FRICTION AND WEAR IN A BOUNDARY CONDITIONED CONFORM CONJUNCTION LUBRICATED WITH ENVIRONMENTALLY ADAPTED OIL

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ABSTRACT

Water-turbines, where the power regulation is angling the turbine blades in journal bearings with slow intermittent motion at boundary lubricated conditions, is one application where it is risk of oil leakage into the nature. Machine breakdowns where oil leakage can cause environmental drawback is a motivation to develop environmentally adapted oils. The importance of reliability is high and a new environmentally adapted oil must not increase the risk of failure e.g. exceed wear or increase friction in an unpredicted way. Test conditions similar to the real application indicate the possibility to replace oils with new environmentally certified ones. Sensitivity of water contamination is very important to study, based on the lack of comparability to mineral oils.

Many tests show the importance of surface- and material parameters, load, type of oil and additives in boundary condition wear and running in process. Wear and friction of highly loaded line contact in boundary conditions are presented in [1] and [2]. These results are not directly comparable to journal bearing wear due to high load and small load area. Journal bearing wear parameters are presented in [3] but lack the environmentally adapted lubricant aspect.

Figure 1 shows a new test-rig principle designed for journal bearings in slow intermittent motion. The shaft is rotating and driven by a servomotor via a planetary gear, this gives many possibilities to operate the speed. Bearing halves are clamped into bearing houses that can be cooled or heated.

The hydraulic cylinder applies load that squeezes the two bearing halves against the rotating shaft and is measured by load cell 2. Load cell 1 measures the force coming from the torque and friction coefficient is calculated. The LVDT-transducer measures the relative wear using the displacement between the two bearing halves. 4 temperature gauges registers the temperature in each bearing half. All signals are computer managed.

Tests are made with babbit journal bearings, \( 40 \times 32 \text{ mm} \), against hardened steel shaft, intermittent motion \( \pm 60^\circ \) pausing 1 s between each movement and maximum speed 0,01 m/s. Different hydraulic oils are used; an environmentally adapted synthetic ester (with and without additives) compared to a conventional mineral oil. Figure 2 plots the load, temperature, friction coefficient and displacement between the bearing houses versus sliding distance. The values of friction are more constant for the synthetic ester than for the mineral oil. Sub-surface temperature and its spreading within the bearing are also more constant for the synthetic ester.

Figure 2. Example of test result, synthetic ester.

Sensitivity of water contamination will be further studied. The result indicates a promising future for the possibility of replacing oils with new more environmentally adapted.

REFERENCES

