

Sampling techniques

What must be measured and evaluated in industrial hygiene sampling is usually the dosage the worker receives—the amount of toxic material he takes into his body. Duration of exposure and concentration and type of material are important. For the concentration measurement, a test can be made on the air in the worker's breathing zone. In some cases, the measuring instrument can be attached directly on the worker and he can carry it throughout the working day (this is done with a film badge for measuring radiation exposure). Relatively few samplers are available at the present time for taking continuous samples in the breathing zone. The other technique is to measure concentration in the breathing zone over carefully selected intervals, then average the results and weight each measurement according to the length of exposure. The result is a time-weighted average concentration.

A satisfactory average exposure measurement during a particular time period, is affected by changes from day shift to night shift, from winter to summer, routine changes in process operations, or daily changes in rate and direction of air movement, temperature, or altitude. Then too, will the presence of the sampler alter the routine of the operation in any manner? Is the contaminant soluble or insoluble in body fluids? What is its particle size distribution and in what portion of the respiratory tract is it likely to deposit? What is its chemical nature? Organic mercury acts quite differently from mercury vapor, which, in turn, is quite distinct from mercury oxide. Finally, are there limitations on the peak dose rates as there are for beryllium and some other compounds?

If the samples are collected at the right places and combined with a time study of the worker's activity, they can give a measure of the worker's intake of the toxic substance.

Whether direct-reading or laboratory techniques are to be used is a matter of professional judgment. The results obtained must be compared with a threshold limit value with a full knowledge of its limitation and consideration of other factors in the situation. Urine assays add to the facts available for making an evaluation of exposure. These, in

turn, must be combined with knowledge obtained by the physician directing an adequate medical program. All this serves to emphasize the basic teamwork approach of the industrial health program.

Types of measuring instruments

The most numerous environmental hazards are chemical and can be conveniently divided into (a) the particulates and (b) the gases or vapors. Particulates are mixtures or dispersions of solid or liquid particles in air and include dust, smoke, mist, and similar materials. Some of these are practically insoluble in body fluids, and exert their effect directly in the lungs while others are soluble and produce systemic poisoning.

Direct-reading instruments for the insoluble materials are difficult to make since such an instrument must count or otherwise determine the number of particles suspended in air, therefore some information regarding particle size is desirable. Direct-reading instruments for this purpose do exist, but they are very expensive and often quite bulky. These usually work on the principle of light-scattering—measuring the light scattered at right angles to the beam.

Gases and vapors can be determined more readily by direct-reading instruments since they form more homogeneous mixtures with air, and separation from the air mass is often unnecessary. This group includes such common materials as carbon monoxide, mercury vapor, hydrogen cyanide, benzene, carbon tetrachloride, and many others. A choice can be made here between direct-reading instruments or samples collected for subsequent laboratory analysis.

The physical hazards—heat and cold, ionizing and nonionizing radiation, and atmospheric pressure are usually measured by direct-reading instruments. In the field of ionizing radiation alone, there are literally hundreds of instruments, most of which have been developed since the early 1950's.

Electrical direct-reading instruments

The first general class of instruments comprises those which give a direct reading on a dial. Frequently these are an electrical meter of some sort, involving electronic circuitry which requires careful maintenance to function properly. Use of some instru-