Course Learning Outcomes for Unit I

Upon completion of this unit, students should be able to:

1. Summarize the historical underpinnings of the field of industrial hygiene.
   1.1 Summarize the work of early pioneers in the field of industrial hygiene.
   1.2 Describe how the Occupational Safety and Health Act of 1970 advanced the field of industrial hygiene.

2. Examine the role of the Occupational Safety and Health Administration (OSHA), National Institute for Occupational Safety and Health (NIOSH), and other relevant organizations that influence workplace safety and health.
   2.1 Describe how organizations such as OSHA and NIOSH protect workers from hazards in the workplace.
   2.2 Summarize the role of the American Industrial Hygiene Association (AIHA) and the American Governmental Industrial Hygiene Association (ACGIH) in industrial hygiene programs.

Reading Assignment

Chapter 1: Introduction to Industrial Hygiene

Chapter 2: The Occupational Safety and Health Act and Industrial Hygiene

Chapter 3: Management Systems

Unit Lesson

The field of industrial hygiene is not new. Scientists have been evaluating occupational-related illnesses and injuries for centuries. Most references link the modern field of industrial hygiene to Dr. Alice Hamilton in the early 20th century (Fuller, 2015). Placing industrial hygiene within a specific scientific discipline can be difficult because practitioners must be proficient in several different disciplines. For example, evaluating employee illnesses related to a specific operation using several chemicals could require an understanding of chemistry to determine chemical state, vapor pressure, vapor density, flammability, and reactivity. However, an understanding of biology, toxicology, and epidemiology might be required to understand how the chemical enters the body, metabolizes, and then causes harm. The industrial hygienist might then be required to employ an understanding of biostatistics to evaluate exposures and hazard assessment/risk assessment techniques to determine the need for implementation of control methods. Finally, an understanding of engineering principles might be required to choose and implement control methods.

Any discussion of industrial hygiene must include the four basic tenants of the field: anticipation, recognition, evaluation, and control. These four tenants guide the industrial hygienist in his or her approach to controlling hazards at a work site. A clear understanding of industrial hygiene should begin with an education in the four tenants.

Anticipation is the process by which the industrial hygienist identifies potential hazards at a worksite. Effective anticipation requires an understanding of the basic principles of job hazard analysis (JHA). In this respect, the safety professional and the industrial hygienist share a common tool—the JHA. In fact, many JHAs are performed to identify hazards that are commonly considered “safety related” and hazards that are commonly considered “industrial hygiene related.” For example, a JHA of a welder working to construct a high rise...
building might identify falls as a hazard. Falls typically are something that a safety professional deals with on a consistent basis, particularly in the construction business. The JHA would also identify exposure to welding fumes as a potential hazard. Inhalation of welding fumes is more commonly addressed by the industrial hygienist, not the safety professional. Of course, it is possible that one individual has the experience and training to function as both the safety professional and the industrial hygienist. As advances are made in the fields of chemistry and physics that are applied to occupational settings, anticipation may become much more difficult, requiring specific expertise and education that may be currently lacking. A good example is the field of nanoparticles. Nanoparticles are being used in many more industries in the last decade. Anticipation of the hazards associated with the use of nanoparticles is difficult because of a lack of toxicological and epidemiological research.

Recognition is the actual observation of the hazards in the workplace. Many people lump anticipation and recognition into one task, but there is a distinct difference between the two tenants. Anticipation is a preliminary assessment which, if performed properly, will allow the industrial hygienist to better identify hazards at a work site. For example, if the industrial hygienist anticipated that welding might be performed at a work site, he or she would be looking for welding operations when he or she actually entered the work site. If the anticipation step was skipped, the industrial hygienist might enter the worksite and not notice that welding operations were present. This could occur because the welding was being performed in an area that was not readily apparent (a confined space), or the welding operations required other work to be performed first. No welding was being performed the day of the site visit, and this lack of anticipation could result in a significant potential exposure being missed. Recognition generally requires the industrial hygienist to spend time observing the workers at their work location, and it requires the industrial hygienist to review available safety data sheets (SDSs). The textbook includes a tool to summarize the work process, which makes it easier to identify work site hazards. The tool is called process mapping and is discussed on page 11 of the textbook.

Evaluation is the tenant that is most commonly associated with the practice of industrial hygiene. During evaluation, industrial hygienists estimate employee exposures to a specific hazard and then compare the results to an occupational exposure limit (OEL). In essence, the evaluation phase is comparable to performing a risk assessment of the hazards identified in the anticipation and recognition phases. Evaluation of exposures can be much more complicated than it might seem. In some locations, there are so many chemical and physical hazards identified in a workplace that the company cannot afford to evaluate all exposures at once. The industrial hygienist would then be tasked with prioritizing the hazards to determine which exposures should be evaluated first. This type of evaluation would require a clear understanding of the toxicology of the hazards that are present.

