

crease in toxicity from ethyl to amyl. Then, as the higher alcohols become less soluble in body fluids, there is a decreasing toxicity with the higher members of this series. The substitution of a chlorine atom for hydrogen atom usually results in an increase in toxicity, however, this cannot be applied as a general rule in all cases. For example, methylene chloride (CH_2Cl_2) is less toxic than carbon tetrachloride (CCl_4) and much less toxic than methyl chloride (CH_3Cl).

The toxicity of a material is not synonymous with its health hazard. Toxicity is the capacity of a material to produce injury or harm. Hazard is the possibility that a material will cause injury when a specific quantity is used under specific conditions. The key elements to be considered in evaluating a health hazard are these:

- The toxicity of the materials used
- The physical properties of these materials
- The absorption probabilities of these materials by individuals
- The extent and intensity of exposure to these materials
- The control measures used

The degree to which a substance will affect living cells can be measured only after recognizable changes have occurred following absorption. Some changes—impaired judgment, delayed reaction time—may be produced at levels too low to cause actual cell damage. Toxicity is dependent upon the dose, rate, method, and site of absorption, plus many other factors, including general state of health, individual differences, tolerance, diet, and temperature.

Entry routes for toxic materials

There are only three ways in which chemical agents can harm individuals:

- 1 By contact with or absorption through the respiratory tract
- 2 By contact with or absorption through the skin
- 3 By contact with or absorption through the digestive tract

In general, systemic industrial poisonings

usually result from

- **Inhalation of toxic agents** Local injury to the skin can be caused by direct contact with an irritant or corrosive material.

- **Ingestion of the toxic agent** can occur to some extent, however, there would generally be considerable inhalation of the material where such conditions exist.

- **Absorption through the skin** can occur upon exposure to some toxic agents. Some liquids and vapors are known to pass through the skin to such a degree that respiratory protection is not adequate against high concentrations. For example, hydrogen cyanide (HCN) is known to pass through the unbroken skin. Consideration should be given to the type of work clothes being worn, if they become saturated with solvents, they will act as a reservoir to bathe the body continually with the harmful material.

- **The absorption of harmful materials by the lungs** is dependent upon the solubility in body fluids, the permeability of the lungs, the volume of inhalation, the volume of blood in the lungs, and the concentration gradient of vapors between the inhaled air and the blood.

The respiratory system is composed of two main areas: (a) the upper respiratory tract airways—the nose, throat, trachea, and bronchial tubes leading to the various lobes of the lungs, (b) the alveoli where the actual transfer of gases across the cell wall takes place.

In general only very fine particles and gases will reach the alveolar sacs. The larger the particle, the sooner it will be deposited through impaction, gravity, etc., on the lining of the airway tubes leading to the sacs. Only particles smaller than about one-half micron are likely to enter the alveolar sac.

The nasopharyngeal passages serve as a heat exchanger and humidifier, warming and moisturizing the inhaled air so that it will not constitute a shock to the delicate lung tissue. The trachea and bronchial tubes have a sticky lining that traps larger particulate contaminants before they can reach the lungs.

The body is poisoned by substances absorbed by the lung in the same way and to the same general extent as it would be if a