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Heat transfer fluids – Determination of thermal stability

热传导液热稳定性测定法

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Foreword

This Standard equivalently adopts German national standard DIN 51528-1994 *Determination Method of Liquid Heat Stability of Heat Carrier*. The main difference between this Standard and DIN 51528-1994 include:

(1) Add the requirements for weighing accuracy of specimen and instrument.

(2) Add the report about appearance of specimen after heating.

(3) The minimum volume of borosilicate glass ampoule is increased to 15 mL from 5 mL.

This Standard was proposed by China Petroleum and Chemical Corporation.

This Standard shall be under jurisdiction of Academy of Science of Petroleum and Chemical of China Petroleum and Chemical Corporation.

Drafting organizations of this Standard: Academy of Science of Petroleum and Chemical of China Petroleum and Chemical Corporation.

Main drafters of this Standard: Wang Fei, and Liang Hong.

Determination method of thermal stability of heat transfer fluids

1 Scope

This Standard specifies the test method of thermal stability of heat transfer fluids of mineral oil and synthetic hydrocarbon type.

This Standard is applicable to the heat transfer fluids used in the open system (the maximum operating temperature under normal pressure is less than its initial boiling point or boiling point) or closed system (the maximum operating temperature is more than its initial boiling point or boiling point).

2 Normative references

The articles included in the following standard have become part of this Standard by reference. Unless otherwise expressly provided in this Standard, the following references shall be the current effective standards.

SH/T 0558 Petroleum distillate boiling range distribution determination method (gas chromatographic method)

3 Terms

This Standard uses the following terms.

3.1 Thermal stability

In the test temperature and test process, the stability that the heat transfer fluid reacts to heating.

Note: Along the rise of temperature, the changes of heat transfer fluid are accelerating, and generate the gas phase decomposition products, products of lower boiling point, products of higher boiling point as well as products which can not be evaporated. The type and quantity of products will affect the use performance of heat transfer fluid.

In order to assess the thermal stability, it needs to determine the content of the generated gas phase decomposed products, products of lower boiling point, products of higher boiling point as well as products which can not be evaporated from heat transfer fluid after heating; and the sum of these products' percentage content is expressed in deterioration rate. The smaller the deterioration rate, the better the product thermal stability.

3.2 Gaseous decomposition products

After heating the sample, the substances of which the boiling point is less than room temperature under the normal pressure, such as hydrogen and methane, etc.

3.3 Products of lower boiling point

After heating the sample, the substances of which the boiling point is less than the initial boiling point of the heat transfer liquid which is not used.

borosilicate glass ampoule; make the gas evaporated completely; then weigh the mass (m_4) of borosilicate glass ampoule, accurate to 0.1mg.

Note: The large borosilicate glass ampoule or specimen that is loaded with high hot-load shall be equipped with the safety protection cover during cooling process. When weighing it, include all glass fragments; remove the adhering condensation water.

8.6.2 Open the stainless steel test device

Put the borosilicate glass ampoule in the Dewar flask; under the condition of frozen acetone or isopropanol and dry ice (about -70°C), reduce the internal pressure. After 5~10min, open the borosilicate glass ampoule; make the gas evaporated completely; then weigh the mass (m_4) of borosilicate glass ampoule, accurate to 0.1mg.

Note: Remove the adhering condensation water when weighing.

8.7 Use SH/T0558 method to determine the range of boiling point of specimen before and after heating.

8.8 Determination of content of unevaporated products

8.8.1 Weigh the mass (m_5) of empty tail ball in the bulb tube distiller, accurate to 0.1mg; then dip 4g of heating specimen in the tail ball; weigh this mass (m_6), accurate to 0.1mg.

8.8.2 Use vacuum pump to pump to vacuum, so as to make the pressure in the bulb tube reach 10Pa ± 0.2Pa finally. Rotate the bulb tube in the bulb tube distiller; heat it to 250°C ± 1°C slowly; maintain this test temperature and pressure until the evaporable part in the unevaporated products is less than 0.1 % of specimen mass (m/m).

8.8.3 Weigh the mass of tail ball after test (m_7), accurate to 0.1mg.

9 Calculation

9.1 Calculation of content of specimen of gaseous decomposition products

The calculation of gaseous decomposition products of specimen G[%(m/m)] is by formula (1):

$$G = (m_3 - m_4)/(m_2 - m_1) \times 100 \quad \text{..... (1)}$$

Where:

m_1 — mass of empty test device, g;

m_2 — mass of test device equipped with specimen which is not heating, g;

m3 – mass of sealed test device, g;

m4 – mass of test device after opening, g.

Note: The gaseous decomposition products of specimen below 0.5%(m/m) is negligible.

9.2 Calculation of content of specimen unevaporated products

The content of specimen unevaporated products U[%(m/m)] is calculated by formula (2):

10 Report

10.1 Type of heat transfer liquid;

10.2 Test time, h;

10.3 Test temperature, °C;

10.4 Deterioration rate, take the average value of three test results, %(m/m), accurate to one digit after decimal point;

10.5 Content of gaseous decomposition products and products of lower boiling point, %(m/m), accurate to one digit after decimal point;

10.6 The content of products of higher boiling point and unevaporated products, %(m/m), accurate to one digit after decimal point;

10.7 Initial boiling point and final boiling point of specimen before and after heating, °C;

10,8 Appearance of heating specimen;

10.9 Conditions which are not consistent with this Standard;

10.10 Test date.

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