On the Behavior of Slits in Hydrodynamic Thrust Bearings

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Hydraulic tribological contacts such as valve plate – cylinder block contain slits, allowing lubricant pockets to form. If pure hydrodynamic lubrication is assumed, these slits are expected to have a negative influence as the average surface pressure in the contact area increases. However, slits help to cool the tribological contact as they allow the fluid to be exchanged; this makes them crucial in highly loaded thrust bearings. In this paper different numbers as well as geometries of slits are compared. A disc on disc tribometer is used to measure friction loss under all states of lubrication by plotting Stribeck curves.
Keywords: Slit, Thrust Bearing, Hydrodynamic, Stribeck

1. Introduction

Highly loaded thrust bearings are widely used in hydraulic pumps. The contact valve plate – cylinder block acts mainly as a hydraulic thrust bearing, which also controls the switching between high and low pressure of the pump. Due to higher demands in power density, hydraulic pumps are used both, at higher rotational speed as well as at increased operating pressures. Both have a significant influence at the tribological behavior in the contact. Especially operation conditions at high pressures combined with low rotational speed cause a critical temperature rise in the contact, which cause irrevocable damage. Slits can help to lower the temperature by exchanging compressed oil in the gap.

2. Method

A ring on ring tribometer is used to measure torque under various rotational speeds and loads as well as the thermal response. The measurement method is explained in **Figure 1**.

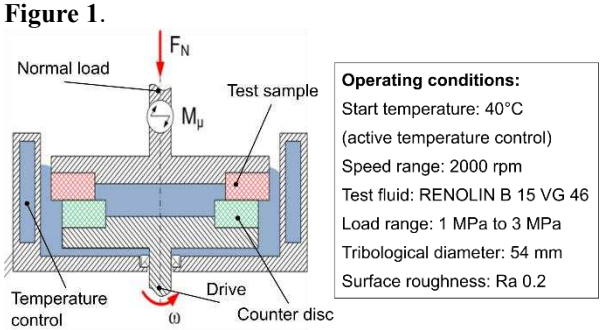

Figure 1: Schematic drawing of the test bench[1],[2]

An assorted set of test discs is shown in **Table 1**.

Table 1: Slits geometry and contact surface

No. of slits	Contact area[mm²]	Contact area[%]
0	1962.71	100
2	1794.18	91.41
4	1625.64	82.83
8	1288.64	65.66

3. Results

Temperature ranges from 40°C to 90°C have been recorded. Whereas zero and two slit discs showed a linear dependence of temperature to rotational speed, all other discs showed a non-linear behavior. Friction torque was between 0.5 and 18 Nm.

A representative result is shown in **Figure 2**.

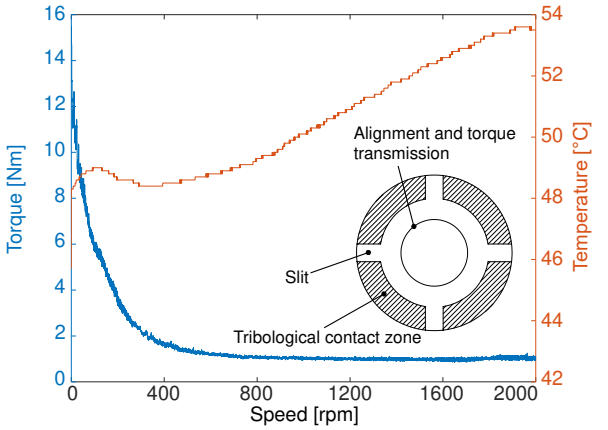

Figure 2: Results of the four slits sample at 2 MPa load

It was further found, that with higher loads and number of slits, the amount of small friction peaks increased. Those discs showed adhesive damage after the test run.

4. Discussion

In high-speed range an increased amount of slits led to a decrease of friction. In low-speed range, where less hydrodynamic pressure build up is expected, less slits are more efficient in terms of friction. The change in thermal behavior can be explained, as in all linear cases as the generated frictional energy was compared to the cooling ability of the test bench. The highest temperature was recorded at the zero slits disc. These results are comparable to bearing simulations of Li and Xie[3].

5. References

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