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The Hazards of Flammable Liquid Spills

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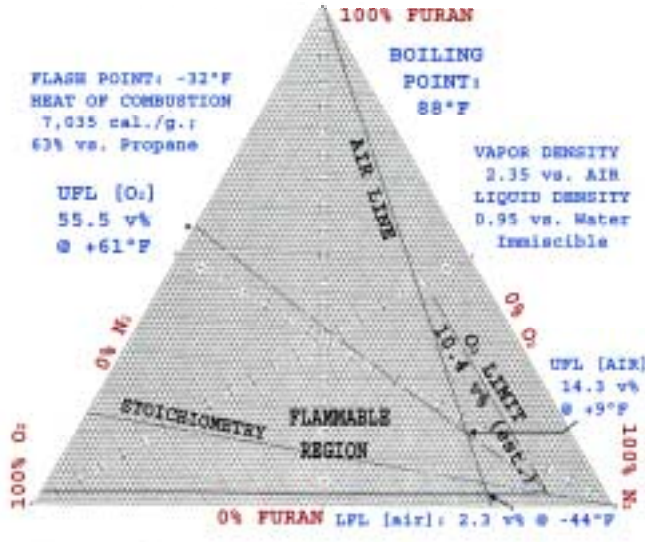
From a dropped beaker to a ruptured hose, spills of flammable liquids can result in a fire or vapor cloud explosion. In the presence of an ignition source, the vapor above the surface of the spilled flammable-liquid can ignite and cause a flash-fire or a vapor cloud explosion if the vapor cloud is formed in a partially confined space. The ignition of a vapor cloud can also lead to a pool fire, which can last for an extended period of time.



Flash and pool fires cause burn injuries to people within the "hot gas cloud". Vapor explosion can damage plant structures that cannot withstand the explosion pressure and can result in injuries or death. If suitable exit routes are not available for persons in the area, the consequences may be life threatening, particularly when the combustion products are toxic. The adjacent Figure shows some of the pertinent properties of a flammable liquid.

Flash-Fire Hazard

The vapors from flammable liquids are heavier than air, and normal exhaust ventilation of laboratories and chemical plants may not provide floor-level removal of heavy flammable vapors. Thus, there may be a large volume of flammable vapors surrounding a spill of flammable liquid. If there is an ignition source within the spreading envelope of flammable vapors, the vapors could ignite, as a flash-fire. Although the duration of a flash-fire may be relatively short, the flame temperature is high, and therefore, combustible materials within the flash-fire could be ignited. This is particularly true for easily ignitable materials, such as newspaper, suspended dust or dust layers, curtains, and light clothing. Persons within the flash-fire usually suffer burn injuries to their exposed skins. The worse situation is when their combustible clothing is caught on fire.

Exposure to Pool Fires

Normally, most pool fires can be easily sensed, however, some materials, such as alcohols and ethers (and hydrogen), can burn with an almost-invisible flame, depending on the amount and type of illumination in the area. As with flash-fires, if a person with combustible clothing is close to a burning pool, the clothing could ignite, with serious consequences. Also, the use of a straight stream of water onto a burning pool of immiscible flammable liquid could scatter the burning liquid (or other burning material), with a hazard to unsuspecting personnel nearby.

Preventive Measures

The primary preventive measures are good engineering design and practice that minimize spills and leaks. Other preventive measures include providing spill containment, providing floor-level ventilation where flammable liquids are dispensed, ensuring that there are no ignition sources in areas where spills might occur, ensuring that there are two exit paths from flammable-liquid (and flammable-gas) areas

per the Life Safety Code (NFPA 101), wearing non-combustible clothing, facial protection and gloves if flammable fluids are to be handled, and treating with extreme caution any spill of flammable liquid.

Spill Clean-Up Hazards

It is important to treat any spill as a hazardous material. Most large chemical plants and laboratories now have spill-response teams, to comply with OSHA's "HAZWOPER" standard, 29 CFR 1910.120(a)(v) and 29 CFR 1910.120(q). Most response teams would arrive at the scene of a spill with flammable-vapor detectors, to determine the extent of flammable vapors and to determine a direction of safe approach, to contain the spill or limit the emission of vapors.

However, it is important that all employees who work in flammable-liquid (and flammable-gas) areas receive at least "First Responder Awareness Level" training, so that they can recognize and avoid a hazardous situation. This includes an understanding of (1) what hazardous substances are, and the risks associated with them in an incident, (2) the potential outcomes associated with an emergency created when hazardous substances are present, (3) the role of individuals in the emergency response plan, (4) the ability to recognize the presence of hazardous substances, and (5) the ability to identify the hazardous substance that has spilled. This level of training is particularly important where there may be periods when the full spill-response team is not available, or where there is no spill-response team. In the latter case, an appropriate response of employees to an emergency, during the period before arrival of local fire-fighters or emergency responders, should be carefully pre-determined, to avoid unnecessary risk.

Clean-up risks can be avoided by frequent drills (and critiques) of the spill-response team. Further, it is important to stress to employees that life-threatening risks are not be taken for the protection of property. With frequent "awareness" training of employees, frequent training in the use of "first-aid" fire extinguishers, and good design of "last-resort" fire-protection facilities (including sprinkler systems), there should be minimal risk from flammable-liquid spills.

How Chilworth Can Help You

Chilworth engineers/safety specialists can help identifying sources of liquid spills, unforeseeable consequences of spills, and preventive measures for controlling liquid spill hazards, as well as identifying, eliminating or controlling ignition sources.

Chilworth Flammability Laboratory not only conducts the whole range of gas, vapor and dust flammability tests, such as flash point, auto-ignition temperature, lower and upper flammable limits, minimum oxygen concentration, and thermal stability, which are required to develop a Material safety Data Sheet (MSDS) and process safety programs for specific processes, but also develop and conduct special flammability tests under actual process conditions. It is vital to realize that the flammability characteristics of materials are affected by process conditions such as pressure, temperature, oxidant gases, size of the vessel, and the material of the vessel. These data are essential for developing process safety programs.

At last but not the least, when processes are outsourced or are conducted by customers, these flammability data provide critical safety information to ensure safety in manufacturing.

For more information on flammability properties of liquids, Chemical Reactions, Dust Explosions and/or Electrostatic Hazards, please contact Richard Prugh, PE, CSP, Sr. Process Safety Specialist and Dehong Kong, Ph.D., CSP, Sr. Process Safety Specialist and Flammability Group Manager at Tel: 609-799-4449 Fax: 609-799-5559 Email: safety@chilworth.com Website: www.chilworth.com