

## Introduction

The flash point is the lowest temperature at which a liquid's vapor will briefly ignite with the presence of an ignition source. Flash point is a primary component of safety management as the information the test provides is implemented into storage and transportation systems. The Koehler Instrument Company's K71000 Automatic Pensky-Martens Closed Cup Flash Point Analyzer is an automated flash point tester that determines the flashpoint of flammable substances, such as biodiesel or mixtures of petroleum liquids with solids.

## Importance of the Flash Point Determination

The flash point is integral for safety in material management, as the Occupational Safety and Health Administration categorizes flammability and combustibility by using the flash point. Flammable liquids tend to have a flash point under 38°C, and combustible liquids tend to have a flash point over 38°C, classifying them as hazardous materials, thus must have strict rules in place to safely manage the materials. The Hazardous Materials Regulation Board utilizes flash point to set regulations for transportation of materials. The use of flash point led to the classification of materials into "flammable liquids" and "combustible liquids," and modified the definition of flammable liquids.

| Flash Point | UN Recommendations | HMR (domestic ground shipments)  |
|-------------|--------------------|--|
| Below 38°C  | Flammable Class 3  | Flammable Class 3  |
| 38°C - 60°C | Flammable Class 3  | Flammable Class 3, with the option to reclassify as Combustible, non-bulk shipments expected |
| 60°C - 93°C | Unregulated        | Combustible (bulk only), non-bulk shipments expected   |
| Above 93°C  | Unregulated        | Unregulated  |

**Figure 1.** UN vs. US regulations on transportation of flammable materials.



## Testing Procedure

- Prepare the liquid sample being tested by pouring it into the cup, and placing the cup inside the machine. After placing the cup, close the hood.
- Use the touch screen to add parameters to the test, these can be the ASTM that correspond to the liquid, or the expected/literature flash point.
- The temperature will appear on the screen as the ignition source gains heat, and the test will cease once a flash is detected by the instrument.
- When the test is completed the temperature of the flash point will appear on the screen, and the number of dips (the heat source touching the sample), it required to reach that temperature.

## Data Analysis

The Koehler Instrument Company's K71000 Automatic Pensky-Martens Closed Cup Flash Point Analyzer is an automatic flash point tester which can test in A, B, and C of ASTM D93, and can detect thermal coupling and ionization rings. The A test method is designated for fuels such as diesel, lubricating oils, and homogeneous petroleum liquids, whereas the B test method is for residual fuel pols, mixtures of petroleum alongside solids, and oils that form a surface film, and the C test method is for specifically biodiesels and is an electronic detection flash point. The Pensky-Martens closed cup test is the standardized way to test for flash point as it produces the most stable and consistent results.

| No. | Compound        | Flash Point (°C) |
|-----|-----------------|------------------|
| 1   | n-Pentane       | -49              |
| 2   | i-Octane        | -12              |
| 3   | n-Dodecane      | 74               |
| 4   | n-Hexadecane    | 126              |
| 5   | Methanol        | 11               |
| 6   | Ethanol         | 13               |
| 7   | Tetrahydrofuran | -14              |
| 8   | Toluene         | 4                |
| 9   | o-Xylene        | 32               |

**Figure 2.** Experimentally determined flash points of organic materials using PMCC.

## Pensky-Martens Closed Cup Test and Benefits

Flash point testing is split into two test methods, closed cup and open cup. Closed cup testing is viewed as more beneficial as it eliminates the loss of heat that occurs due to the distance between the ignition source and the test sample. The Pensky-Martens Closed Cup Test (PMCC) is a method for testing flashpoint which is standardized as ASTM D93, and specially used for determining the flashpoint of petroleum products or biodiesel.

## K71000 Automatic Pensky-Martens Closed Cup Flash Point Analyzer

The K71000 Automatic Pensky-Martens Closed Cup Flash Point Analyzer, manufactured by Koehler Instrument Company, Inc. follows ASTM D93 to detect the flashpoint of volatile materials. The machine has a system software which runs on an integrated processor, with an 8.5" LCD touch screen interface that displays all operating parameters and the results in one simple location, along with storage for over 65,000 Data Results. The instrument operates from ambient to 405 °C, with a dual fan system directly cooling the test cup and the surroundings. The machine includes a built-in fire suppression system which floods the machine with inert gas in the case of a fire, and automatic barometric pressure correction.



## Conclusion

The Koehler Instrument Company's K71000 Automatic Pensky-Martens Closed Cup Flash Point Analyzer features a user friendly interface along with a cohesive setup in order to determine the flash point of a liquid. The instrument is unique in its dual option of gas or electric ignition, a dual fan system, and a built in fire suppression system, along with the touch screen interface with an integrated processor and simple to read results.

## References

- "Operations and Instructions Manual - Koehler Instrument Company, Inc." *Koehler Instrument Company, Inc.*, Accessed 11 Feb 2022.
- Standard 1910.106 "Occupational Safety and Health Administration," Accessed 11 Feb 2022.
- "Hazardous Materials Regulations: Combustible Liquids". *Federal Register*, 2010, Accessed 22 Feb 2022.