Assessing Low Temperature Characteristics of Fuels Through Cloud and Pour Point Determination

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Introduction

The functionality of petroleum products can be compromised at low temperatures. The cloud point and pour point of a fuel describes the temperatures at which a fuel might be inadequate for its intended use. Additives can be used to improve the low temperature characteristics and operability of fuels. The K77000 Automatic Cloud and Pour Point Analyzer provides an efficient and accurate method to determine the cloud point and pour point of fuels within a single unit.

K77000 Automatic Cloud and Pour Point Analyzer

The K77000 instrument is an automated test system capable of determining the cloud point of a fuel via optical detection and the pour point of a fuel using an automatic tilt method. These methods are described in test methods ASTM D5771 and ASTM D5950 by the American Society for Testing and Materials. To perform a test the user starts by attaching the cloud point or pour point specialized head attachment on the top of the instrument. The instrument will automatically detect which head is connected. The instrument can operate with samples at temperatures in the range of -105°C to +50°C.

Figure 1. The K77000 Automatic Cloud and Pour Point Analyzer.

Testing Preparation

Before testing using the K77000 instrument, several easy but important steps must be performed. First, a cork ring is to be fit around the testing jar. Once the cork ring is secured, proceed to pour the sample fuel into the testing jar. Next, load the prepared jar into the test sleeve. Secure the selected head, set the desired parameters, and click the start button to begin experimentation.

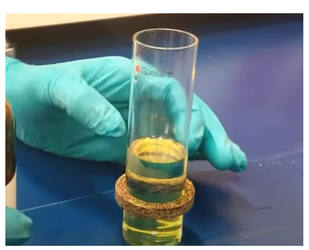

Figure 2. Fully prepared test jar.

Test Results

At the start of the process, the fuel is preheated to a desired value. Once the desired value is reached, cooling occurs until the cloud point or pour point is determined. Throughout experimentation, a graph is presented on the instrument's interface. Once testing is completed, the results are stored under the results tab, which is included on the touch screen display panel. When selected, all saved past tests are shown. After selecting a test, the stored graph can be viewed, printed, or exported elsewhere.

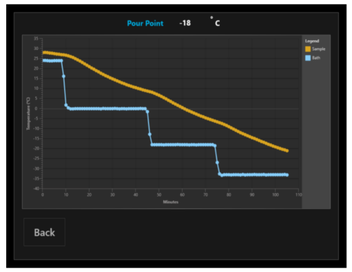

Figure 3. Sample graph shown during the testing.

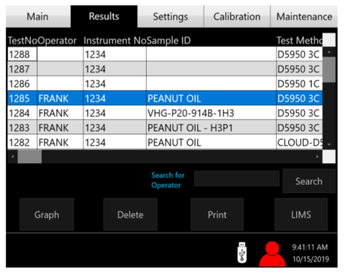

Figure 4. Results tab from the interface of the K77000 instrument.

Methodology

ASTM D5771

As a fuel approaches its cloud point, the fuel becomes cloudy as solidified wax forms. This testing method utilizes a specialized optical sensor to observe layers of the fuel up to 40 mm thick. The automatic instrument will observe the fuel first at a liquid state. As time passes the fuel begins to change from a single-phase to a two-phase system. Once the change is observed the temperature of the cloud point is measured.

ASTM D5950

For determination of the pour point the automated instrument will undergo the tilt method. Utilizing a similar optical sensor, periodically (every 1°C or 3°C) the instrument automatically tilts the test jar. As a fuel reaches its pour point, flow is halted. Therefore, the instrument will measure the pour point once it detects no movement on the surface of the jar when tilted. The lowest temperature at which there is still movement of the fuel when the container is tilted is tested for.

Potential Additives

The usage of fuels at extreme cold conditions is not reliable due to the fuel eventually reaching its cloud point or pour point. Additives can be used to supplement the cold weather operability of fuels and lubricants that are susceptible to low temperatures. In this study, ethanol and methanol were mixed with diesel fuel at different volume percentages. The testing methods ASTM D5771 and ASTM D5950 were used to find the cloud point and pour point of the mixture, respectively. The differences were observed.

Volume %	Methanol	Ethanol
0	0°C	0°C
5	-4°C	-1°C
10	-8°C	-1°C

Figure 5. Cloud Point Observation.

Volume %	Methanol	Ethanol
0	-5°C	-5°C
5	-12°C	-17°C
10	-15°C	-22°C

Figure 6. Pour Point Observation.

The addition of methanol is shown to have a greater effect on the fuel's cloud point while the addition of ethanol is shown to have a greater effect on the pour point. The evidence of an improvement in cloud point and pour point is clear. The use of different additives in different environments will be able to increase a fuel's operability.

Conclusion

The K77000 Automatic Cloud and Pour Point Analyzer is a user-friendly and intuitive instrument for cloud point and pour point determination. The new automated technology allows for hand-free experimentation without constant monitoring. Testing for cloud point and pour point is vital to ensure that the appropriate fuels are being used in low temperature environments. Additionally, appropriate additives can be used to supplement and enhance low temperature characteristics as needed.

References

- ASTM D5771 "Cloud Point of Petroleum Products and Liquid Fuels (Optical Detection Stepped Cooling Method)" (ASTM International)
- ASTM D5950 "Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)" (ASTM International)
- K7700X Auto Cloud and Pour Point Analyzer Operation and Instruction Manual (Koehler Instrument Company, Inc.)
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