The Industrial Hygiene Process: Managing the Occupational Health of Employees to Contribute to the Health of the Steel Industry

What is the cost of illness per claim to the steel industry?
In 2001, the average cost for an occupational noise-induced hearing loss was $14,000. For respiratory system-related pneumonia, the per-claim loss was $115,000. For an occupational skin disorder, the per-claim loss averaged $5,300. These average costs do not include the possible related compliance penalties from regulatory agencies, the loss in production time, the loss in quality or the loss due to reduction in team morale.

Many of these occupational-related illnesses — such as hearing loss, silicosis, “black lung,” asbestosis, lung cancer, and muscular skeletal disorders from repetitive motion — require significant time, perhaps 10–20 years, to develop. This time period is generally referred to as a latency period. However, we must not forget that short-term or acute excessive exposures may lead to occupational illness as well, such as “metal fume fever,” skin rashes/burns, and “welder’s flash.” Excessive hazardous gas exposure, e.g., carbon monoxide, can result in a fatality.

The approach to addressing occupational health continues to lie in the industrial hygiene process and incorporating this process into the overall management system.

Industrial hygiene is the science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace that may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.

The various environmental factors or stresses that may cause occupational-related illnesses or impaired health can be classified as chemical, physical, biological or ergonomic. Chemical hazards may arise from dusts, fumes, vapors and mists. Physical hazards include: noise; vibration; extremes of temperature, i.e., heat or cold stress; ionizing radiation, i.e. x-rays; gamma rays; alpha and beta; non-ionizing radiation, i.e., electromagnetic fields (EMF); microwaves; light; lasers; ultraviolet (UV) and infrared (IR). Biological hazards include: mold, fungi, bacteria, viruses, bird droppings and blood/body fluids. Ergonomic hazards may arise from repeated motions in awkward positions or “out of neutral” postures.

The distinction between toxicity and hazard is an important one in assessing the workplace environment. The toxicity of a substance describes the nature, degree and extent of undesirable effects. Toxicity is a basic biological property of a material and reflects its inherent capacity to produce injury. Hazard describes the likelihood of this toxicity to occur. Thus, hazard is the probability or likelihood of injury resulting from actual use of a substance in the quantity and manner proposed. In evaluating the hazard of a substance, it is necessary to know not only its toxicity, but also its physical and chemical properties, along with the manner and quantity in which it is to be used. These factors determine how much enters the body, by what route, how frequently and for how long. This is described simply as the exposure. Therefore, it is possible to have a high degree of hazard associated with a low order of toxicity, and a low degree of hazard associated with a high order of toxicity, depending upon exposure.

Industrial hygienists are scientists and engineers committed to protecting the health and safety of people in the workplace and the community. An industrial hygienist is a person having a college or university degree or degrees in engineering, chemistry, biology, physics, medicine, or related physical or biological sciences, or specifically in industrial hygiene who, by virtue of special training, has acquired competence in industrial hygiene. Industrial hygienists are trained to anticipate, recognize, evaluate, and recommend controls for environmental and physical hazards that can affect the health and well-being of workers. Industrial hygienists analyze, identify, and measure workplace hazards or stressors that can cause sickness, impaired health, or significant discomfort in workers through chemical, physical, ergonomic or biological exposures. Two roles of an industrial hygienist are to spot those conditions and to help eliminate or control them through appropriate measures.

A professional industrial hygienist is a person possessing either a bachelor’s degree in engineering, chemistry or physics, or a bachelor’s degree in a closely related biological or physical science from an accredited college or university, who also has a minimum of three years of industrial hygiene experience. A completed doctoral in a related physical, biological or medical science or in related engineering can be substituted for two years of the three-year requirement. A completed master’s degree in a related physical or biological science or


Safety First

in related engineering can be substituted for one year of the three-year requirement. Under no circumstances can more than two years of graduate training be applied toward the three-year period.

While this definition does not include certification, the American Industrial Hygiene Association recognizes the need for such certification by every professional industrial hygienist as an appropriate hallmark by one’s peers and strongly urges all eligible members to obtain American Board of Industrial Hygiene certification.

