Development of a Closed-Cup Pensky-Martens Test to Numerically Determine the Flash Point of Flammable Liquids

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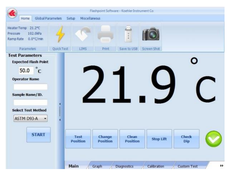
Introduction

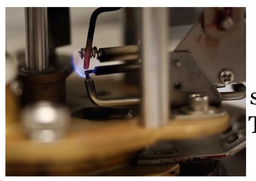
The flash point of a liquid is defined as the lowest temperature at which the vapors formed above the liquid will briefly ignite in proximity to an ignition source. In the petroleum industry, determination of flash point is vital to ensuring safety when considering the proper environment for the storage and transportation of volatile substances. The K71000 Automatic PMCC Flash Point Analyzer manufactured by Koehler Instrument Company, Inc. is a fully automatic flash point tester that can determine the flash points of flammable substances via the Pensky-Martens closed cup test, as specified in ASTM D93.

Operating the Instrument

Prepare liquid to be tested by pouring it into the cup, placing the cup into the K71000, and closing the hood.

The left sidebar can be used to apply parameters such as expected flash point and the specific ASTM procedure for respective liquid before beginning the test.





During the test, the temperature on screen will increase as the ignition source periodically "dips" into sample. The test will automatically cease once a flash is detected by sensors.

Once the K71000 completes the test, it will display the flash point temperature on screen, as well as the number of "dips" required to reach the flash point.

Figure 2. Procedure for operating the K71000 with pictures detailing preparation of a sample, touch screen set up, flash point testing, and test results.

What is the Pensky-Martens Closed Cup Test?

The primary testing methods for flash point determination are classified as either open or closed cup tests. Since the measured value for the flash point can vary depending on the distance from the ignition source, closed cup tests are typically preferred, as the resultant flash points will be lower, erring on the side of caution. The Pensky-Martens closed cup test, which is standardized as ASTM D93, entails placing an oil sample in a cup that is subsequently closed off to atmospheric disturbance. An ignition source then periodically heats the sample within the closed vessel, until the sample flashes and the flash point is determined. ASTM D93 details three different procedures depending on the type of sample: procedure A, procedure B, or procedure C.

Importance of Flash Point Determination

The flash point of a liquid is a crucial property to consider for safety. The Occupational Safety and Health Administration (OSHA) uses flash points to categorizes liquids as either combustible (flash point > 100° F) or flammable (flash point < 100° F) as specified in Standard 1910.106. Beyond safety, a comparison between the baseline flash point of an oil and the flash point for a separate sample of the same oil can be used to discern any changes within the sample of oil. This can include changes in oil chemistry such as thermal cracking (decreases flash point) and polymerization (increases flash point); additions to the oil which can either increase or decrease the flash point depending on the additive; or subtractions from the oil such as thermal evaporation which will increase the flash point.

No.	Compound	FP (°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 3. Experimentally determined flash points for various organic compounds via the Pensky-Martens Closed Cup Test.

The K71000 Automatic PMCC Flash Point Analyzer

The K71000 Automatic PMCC Flash Point Analyzer (K71000) is a fully automatic flash point tester that adheres to procedures A,B, and C of ASTM D93, among other ASTM standards. The K71000 is integrated with a Windows OS and has an 8.4' touch screen display that includes a variety of user functions for ease of use. It includes a dual fan cooling system as well as an inert gas fire suppression system ensuring complete customer safety.

Figure 1. The Automatic Pensky-Martens Closed Cup Tester shown with the startup display, and a closed hood ready for testing flash points.

Conclusion

The K71000 Automatic PMCC Flash Point Analyzer offers a comprehensive and simple set up to determine the flash point of a liquid via the Pensky-Martens closed cup test. The instrument also provides unique versatility through the option of either gas or electric ignition, a dual sensor setup for flash point detection, and a touch screen interface with an assortment of convenient features.

References

ASTM D93 "Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester" (ASTM International)

Standard 1910.106 "Occupational Safety and Health Administration" (U.S. Department of Labor)