FACTORS AFFECTING THE FLASH POINT TEMPERATURE OF CHEMICALS AND CHEMICAL MIXTURES

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The flash point of a liquid is the lowest temperature, corrected to the standard atmospheric pressure of 760mmHg (101.3Kpa), at which sufficient vapor exists above a liquid surface to form an ignitable mixture with an oxidant (usually oxygen in air). Most material safety data sheets (MSDS’s) provided by the manufacturers of combustible or flammable liquid chemicals contain the flash point data. The data provided in MSDS’s are generally for measurements conducted in air at atmospheric pressure.

Typically, flash points are measured using standardized testing methods in either open cup or closed cup. The closed cup method gives more conservative flash point data compared to the open cup method. The reason for this is that during a flash point test using an open cup tester, the more volatile components of a multi-component mixture may be lost before the application of the ignition source. Therefore, closed cup flash point data is generally preferred to open cup data and is used by both Department of Transportation (DOT) and National Fire Protection Agency (NFPA) to classify liquids. Some of the basic standard methods for measuring the flash point temperature of liquids are summarized below [1];

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Flash point data are available for most pure liquids, but very limited data are available for mixtures and if available, they are usually in air at ambient pressures. Many industries work with mixtures under different conditions of temperature, pressure and oxidant gas according to their process. The flash point temperatures of pure liquids and mixtures can be greatly influenced by the process conditions.

Factors Affecting the Flash Point Temperature

- **Pressure** – The flash point temperature increases with increasing pressure and decreases with decreasing pressure.
- **Oxidant** – The flash point temperature of a pure liquid or mixture is greatly influenced by the type of oxidant atmosphere (i.e. flash point of a chemical in air will be different than the flash point of the same chemical in another oxidant like chlorine).
- **Others** - Tester configuration, sample size, ignition source, temperature control, sample homogeneity, drafts, and operator bias.
When the flash point temperature of a chemical is to be measured at a pressure other than atmospheric pressure or in an oxidant gas other than air, then it may not be feasible to determine the flash point temperature using one of the standard methods summarised above. Limitations that exist in the standard closed cup apparatus are:

- Some closed cup testers are not leak tight to maintain a fixed pressure either above or below atmospheric pressure.
- When testing using a closed cup tester, opening the cup lid to introduce the pilot flame, may cause some portion of the flammable vapours to escape, thus affecting the results.
- Due to leak issues and operating procedures (i.e. opening the cup lid to introduce a pilot flame), it may not be possible to use other oxidant gases, especially if the oxidant gas is toxic, as it may create a hazardous and unsafe work environment in the laboratory.

“Equilibrium Closed Bomb” (ECB) Apparatus to Measure Flash Point Temperature

Chilworth has developed an “equilibrium closed bomb” (ECB) apparatus that can be used to measure the flash point temperature of chemicals and mixtures in a reduced or pressurized atmosphere. Since the apparatus is leak tight, it can also be used to measure flash point temperature in oxidants other than air, especially toxic oxidants (e.g. fluorine, chlorine, bromine, etc). The ECB test apparatus consists of a cylindrical stainless steel vessel with a temperature range of -50°C to +150°C. Thermocouples and pressure transducers are utilized to measure the liquid and vapour space temperatures and pressure. A continuous electrical arc is used as the ignition source.

ECB apparatus has been calibrated by measuring the flash points of known chemicals in air at 1.0 atmosphere pressure. The flash point data recorded were in good agreement with the published data for the same chemicals. Chilworth has conducted numerous flash point measurements successfully on various chemicals at different pressures and/or in oxidant gases other than air using the ECB apparatus.

How Chilworth Global Can Help With Your Flammability Needs

Very limited data on the flammability properties of chemicals or chemical mixtures at adverse conditions of temperature and pressure are currently available. In such cases, the flammability properties of chemicals must be experimentally determined at their process conditions to ensure safety of a chemical process. Chilworth Global has a highly specialized flammability laboratory with full-scale testing facilities, a wide variety of process equipment (i.e. pressure vessels of various sizes, shapes and material of construction) and recognized expertise for the determination/study of the flammability characteristics of chemicals under process conditions. Our testing and research facilities include four “barricade cells” for the study/testing of materials under dangerous temperature and pressure conditions. The “barricade cells” are designed to withstand explosions of 10-lbs TNT equivalent and have the capability to monitor the system control parameters from a safe control room area. Blast and missile resistant widows allow direct observation of the experiments.
We have utilized these facilities and expertise to help our clients identify potential gas/vapor explosion hazards under specific process conditions, in various forms, including:

- Incident investigations
- Characterization of flammability hazards under representative process conditions
- Research on flammability of chemicals under special conditions
- Flammability of hybrid mixtures

References


For further information regarding testing for the flammability properties of chemicals at elevated temperatures and pressures, please contact Anand Kenchenpur, Manager-Flammability Group at Tel:609-799-4449, Fax:609-799-5559, email: akenchenpur@chilworth.com. You may also visit our website at: www.chilworth.com.