SeaBright INSURANCE COMPANY

Supervisors’ Safety Update

Ideas and Strategies for Leaders

SSU 1999-12

AIRBORNE HEALTH HAZARDS

By SeaBright Insurance Loss Control

The Occupational Safety and Health Act of 1970 (OSHA) requires all employers to provide a safe place for their employees to work. Today, more than ever, workers in a wide variety of occupations may be exposed to substantial concentrations of potentially hazardous chemicals while doing their jobs. The number and complexity of new substances used in the workplace today requires some knowledge of how exposures can occur to help prevent contact with chemicals that can cause disability, disease, or even, in extreme cases, death.

In most cases, OSHA has established maximum exposure levels, called Threshold Limit Values (TLVs), for airborne concentrations of chemicals; the term TLV refers to the airborne concentration of substances and conditions under which it is believed most workers may be repeatedly exposed without adverse effect. The basic idea is simply that for each substance there is some tolerable level of exposure below, which no significant adverse effect occurs. However, it should be recognized that individual susceptibility varies considerably and there may be some individuals for who discomfort, the aggravation of a preexisting condition, or the development of occupational illness or disease may still be a problem at or below the TLV.

The best way to protect ourselves from the effects of airborne chemicals is to reduce or eliminate our contact with them as much as possible. To do this, it is necessary to recognize the various forms airborne chemicals can take and a knowledge of their routes of entry into the body.

Airborne chemicals exist in various states such as vapors, gases, dusts, fumes, and mists.

To easily illustrate these states, consider the every day substance of water. As a **solid**, water is called ice. The shape of which can be changed by only a moderate amount of force. However, its volume can be changed only by the application of very great force. In other words ice is only slightly compressible. Raise ice’s temperature and it melts and passes into the **liquid** state as water. Its shape will then depend on the shape of the vessel that contains it, or if spilled on the ground, it will flow into whatever cavities or spaces there are between the particles that make up the soil. In a liquid state, water’s volume can be changed very little, because, like ice, it is nearly incompressible. Heated to boiling in an open vessel, water changes to a **gas** or **vapor** and will expand and disappear completely into the air. Heated in a closed vessel, the vapor is retained in the form of steam, causing pressure on the sides of the vessel.

Under normal conditions, few substances can change as readily into the three states of matter as can water. Supervisors should recognize, though, that in many chemical processes a change in the state of matter – from a solid to a liquid to a gas – may have marked safety implications for employees working in the area.

VAPORS

A vapor is the gaseous state of a substance that at ordinary temperatures is a solid or a liquid. For example, gasoline, normally a liquid, vaporizes to produce a gas which, when mixed with the correct amount of air, makes our automobiles run. Water evaporates to form a gas that we refer to as water vapor. Sometimes vapors are used in useful processes such as vapor degreasing, but more often vapors, in some cases by-products of a liquid or solid produced for other purposes, are a nuisance. Many vapors are toxic, one example being the vapor of carbon tetrachloride. Supervisors should be aware of materials in the workplace that can vaporize. If there are vapors present, extreme caution should be exercised until concentration levels and hazards can be determined.

DUSTS

For all practical purposes, we can define dust as particles of solid matter generated by grinding or crushing materials such as rock, coal, wood, or grain. With the exception of some fibrous materials, most large particles of dust are deposited by gravity or filtered out by the nose and are not inhaled. Generally dust particles must be smaller than 5 microns to penetrate the alveoli, the air sacs in the lungs. These particles of dust capable of penetrating the alveoli are called "respirable dust" and cannot usually be seen with the naked eye. With certain lighting they are often perceived as a "haze." Most industrial dusts consist of particles that vary widely in size with the small particles greatly outnumbering the larger ones; consequently, when dust is noticeable in the air near an operation there are probably more invisible particles (respirable dust) present than visible ones. Any process that generates fine dust that remains suspended in the air long enough to be breathed should be suspect and regarded as hazardous until proven otherwise. Suspended dust in the air means bad air for breathing, and if the dust is combustible, as is grain dust, a potential fire and explosion hazard may exist as well.

