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**Standard test method for oil separation from
lubricating grease by centrifuging (Koppers method)**

润滑脂离心分油测定法

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Standard test method for oil separation from lubricating grease by centrifuging

Warning: This Standard may involve certain hazardous materials, operations and equipment, but it does not make recommendations on all related safety issues. Therefore, before using this Standard, users shall establish corresponding safety and protective measures, and determine the applicability of relevant regulations and restrictions.

1 Scope

This Standard applies to the determination of oil separation tendency of lubricating grease under high centrifugal force.

This Standard specifies the determination method of oil separation from lubricating grease by centrifuging.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 269, Lubricating grease and petrolatum - Determination of cone penetration (GB/T 269-1991, eqv ISO 2137:1985)

3 Terms, definitions and symbols

The following terms, definitions and symbols apply to this document.

3.1 Terms and definitions

3.1.1 Lubricating grease

A stable semi-fluid to solid product that is formed by dispersing thickener in liquid lubricant.

Note: Under the action of surface tension and other physical forces, the dispersal of the thickener forms a two-phase system, and can make the

The relative centrifugal acceleration is related to the normal gravity acceleration (9.81 m/s²); it is represented by the symbol G. Calculate according to Formula (1) or Formula (2):

$$G = 1.02 \times 10^{-4} \times r \times \omega^2 \dots\dots\dots(1)$$

$$\text{Or } G = 1.12 \times 10^{-6} \times r \times n^2 \dots\dots\dots(2)$$

4 Method summary

Place the pair of centrifuge tubes which contain the lubricating grease sample into the centrifuge. The lubricating grease sample is subjected to a centrifugal force whose G value is 36000 at 50 °C ± 1 °C within a specified time. The oil separation rate of the lubricating grease is expressed by the volume fraction of oil separation during the test period.

5 Method application

This Standard is especially useful in evaluating the degree of separation of lubricating grease into liquid and solid under strong centrifugal force. In mechanical aspects such as flexible shaft coupling, universal joints and rolling element insertion bearings, lubricating grease is susceptible to increased and long-term centrifugal forces. The results that are obtained in this Standard have a good correlation with the actual application. Under the condition that it is agreed by the parties, this Standard can also be used for measurement under other conditions, but the precision is no longer applicable.

6 Instruments and apparatuses

6.1 High-speed centrifuge whose G value is up to 36000. Assemble the equipment on a horizontal surface, so that air can flow smoothly to the motor. This is crucial for the long life of the motor. It is required that the centrifuge shall include:

6.1.1 Fixed-axis rotor: there are multiple positions for placing centrifuge tubes; it can maintain a G value of 36000.

6.1.2 Thermometer: it is better to use the scaled type, which is installed near the fixed-axis rotor (5 mm ~ 15 mm) so as to be able to measure the temperature.

6.1.3 If this device does not have automatic temperature control, a hollow choke valve is required, which is installed at the air inlet of the centrifuge room to control the temperature. Some designs require a vent throttle.

6.1.4 Centrifuge tubes of transparent material: when the G value is 36000, it can withstand at least 100 h.

Note: polypropylene centrifuge tubes are considered durable.

6.2 Balance: it can weigh 100 g; its sensitivity is at least 0.1 g.

7 Sampling

7.1 The amount of lubricating grease samples that are used for analysis shall be sufficient to ensure that a representative part is selected for testing. For each time when it is centrifuged, each cubic meter of centrifuge tube needs to be filled with about 0.5 g of lubricating grease sample. Check for any inconsistencies such as oil separation, phase change or contamination. If any abnormal conditions are found, obtain a new sample.

7.2 The sample temperature is 15 °C ~ 35 °C.

8 Instrument preparation

8.1 Check the centrifuge components; pay special attention to whether the fixed-axis rotor is clean. Any deposit on the surface will affect the balance of the fixed-axis rotor.

8.2 Check the necessary number of centrifuge tubes that are used in the test; discard those centrifuge tubes which have scratches or imperfections on the surface.

9 Test steps

9.1 Two centrifuge tubes are required for each lubricating grease sample. For each test, a new centrifuge tube shall be used; care shall be taken to avoid scratches.

9.1.1 Determine the total volume V_t of the centrifuge tube by filling it with water; it is expressed in cm^3 ; then, inject it into the measuring cylinder for measurement.

9.1.2 Use a Vernier caliper to measure the inner diameter; express it in mm.

9.2 Remove the lubricating grease sample from the container; do not include the oil that is deposited on the surface of the lubricating grease sample.

9.3 Each cubic centimeter of the centrifuge tube needs to be filled with about 0.5 g of lubricating grease sample (for example, a centrifuge tube whose

11.1.3 Duration of the test, in hours (h).

11.1.4 Test temperature, in degrees centigrade (°C).

11.2 In order to simplify the test and report the oil separation rate of the lubricating grease, the centrifugal acceleration level and the test temperature shall be consistent, that is, the G value is 36000 and the test temperature is 50 °C. Therefore, the expression of lubricating grease centrifugal oil separation rate is reported in K_{36} .

$$K_{36} = \varphi/t \dots\dots\dots (6)$$

Where:

φ -- oil separation rate, in % (volume fraction), (see 10.3);

t -- cumulative test time, in hours (h) (see 9.14).

The expression K_{36} cannot be simplified; the values of φ and t shall be reported.

11.3 Use the average value of the test results of two centrifuge tubes of the same lubricating grease as the report number of oil separation rate (see 10.3).

11.4 The values of φ and t in Formula (6) are the measured values of those stable oil separations at that time. Between two consecutive readings, the increase in φ is less than 10%.

11.4.1 If the oil separation is not stable before the 24 h of cumulative test time, use the 24 h test result as the report number.

11.4.2 If the cumulative test time exceeds 24 h, except that the cumulative test time exceeds 24 h, the rest meet the requirements of 11.4, the test results can be used as the report number. See Appendix A for examples of calculation results.

12 Precision and deviation

12.1 Precision

Use the following provisions to determine the reliability of the test results (95% confidence level).

12.1.1 Repeatability (r): the difference between the results of the two oil separation rates (see 10.3) that are measured by the same operator, in the same laboratory, with the same instrument, and to the same sample, which shall not exceed 4.8%.

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