The American Board of Industrial Hygiene has established that successful candidates for certification shall attain the status of Diplomat of the American Academy of Industrial Hygiene, subject to compliance with requirements established by the American Board of Industrial Hygiene.

According to the American Academy of Industrial Hygiene’s Code of Ethics for professional practice of industrial hygiene, the primary responsibilities of the industrial hygienist are as follows:

- To protect the health of employees.
- To maintain an objective attitude toward the recognition, evaluation and control of health hazards, regardless of external influences, realizing that the health and welfare of workers and others may depend on the industrial hygienist’s professional judgment.
- To counsel employees regarding the health hazards and necessary precautions to avoid adverse health effects.
- To respect confidences, advise honestly, and report findings and recommendations accurately.
- To act responsibly in the application of industrial hygiene principles toward the attainment of healthful working environments.
- To hold responsibilities to the employer or client subservient to the ultimate responsibility to protect the health of employees.

The success of an industrial hygiene and safety program requires the cooperation and coordination of many areas of an organization. Medical, operations management, engineering, safety, purchasing, legal, human resources, employees and top management are all needed for a successful program.

The Industrial Hygiene Process

Every industrial hygiene program must address five key areas:

- Health hazard recognition.
- Health hazard evaluation.
- Health hazard control.
- Employee education and training.
- Audit of the program’s effectiveness and update of the program for continuous improvement.

How the industrial hygiene program proposes to address these elements must be contained in a written plan. In addition, an organized means to document and record the associated information must be put into place. Especially important is a computerized data management system to store, retrieve, treat and review the industrial hygiene exposure data. The industrial hygienist is a “workplace detective.”

Recognition

The first step in recognizing potential concerns in an occupational environment is to become familiar with the operations in the plant. Knowledge of the process and/or equipment is vital. Several program elements are utilized to accomplish the recognition phase. Preparation as to the process by the industrial hygienist is essential. Process flow diagrams, process descriptions and/or standard operating procedures, along with equipment reviews should be obtained and reviewed prior to any walk-through. Reference books or Internet sources describing the processes involved can serve as a source for the terminology used in the process. An invaluable reference source for the industry as to terminology and process is The Making, Shaping and Treating of Steel. Useful industrial hygiene general references regarding processes and possible hazards are: Recognition of Health Hazards in Industry and In-Plant Practices for Job-Related Health Hazards Control — Production Processes.

Additional background information can be obtained from a review of past industrial hygiene exposure surveys, if available, as well as industrial hygiene reports from similar facilities. Initial discussions and interviews from operating management, process engineers, frontline workers, and safety and medical personnel will be beneficial. Education and training of the frontline management and workers as to the basics of the industrial hygiene process will not only be valuable for the success of the preliminary recognition task, but the educated workforce can alert the industrial hygienist as to any “new” potential hazards or process changes as these arise.

The next task of the recognition phase is the walk-through survey or preliminary industrial hygiene assessment survey. The preliminary survey should review (1) the raw materials, products and byproducts, (2) sources of the possible exposure contaminants, (3) types of physical agents, (4) control measures in place, (5) occupational titles, (6) the number of employees working each particular occupation per shift. An important tool of the survey is the chemical inventory, which is required as part of the OSHA Hazard Communications Program. A review of the material safety data sheets and toxicology information for the raw materials, and possibly the intermediaries along with byproduct/waste products, must be performed.

The preliminary industrial hygiene assessment should be periodically reviewed and updated. The frequency depends on the size and complexity of the facility operations.

Evaluation

Evaluation is the phase of the process in which the industrial hygienist gives a professional opinion on the degree of risk present in the workplace. The risk associated with a particular health stressor depends on several factors: the nature of the hazard, the magnitude of exposure, the duration of the exposure and the individual’s susceptibility.

