Course Learning Outcomes for Unit VI

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

5. Evaluate common workplace hazards.
   5.1 Perform a risk assessment of fire hazards at a manufacturing facility.
   5.2 Determine the applicability of the Life Safety Code to a manufacturing facility.

6. Formulate hazard abatement strategies for common workplace hazards.
   6.1 Recommend controls to reduce the risks associated with fire hazards at a manufacturing facility.
   6.2 Recommend controls to reduce the risks associated with combustible dust at a manufacturing facility.

Course/Unit Learning Outcomes	Learning Activity
5.1	Unit Lesson Chapter 19, pp. 410–439 Unit VI Case Study
5.2	Unit Lesson Chapter 19, pp. 410–439 Unit VI Case Study
6.1	Unit Lesson Chapter 19, pp. 410–439 Unit VI Case Study
6.2	Unit Lesson Chapter 19, pp. 410–439 Unit VI Case Study

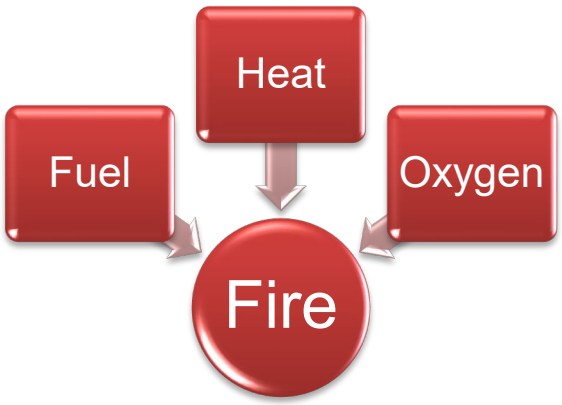
Reading Assignment

Chapter 19: Fire Hazards and Life Safety, pp. 410–439

Unit Lesson

In the last unit, we considered mechanical and fall hazards, including performing risk assessments on the hazards. We also looked at some control methods for those hazards. In this unit, we discuss fire hazards. Most safety positions will include at least one fire hazard, and many safety professionals must deal with multiple fire hazards. While most accidents involving mechanical or fall hazards involve a small number of individuals at a time, fires can injure or kill many more individuals in one instance.

The textbook contains some good definitions related to fire safety. You should review and become familiar with those definitions. Two of the more important concepts for fire safety are the *fire triangle* and the *fire tetrahedron*. Most of you are probably familiar with the images in Figure 19-1 (page 410) of the textbook (Goetsch, 2019). The basic concept of these figures is that it takes the presence of a fuel source, oxygen, and heat to produce a fire. Removing one of the three variables will prevent or stop a fire. If you think of how wildfire firefighters work to remove brush from in front of a moving wildfire, you see the concept of removing one of the variables (fuel) in order to contain the fire.



Elements of the fire triangle
(Goetsch, 2019)

The figure of the fire tetrahedron presents another concept that is important for safety practitioners at occupational facilities. We sometimes think of fuel for fires as being some flammable material like paper or wood. However, some chemicals can also serve as fuel. Another important aspect of some compounds is that they can react with other compounds, and the reaction can create heat and flammable gases. This can be seen with the reaction of a strong acid and a metal. For example, when concentrated sulfuric acid is exposed to zinc it produces zinc sulfate, hydrogen gas, and some heat. The amount of heat is typically not enough to cause the hydrogen gas to burn, but if an ignition source is near the reaction, an explosion or fire may occur.

Goetsch (2019) introduces another concept, *spontaneous combustion*. The example the textbook provides involves oily rags. However, some chemical reactions produce hydrogen gas that can spontaneously ignite. A good example would be the reaction between elemental sodium and water. The reaction produces sodium hydroxide and hydrogen gas and enough heat to ignite the hydrogen gas. This is why you have to take special storage precautions if you use elemental sodium at your workplace. There are several other metals that have similar reactions with water. Some can produce enough heat to spontaneously ignite the hydrogen gas while others do not produce enough heat to cause spontaneous combustion.

