Controlling Fire Hazards from Flammable and Combustible Liquids at Chemical Facilities

From a property underwriting perspective, the presence of flammable and combustible liquids introduces serious loss exposures for chemical distributors and manufacturers. This article will explore the science behind XL Environmental's property underwriting approach for these high hazard risks.

Defining Flammable & Combustible Liquids

There is a technical distinction between a flammable liquid and a combustible liquid. By definition, a flammable liquid has a flash point of under 100 degrees Fahrenheit (F), and a combustible liquid is defined as any liquid with a flash point greater than 100 degrees F. Since lower flash point combustible liquids have the same tendency to burn rapidly with intense heat as flammable liquids do, the term "flammable liquids" is used to refer to both flammable and combustible classes.

Flash Point

Flash point is defined as the lowest temperature of a flammable liquid at which it gives off vapor sufficient to form an ignitable mixture with the air near the surface of the liquid or within the vessel containing it. Notice that the essence of the definition for flash point is the relationship between temperature and the presence of sufficient vapors for combustion. This is because flammable liquids do not burn, rather it is the vapors from a flammable liquid which burn.

The flash point definition makes reference to all three elements of what is known as the fire triangle: heat, oxygen and fuel. These are the elements necessary for combustion. When heated to its flash point, a flammable liquid, the fuel, gives off enough vapors for combustion to take place, provided that a sufficient quantity of oxygen is present and an ignition, or heat source, is introduced. Thus a chemical stored in a warehouse in a closed container with a flash point of 80 degrees F will not burst into flames on a hot summer day since there is not sufficient oxygen present for combustion to take place, nor is there an ignition source.

Understanding the concept of flash point is an important step in evaluating the relative fire risk for a chemical facility. By sorting chemicals according to their flash points and quantities stored within each range, an overall "flash point profile" can be developed to identify potential fire hazards.

It is important to note, however, that flash point is only one of a number of fire hazard properties of a flammable liquid which should be considered when evaluating the relative fire risk of a given chemical. The other properties are Ignition Temperature, Flammability (Explosive) Limits, Specific Gravity (Relative Density), Vapor Density, Boiling Point, Melting Point and Water Solubility. Definitions of these terms as well as a comprehensive list referencing these properties and recommended extinguishing methods for common industrial chemicals can be found in the National Fire Codes NFPA 325M, Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids.

Grounding And Bonding

Buildup of static electricity charges on containers and people can cause sparks that ignite flammable liquid vapors, particularly in areas where dispensing takes place. These static charges must be electrically drained off by grounding and bonding to prevent the discharge of vapor-igniting sparks. Grounding refers to the use of cables connecting an earth ground to each drum involved in dispensing. Bonding refers to connecting the containers involved in any dispensing operation with a wire to prevent spark.

Electrical Apparatus
Because of the prevalence of flammable vapors at chemical facilities, sparks from electrical devices can ignite vapors and cause a fire or explosion. For this reason it is common practice to use specially designed "explosion proof" outlets, fixtures and switches which encase the electrical apparatus to isolate any spark from the air around it. There are different classes of these devices, which are specified according to the likelihood of flammable vapors in a certain area.

**Venting**

Drums and aboveground storage tanks should be equipped with atmospheric vents to prevent creation of a vacuum when liquid is being drained off. This will also allow the interior of tanks or drums to remain at atmospheric pressure despite variations in temperature, and thus prevent collapse or explosion. Since flammable vapors are denser than air, they will collect around the floor, particularly in a chemical facility’s dispensing area. For this reason, low level mechanical ventilation is usually a good idea (with appropriate environmental controls, of course).

**Extinguishing Systems**

*Sprinklers:*  
While sprinkler systems are not the most effective weapon for controlling flammable liquid fires, they are still useful, particularly within enclosed flammable liquids storage rooms. Application of sprinkler water to a flammable liquids fire has the effect of absorbing the heat from the fire and keeping the surroundings cool. However, over the large floor space of a distribution warehouse, the rapid propagation and high heat release aspect of flammable liquids fires tends to cause rapid spread over a large area (particularly if chemicals are stored in combustible containers). This condition tends to overtax sprinkler systems and render them ineffective. As a general rule, the most effective agent for controlling a flammable liquids fire is an automatic foam system. But a sprinkler system is better than no system and can always serve as a back up.

*Foam:*  
There are a number of types of fire fighting foams available commercially. The details of each are beyond the scope of this article; however, a basic discussion of how foams work can be helpful.

Foam is produced by mixing a foam concentrate with water at the appropriate concentration and then agitating it in air to form bubbles. When applied to a burning flammable liquid, the bubbling foam forms a barrier that separates the liquid from the air and interrupts the combustion process.

Foams are divided into three categories: Low Expansion Foam, Medium Expansion Foam and High Expansion Foam. The determination of which foam to use depends upon the compatibility with the chemicals involved in the anticipated application, as well as the size and topography of the area involved. Foams are not recommended for use on electrical fires since they conduct electricity; neither should they be used on water reactive liquids.

*Carbon Dioxide:*  
Carbon dioxide is desirable as an extinguishing agent because it is noncombustible and will not react with other liquids. It can be used despite the presence of electrical apparatus and leaves no residue after it is used. Carbon dioxide is a gas at room temperature and functions as an extinguishing agent by displacing and cooling all of the oxygen surrounding a fire. For chemical facilities, the most effective carbon dioxide extinguishing system is a total flooding system, in which an enclosed area is filled with the gas through spray nozzles actuated by smoke and/or heat detectors. Carbon dioxide is not effective if used outdoors since it dissipates rapidly.

The presence of flammable liquids in bulk quantities at a chemical facility is a serious threat to any insured's property. Fortunately a number of fire protection methods have been developed to attempt to minimize this exposure. The starting point is having facility managers who understand the risks involved and who are committed to implementing proper fire protection procedures and fire fighting systems.