

Elements of Industrial Toxicology

Industrial toxicology is primarily concerned with the physiological effects produced in individuals who have been exposed to harmful materials during the course of their employment. The constant introduction of new industrial processes, operations, and techniques involving new chemicals make a knowledge of toxicology important to the safety professional who is frequently called upon for advice concerning the dangers associated with the use of various chemical agents.

A safety professional setting up a program to minimize injury from the use of mechanical tools will be concerned with the physical characteristics of the machine tool or machinery and the manner in which the various parts of the machine come into contact with the operator and cause harm. Similarly, he is concerned with how chemical agents can approach or contact individuals, how that contact can be prevented, and how extensive the injury can be if contact does occur, based on the properties of the chemical agents involved.

The principle job of the industrial toxicologist is to obtain sufficient basic information concerning the biological action and potential toxicity of a chemical substance so that its relative hazard to man may be ascertained. The toxicologist must analyze the points of attack of chemical agents and clarify the mechanism of effect, with the view towards prevention, recognition, and treatment of chemical intoxications.

Hamilton and Hardy (see "References") state that industrial and nonindustrial toxicology differ in three important ways:

- First is the manner in which the material is absorbed into the body. In *nonindustrial cases*, the most common way is orally, through the mouth, then through inhalation, and lastly through skin absorption, in *industrial cases*, entrance through the respiratory tract with the inspired air is of overwhelming importance compared with skin absorption or entrance through the gastro-intestinal tract.

- The second difference is that industrial poisoning tends to be of the chronic variety, whereas nonindustrial poisoning is more often acute. But acute cases do occur in industry, although they are far less numerous

than the chronic cases.

- The third difference is that generally industrial poisoning is a result of exposure to a mixture of substances compared with a single material for nonindustrial cases. These harmful industrial materials are absorbed without the voluntary participation of the persons concerned, often hardly observed or even completely unobserved.

Chemical Toxicity

If administered in a suitable manner and in sufficient dosage, practically any substance can be harmful to man. It is recognized, therefore, that there are degrees of harmfulness and degrees of safeness for all materials. These degrees are primarily related to the amount of material that is present in the body—a relationship exists between the biologic effect of a chemical agent and its dose or concentration in the human body.

Many chemical agents are nonselective in their action on tissues or cells, they may exert a harmful effect on all living matter. Other chemical agents may act only on specific cells. Another agent may be harmful only to certain species, other species may have built-in protective devices.

Toxicity is relative. It refers to a harmful effect on some biologic mechanism. The term "toxicity" is commonly used in comparing one chemical agent with another, but such comparison is meaningless if the biologic mechanism and the conditions under which the harmful effects occur are not specified.

Princi (see "References") states that a chemical stimulus may be considered to have produced a toxic effect when it satisfies the following criteria:

1. An observable or measurable physiologic deviation has been produced in any organ or organ system. The change may be anatomic in character and may be acceleration or inhibition of a normal physiological process, or it may consist of a specific biochemical change.

This chapter was revised by Julian B. Olshifski, P.E., based upon reviews by selected members of the National Safety Council.