

washing, toilet, and eating facilities, healthful drinking water, and control of insects and rodents

- 9 Special control methods for specific hazards, such as reduction of exposure time, film badges and similar monitoring devices, continuous sampling with preset alarms, and medical programs to detect intake of toxic materials
- 10 Training and education to supplement engineering controls

Substitution

Replacement of a toxic material with a harmless one is a very practical method of eliminating an industrial health hazard

In many cases a solvent with a lower order of toxicity or flammability may be substituted for a more hazardous one. In a solvent substitution, it is always advisable to experiment on a small scale before making the new solvent part of the operation or process. For example, carbon tetrachloride can be replaced by solvents such as methyl chloroform, dichloromethane, aliphatic petroleum hydrocarbons, or one of the fluorochlorohydrocarbons. (The precautions listed earlier in this chapter should be reviewed.) Detergent-and-water cleaning solutions can be considered for use in place of organic solvents. Benzene can be replaced by toluene in most lacquers, synthetic-rubber solutions, and paint removers. Natural rubber cements with aliphatic hydrocarbon solvents can perform virtually the same function as benzene cements. The felt-hat industry has controlled the hazard of mercurialism by substituting mercury-free coloring materials. Foundries using parting compounds that contain free silica can minimize the silicosis hazard by substituting relatively harmless powders. Sandstone grinding wheels have been largely replaced by artificial abrasive wheels usually made of aluminum oxide.

Changing the process

A change in process often offers an ideal chance to improve working conditions. Most such changes, of course, are made to improve quality or reduce cost of production, only occasionally to improve the in-plant environment. Yet, we must always keep this possible

benefit in mind. This applies to the safety professional more than anyone else.

In some cases, a process can be modified to reduce the exposure to a dust or fume and thus markedly reduce the hazard. In the automobile industry, the amount of lead dust created by grinding solder seams with small high-speed sanding disks was greatly reduced by changing to hand filing. Brush-painting or dipping instead of spray painting will minimize the concentration of airborne contaminants from toxic pigments. Other examples of change of process are arc welding in place of riveting, vapor degreasing to replace hand-washing of parts, airless spraying techniques and electrostatic devices to minimize overspray as replacements for hand-spraying, and machine application of lead oxide to battery grids which reduced lead exposure in making storage batteries.

In buying individual machines, the need for accessory ventilation, noise suppression, vibration and heat control should be considered *before* purchase. Often the best approach is to thrash out these requirements with the supplier in advance.

Isolation or enclosure

Some potentially dangerous operations can be *isolated* from the people nearby, which solves the exposure problem. The isolation can be by a physical barrier (such as an acoustic box to contain noise from a whining blower or a screaming rip saw), or by time (such as providing semi-automatic equipment so a person doesn't have to stay near the noisy machine constantly), or by distance (remote controls).

Isolation is particularly useful for limited operations requiring relatively few workers or where control by any other method is too difficult or too expensive. The job is isolated from the rest of the operation and thus the majority of the workers are not exposed to the hazard. The workers actually concerned with the operation can then be protected by installing a ventilation system which probably would not have been satisfactory if the operation had not been isolated and thus able to be enclosed.

Enclosing the process or equipment is a desirable method of control since the enclosure will prevent or minimize the escape