FUMES

Fumes form when heated particles from a solid – such as a metal – condense in the air. The solid particles that make up fumes are extremely small and as such are readily inhaled deep into the small alveoli of the lungs; they are, consequently, very hazardous. Vapors produced from molten metals during welding, metalizing, and other operations can be harmful if inhaled. Toxic fumes can also be produced when welding or heating structures that have been painted with red lead or other coatings containing metals, galvanized metals, and soldered metals.

MISTS

Mists form when a vapor condenses back into the liquid state and suspends in the air. Splashing, atomizing, or otherwise breaking up a liquid may also form mists. We often think of mists as the finely divided liquids we see suspended in the air; oil mists produced by grinding and cutting operations, acid mists from electroplating, paint spray mists, or the condensation of water vapor that forms a fog or rain are some examples.

ROUTES OF ENTRY INTO THE BODY

A given chemical usually takes one of the following three routes of entry into the body: inhalation, skin contact, or ingestion; it should be obvious, however, that some chemicals have multiple routes of entry.

INHALATION

Inhalation is a particularly important route of entry because of the rapidity with which toxic material can absorb into the lungs, pass into the blood stream, and reach the brain. The lungs have an enormous gas-tissue interface due to their vast blood-capillary network. With the lungs' continuous blood flow and extremely rapid rate of absorption, highly water-soluble chemical gases can be immediately and directly absorbed into the blood stream to affect all organs in the body, making inhalation the most dangerous route of entry. Other chemicals less soluble in body fluids can remain in the lungs for extended periods of time resulting in inflammation, edema, fibrosis, or allergic sensitization. Gases and vapors can produce an immediate irritation and inflammation of the respiratory tract and pulmonary edema, which can be fatal. Prolonged exposures can lead to chronic inflammation or fibrosis of the lung and in some cases malignancy.

SKIN CONTACT

One principle function of the skin is to serve as a protective barrier against entry of foreign substances into the body, and it generally does a good job. However, about one in four industrial substances have some appreciable exposure caused by skin absorption. In fact, fatal poisonings have occurred from brief exposure of the skin to highly toxic substances. Highly toxic substances include parathion, organic phosphates, alkali leads and tins, phenol, cyanides, and hydrocyanic acid. Chemical contact with the skin can result in three possible actions: the skin can act as an effective barrier, the substance can react with the skin and irritate it resulting in dermatitis, or the substance can penetrate the skin, enter the blood stream and act as a systemic poison. Skin contact often occurs when workers use solvents to clean their hands.

INGESTION

Health hazards to workers from ingestion of chemicals are generally very low in comparison to those from inhalation and skin contact routes. The reasons for this are as follows: the number of substances that can be ingested are fewer as it is generally not possible to ingest vapors or gases; the frequency and degree of contact is limited compared to other routes of entry; and toxicity by mouth is lower than by inhalation due to poor absorption into the blood stream, the high acidity of the stomach, the alkaline environment of the small intestine, and dilution caused by stomach contents and food. All of these interactions probably combine in some way to reduce the toxicity of ingested chemicals. There are notable exceptions to this, however; for example, toxic materials such as arsenic, cadmium, lead, and mercury can have a cumulative action in the tissues or organs.

PROTECTIVE MEASURES

When it is not possible to render the working environment completely safe, it may be necessary to isolate the worker from the environment by the use of personal protective equipment. Where it is not possible to enclose or isolate the process or equipment, provide ventilation, or other control measures, personal protective equipment must be provided and used. However, personal protective equipment has one serious drawback – it does nothing to reduce or eliminate the hazard. This requires the supervisor to constantly monitor the use of protective equipment to make sure that it is being used correctly. Whenever possible, the hazards should be engineered out first.

SUMMARY

To recognize environmental hazards you must first know the raw materials used, the nature of the products and by-products produced, and the various states in which chemicals can exist. Process chemicals can exist as fumes, dust, vapor, or mist, each of which may have unique hazards. Exposure to chemicals can create health hazards if they are ingested, inhaled, or absorbed through the skin. Keeping these facts about chemicals in mind, appropriate protective measures should be taken to protect workers and ensure a safe working environment.