Another group of compounds some of you may encounter are *pyrophoric gases*. These gases can ignite with no outside ignition source. Basically, if the temperature of the air is above an auto-ignition temperature the gas will self-ignite. The pyrophoric gases most commonly used in industrial processes include the metal hydrides and non-metal hydrides like phosphine, diborane, germane, and silane. These compounds are commonly used in the preparation of semiconductors, electronics, and some pesticides. Another pyrophoric compound is trimethylgallium, which has been used in conjunction with arsine to produce gallium arsenide chips.

Another important term for you to understand is *flash point*. The definition is provided on page 414 of the textbook. Basically, the lower the flash point, the more flammable the compound. OSHA has designated classes of both flammable and combustible liquids based on the flash point (Goetsch, 2019). You can view the different classes of flammable and combustible liquids as they previously existed, on page 414 of the textbook.

An interesting development from the release of the revised hazard communication (HAZCOM) standard involves the terms *flammable* and *combustible*. The new HAZCOM standard uses the definitions developed in Europe for the Globally Harmonized System (GHS) of HAZCOM. The definitions place liquids into one of four categories of flammable liquids. Those definitions did not have a definition for combustible liquid. Some of the classes of combustible liquids have been included in the GHS definition of a Category 4 flammable liquid. Some of the classes of combustible liquids were not included in any of the definitions of categories of flammable liquids. OSHA had to rewrite portions of existing regulations like 29 CFR 1910.106, which was titled “Flammable and Combustible Liquids.” That regulation is now titled “Flammable Liquids” and no longer contains definitions of combustible liquids (OSHA, 1970c). Therefore, the information in the textbook on flammable and combustible liquids and their classes is dated, and you should refer to 29 CFR 1910.1200 and 29 CFR 1910.106 (general industry) and 1926.152 (construction industry) for current definitions and

categories (OSHA, 1970d; 1970e). You can view the different classes of flammable and combustible liquids, as they previously existed, on page 414 of the textbook.

Another interesting development concerning fire safety also arose from the release of the updated Hazard Communication Rule. The new regulation included a system to place hazards into one of four categories based on the risk associated with the hazard flash point and boiling point. For flammable liquids, the greatest risk of flammability is Category 1 and the least risk is Category 4. For those of you familiar with the ratings used by the National Fire Protection Association (NFPA) and the Hazardous Materials Identification System (HMIS), a 4 is the highest rating (most flammable) and a 1 is the lowest rating (least flammable). As you can see, the ratings are exactly opposite. The differences in rating systems can cause some confusion for the employees you work with. The one positive variable is that the OSHA category ratings are not required on the GHS label, and are typically only found in Section 2 of the safety data sheet (SDS). This means that the workers you routinely work with will rarely see the GHS ratings side-by-side with the NFPA and HMIS labels. Still, the contradiction should be covered in the HAZCOM training sessions you conduct.

Another important variable in implementing an effective fire prevention program is the selection and placement of fire extinguishers. This task has become simpler over the years. A few decades ago, you would need to select a Type A, B, or C fire extinguisher based on the type of fire you might expect. In some cases, you would need to have multiple classes of fire extinguishers. Today, almost all fire extinguishers are Class A, B, C, meaning they will cover all three classes of fires. Class D fires are a little different. Not that long ago, there were no Class D fire extinguishers. Basically, if you had metallic compounds that could ignite you had a box of powder you would throw over the fire, which *smothered* the fire (cut off oxygen). This was the approach that you had to take in the case of a trimethylgallium fire described earlier. That response required a member of the fire team entering the space in a fire proof suit and carrying a box of the powder. You can imagine the difficulty of extinguishing this type of fire. Today, you can purchase Class D fire extinguishers for these types of situations.

The placement of fire extinguishers many times causes problems with fire prevention programs. Basically, you need to determine if you have enough fire extinguishers of the proper class, if they are placed in the proper locations, and if they are readily accessible. Luckily, OSHA has regulations you can use to determine the number and location of fire extinguishers. You can find a review of those OSHA requirements on page 418 of the textbook. Accessibility is a common problem in facilities, usually because someone has placed some material in front of the fire extinguisher, blocking access. It can take a great deal of a safety professional’s time checking to make sure the fire extinguishers are not blocked.