Another problem that may be present during the evaluation phase is the presence of chemicals for which there are no OELs and limited toxicological and epidemiological data. Dismissing these exposures without some type of evaluation can result in serious health risks for the workers the industrial hygienist is trying to protect. A recent example would be the employees working at a microwave popcorn manufacturing facility. Several employees experienced a serious, debilitating disease called bronchiolitis obliterans. Bronchiolitis obliterans is a condition that involves lung fibrosis and small airway obstructions. Some of the workers at the plant required lung transplants. An investigation by scientists from the Center for Disease Control and Prevention (CDC) identified the chemical diacetyl, a component of the butter flavoring added to the popcorn as the causative agent. The plant did not have an industrial hygienist on staff and had not had an evaluation of the process performed. If an industrial hygienist had performed a survey, the exposure might have been identified and evaluated prior to the harm occurring.

During the evaluation phase, the industrial hygienist commonly places workers into similar exposure groups (SEGs). SEGs allow the industrial hygienist to compare and evaluate the workers’ exposure levels with similar exposure profiles while using fewer samples. In other words, the industrial hygienist can evaluate exposures for a group of workers with similar exposures without having to sample everyone in the workplace. This is especially useful when there are several hundred (or thousand) workers at one facility. The use of SEGs requires a thorough anticipation and evaluation phase to be performed prior to evaluation. For example, a facility that manufactures automobile parts using 500 stations with robotic welding could be evaluated using fewer than 500 samples if the anticipation and recognition phases showed that 250 of the workers performed the same basic work with similar local exhaust ventilation systems. These individuals could be placed in one SEG, and a subset could then be sampled.
After placing the workers into SEGs, the industrial hygienist must also choose a method for evaluation. We will study sampling methods for both chemical and physical hazards in a later section. The main point to remember for this unit is that the evaluation method(s) that are used must also be evaluated to determine the accuracy and reliability of the method(s). The most commonly used sampling methods for chemical exposures are validated methods published by the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH).

The last of the four tenants is control. Once the hazards have been evaluated, control methods must be identified and implemented for hazards in which an unacceptable risk is present. In some cases, control methods are required because exposures exceed an OSHA permissible exposure limit (PEL), or a substance-specific OSHA regulation requires the control(s). In some instances, an industrial hygienist may recommend a control method even if the OSHA PEL has not been exceeded because the industrial hygienist believes the residual risk presents an unacceptable risk to workers. OSHA has established a hierarchy of controls to guide the industrial hygienist in selecting control methods. We will study the hierarchy of controls and available control methods in more detail in future units.

There are several organizations that are important in the practice of industrial hygiene. In addition to the regulatory agencies like OSHA and NIOSH, many industrial hygienists belong to organizations like the American Conference of Industrial Hygiene (AIHA) and the American Conference of Governmental Industrial Hygienists (ACGIH). These organizations offer additional resources to industrial hygienists that make the job of anticipation, recognition, evaluation, and control easier. Many industrial hygienists also seek certification from the American Board of Industrial Hygienists (ABIH), which demonstrates that the industrial hygienist has progressed in the field to a point in which he or she has advanced skills and knowledge.

One obstacle the industrial hygienist has to deal with is the relationship between some of the organizations. Only OSHA publishes regulations that are legally binding for the industrial hygienist. However, in some instances, the guidelines published by the other organizations (particularly the ACGIH) are based on more recent scientific data. Deciding whether to apply the OSHA PELs or the ACGIH threshold limit values (TLVs) during the evaluation phase can be tricky, especially if a corporation has a policy that only regulatory limits may be used. At times, one of the most difficult tasks an industrial hygienist may face is trying to convince a corporate manager to apply more stringent guidelines to a work site instead of the OSHA regulatory limits because it is better for the health and safety of workers present at the site.

Reference


Suggested Reading

The CSU Online Library contains many articles that relate to the reading assignment in this unit. The following are just a few of the related articles that can be found in the library’s databases.

In order to access the resource below, you must first log into the myCSU Student Portal and access the GreenFile database within the CSU Online Library.

One of the primary control methods of OSHA’s hierarchy of controls is elimination/substitution. It may be difficult for industrial hygienists to evaluate chemicals for substitution.


In order to access the resource below, you must first log into the myCSU Student Portal and access the Business Source Complete database within the CSU Online Library.
Industrial hygiene practices have been used to improve workers’ health for decades. In some cases, advances were difficult because of faulty research from specific businesses. The following article discusses the conflicting work of the asbestos industry professionals and other researchers, including industrial hygienists.


The Occupational Safety and Health Administration (OSHA) published an informational booklet on industrial hygiene, *OSHA 3143*. Click [here](https://www.osha.gov/Publications/OSHA3143/OSHA3143.htm) to view the resource below.


**Learning Activities (Non-Graded)**

Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.

The National Institute for Occupational Safety and Health (NIOSH) publishes the Pocket Guide to Chemicals. Access the pocket guide at [www.cdc.gov/niosh/npg](http://www.cdc.gov/niosh/npg), and search for several chemicals. How do the OSHA permissible exposure limits (PELs), the NIOSH recommended exposure limits (RELs), and the ACGIH threshold limit values (TLVs) for the chemicals you chose compare? Which of the three values appear to provide the most protection for workers’ health?