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Research on Visco-temperature Characteristics of Turbine oil

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Abstract

Dynamic viscosities of No.22 steam turbine oil under different temperature conditions were experimentally measured through Brookfield DV3T rheometer. Based on the experimental data, a new visco-temperature characteristics model was established and compared with Reynolds visco-temperature characteristics model and Vogel visco-temperature characteristics model. The results show that the new model has higher accuracy than the other two models in the given temperature range. The dynamic viscosity of No.22 steam turbine oil decreases with the increase of temperature, but the rate of declines slows down with the rising of temperature. The experimental data and the model may have practical applications in lubrication analysis.

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1. Introduction

Visco-temperature characteristics is an important index of lubrication oil. Under different temperature conditions, oil has different viscosities. As a lubricant of sliding bearing, the performance of lubricating oil plays a crucial role in the life and accuracy of bearings directly. Since the sliding bearings are used in high and super high speed cases mainly, the excessive temperature rise of bearing is a major reason to lower the accuracy of the main shaft system and limit the bearings working speed higher [1], and the viscosity of lubricating oil changes with the temperature. So the research on visco-temperature characteristics of lubricating oil plays a significant effect on promoting the performance of sliding bearing.

Many researchers have studied this aspect and made some conclusion. Wang performed some experiments and obtained the viscosities of high speed aviation lubricating oils at different temperature, and established the dynamic database on visco-temperature performance of aviation lubricating oils [2-4]. Zhu measured the visco-temperature

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characteristics and rheology behavior of heavy oil[5]. This study aims to analyze the visco-temperature characteristics of No.22 steam turbine oil which is used in the lubricating of sliding bearing widely.

Nomenclature

w	angular velocity of spindle(rad/sec)	τ	Share stress(dyne/cm ²)
R_b	the radius of container(cm)	L	Effective length of spindle(cm)
R_c	The radius of spindle(cm)	t, t_0	Temperature(°C)
x	Radius at which shear rate is being calculated (cm)	μ_0	The viscosity at temperature t_0 (P)
M	Torque input by instrument(dyne-cm)	μ	Dynamic viscosity(P)
r	Share rate(sec-1)	a, b, k, c	Constants

2. Experiment Model

2.1. Experiment apparatus

Brookfield DV3T rheometer and a series of LV spindles were used to measure the dynamic viscosities of oil under different temperature conditions, and they were purchased from Brookfield AMETEK, Inc. A water bath equipment was also purchased from the company and it provided a constant temperature system during the experiment. No.22 steam turbine oil was purchased from Wuhan Lanlian lubricating oil company. In addition, thermometer, beaker and water were also main experimental materials. The experimental apparatus is shown in the Fig. 1.

2.2. Experimental principles

The Brookfield rheometer is a kind of rotational equipment. It measures the torque required to rotate an immersed spindle in the oil. The spindle is driven the by a motor through a calibrated spring; deflection of the spring



Fig.1. Experimental apparatus

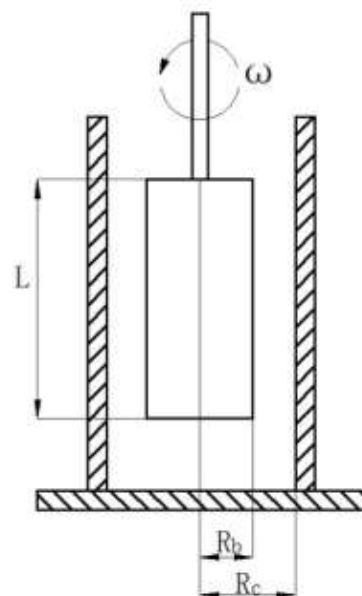


Fig.2. The geometries of spindle and container

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