OSHA also has a requirement for monthly visual inspections, annual maintenance checks, and hydrostatic tests (based on the construction material of the fire extinguisher). These requirements can be reviewed in 29 CFR 1910.159 (OSHA, 1970a). Most employers will use an outside service to perform all of these required checks and tests, but some establishments perform the monthly visual inspections internally. If you choose this procedure, make sure you document the visual inspections. Most safety professionals use a tag attached to the fire extinguishers with each month listed where you can date and initial to document the visual inspection.

The last large task that you may be required to perform is training in the use of the fire extinguishers. This training is only required if you allow some of your employees to fight incipient fires. This training basically covers how to use the fire extinguisher and how to fight a fire in the incipient stages with the extinguisher. Many companies will also use an outside service to perform this training.

Another large control that you might need to oversee is exit routes for your facility. Most of you can summarize reports you have read where fatalities occurred because there were inadequate evacuation routes during a fire. OSHA has requirements for your evacuation program. You can read a summary of the requirements on page 425 of the textbook.

The final section of Chapter 19 deals with Life Safety Codes. As the textbook reminds you, the Life Safety Code is published by the National Fire Protection Association (NFPA). Even though the NFPA does not publish regulations like OSHA does, some of the standards and guidelines published by the NFPA are incorporated by reference. There is a list of the standards that have been incorporated by reference in 29 CFR 1910.6 (OSHA, 1970b). If you scan through the standards on the list, you will see that NFPA 101-2009, which is the Life Safety Code, has been incorporated by reference for several OSHA regulations. This

designation means the required sections of the standard carry the same legal weight as the OSHA regulations. You should review the requirements of the Life Safety Code that are summarized in the textbook.

References

Goetsch, D. L. (2019). *Occupational safety and health for technologists, engineers, and managers* (9th ed.). Pearson.

Occupational Safety and Health Administration. (1970a). *Occupational safety and health standards: Fire protection: Portable fire extinguishers* (OSHA Standard No. 1910.157). United States Department of Labor. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9811

Occupational Safety and Health Administration. (1970b). *Occupational safety and health standards: General: Incorporation by reference* (OSHA Standard No. 1910.6). United States Department of Labor. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9702

Occupational Safety and Health Administration. (1970c). *Occupational safety and health standards: Hazardous materials: Flammable liquids* (OSHA Standard No. 1910.106). United States Department of Labor. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9752

Occupational Safety and Health Administration. (1970d). *Occupational safety and health standards: Toxic and hazardous substances: Hazard communication* (OSHA Standard No. 1910.1200). United States Department of Labor. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10099

Occupational Safety and Health Administration. (1970e). *Safety and health regulations for construction: Fire protection and prevention: Flammable liquids* (OSHA Standard No. 1926.152). United States Department of Labor. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10673&p_table=STANDARDS

Suggested Reading

In order to access the following resources, click the links below.

While some fire hazards are easy to identify, you may sometimes miss fire hazards. The following discusses fire hazards, assessments, and preparedness programs for academic libraries.

Iske, S. D. A., Jr., & Lengfellner, L. G. (2015, October). Fire, water, & books: Disaster preparedness for academic libraries. *Professional Safety, 60*(10), 39–46. https://search-proquest-com.libraryresources.columbiasouthern.edu/docview/1735009821?accountid=33337

There are a great number of OSHA regulations and standards from agencies outside of OSHA for fire protection. The following OSHA document summarizes most of those documents and has links, so you can access and review the documents.

Occupational Safety and Health Administration. (n.d.). *Fire safety*. United States Department of Labor. https://www.osha.gov/SLTC/firesafety/standards.html

OSHA does not currently have a published definition for combustible dust; however, it has published a guidance document for combustible dusts. The following OSHA document contains some interesting information about combustible dust hazards.

Occupational Safety and Health Administration. (2009). *Hazard communication guidance for combustible dusts* (OSHA Publication No. 3371-08). United States Department of Labor. https://www.osha.gov/Publications/3371combustible-dust.html

Learning Activities (Nongraded)

Nongraded 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.

OSHA has developed some training aids for safety professionals. Go to the following link, and review some of the training for fire safety. Which training resource(s) did you find to be the most useful?

Occupational Safety and Health Administration. (n.d.). *Fire safety*. United States Department of Labor. https://www.osha.gov/SLTC/firesafety/additionalinformation.html