. Brick (Ed.). *Handbook of the medical consequences of alcohol and drug abuse* (pp 579-607). New York: Haworth Medical Press.

Center of Alcohol Studies
607 Allison Road, Piscataway, NJ 08854-8001
Telephone: (732)445-2190
Fax: (732)445-3500
CAS Library (732)445-4442

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

© 2004 Rutgers, The State University of New Jersey. All rights reserved.