The number and frequency of the samples are dependent on work conditions. Close observation of the monitoring is essential. Operating conditions must be tracked along with production and raw material use. The use and effectiveness of controls that are present, such as local exhaust ventilation and general ventilation, must be verified. Environmental conditions, both outdoor and indoor, must be observed. The movement, location and duration involved in various tasks of the employee being evaluated must be recorded and are invaluable in the evaluation of the exposure. Typically, a baseline or initial evaluation survey may involve the collection of samples over the course of several days or shifts under several conditions. Statistical analyses of the exposure samples collected over several periods should be incorporated in order to best characterize the representative exposure.

Sample results are compared to regulatory exposure limits such as OSHA Permissible Exposure Limits or Action Levels.
or professional or manufacturer’s guidelines such as ACGIH Threshold Limit Values.

In the interpretation of the results, the industrial hygienist must be cognizant of the advantages and limitations of the sampling/analytical methods utilized, as well as the possible interferences of the analytical procedures and/or the instrumentation used in the environment being evaluated. One must not “blindly” accept the numbers of the results without understanding the possible limitations and interferences.

Control

Industrial hygienists use occupational monitoring/sampling, both personal and area monitoring, and analytical methods to detect the extent of worker exposure. They also employ engineering, work practice controls, and other methods to control potential health hazards.

Engineering controls minimize employee exposure by either reducing or removing the hazard at the source or isolating the worker from the hazard.

Engineering controls include eliminating toxic chemicals and replacing harmful toxic materials with less hazardous ones, enclosing work processes or confining work operations, and installing general and local exhaust ventilation systems.

Work practice controls alter the manner in which a task is performed. Some fundamental and easily implemented work practice controls include:

- Following proper procedures that minimize exposure while operating production and control equipment.
- Inspecting and maintaining process and control equipment on a regular basis.
- Implementing good housekeeping procedures.
- Providing good supervision.
- Mandating that eating, drinking, smoking, chewing tobacco or gum, and applying cosmetics in regulated areas be prohibited.

Administrative controls include controlling employees’ exposure by scheduling production and workers’ tasks in ways that minimize exposure levels. For example, employers might schedule operations with the highest exposure potential during periods when the fewest employees are present.

When effective work practices and/or engineering controls are not feasible to achieve the permissible exposure limit, or while such controls are being instituted, and in emergencies, appropriate respiratory equipment must be used. In addition, personal protective equipment such as gloves, safety goggles, helmets, safety shoes and protective clothing may also be required. To be effective, personal protective equipment must be individually selected, properly fitted and periodically refitted; conscientiously and properly worn; regularly maintained; and replaced as necessary.

The development of a periodic exposure monitoring program based on more limited sampling of similar exposure groups (SEG) and statistical analysis can be implemented to discern possible exposure trends and the effectiveness of controls.

Education and Training

As stated earlier, the awareness of employees as to the basic principles of industrial hygiene and the industrial hygiene process will improve the preventive nature of the program. The education of frontline management, workers, and engineering personnel will allow for early input on process design and afford the opportunity to control potential exposures before they can become a concern. Elements of training include new employee training, periodic updates, hazard communication training, posting of hazardous areas, material safety data sheets and labeling.

Audit and Update for Continuous Improvement

The preliminary industrial hygiene assessment must be periodically reviewed and updated. The industrial hygienist and safety professionals must remain in contact with the operations and engineering management in order to stay current as to new processes or changes in processes, work practices or procedures that may affect exposure potentials. The awareness of the workforce as to the basic industrial hygiene process can play a significant role in the continuous improvement of the program. Involvement of the industrial hygienist and safety professionals in process design as early as practical can pay benefits to avoid possible expensive retrofit costs for controls later.

The industrial hygiene program and the industrial hygiene process can serve the industry by reducing the costs for potential health-related claims and protect the workforce. Other indirect advantages of the industrial hygiene process lie in improvement of morale and productivity, as well as contributing to product and workplace quality improvement.

— Bernard J. Quinn is president/CEO of AM Health and Safety Inc.

If you have questions about this topic or any other safety issues, please contact safetyfirst@aist.org.