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Heat Transfer During Hydrodynamic Lubrication in a Half-journal Bearing

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ABSTRACT
Journal bearings are widely used in industrial turbomachinery such as turbines, pumps, and compressors due to their simple design and high load-carrying capabilities. When the bearing is lubricated with oil, the hydrodynamic film formed in a micron-sized gap between the two bearing surfaces should withstand the high loads without breakdown as well as effectively carry away any heat produced during loading. In this work, we experimentally investigate the heat exchange between the solid bearing and the lubricant. A test rig has been built to study the hydrodynamic behaviour of a lubricant flowing in a half-journal bearing under controlled conditions of a steady applied load, rotational speed, and feed flow rate, allowing comparison between experimental data and computational modelling as performed by Layton et al [1]. The experimental rig, shown in Fig. 1, can measure the thickness profile of the film through ultrasonic sensors mounted on to the inner surface of the sleeve. The bearing is anticipated to be operated under loads ranging between 2 kN and 30 kN, with rotational speeds ranging from 500 rpm to 2000 rpm. Temperatures are recorded along the bush and the shaft. The lubricant inlet and outlet temperatures are also measured which provides valuable boundary information for future model development and validation. The data generated from this testing quantifies heat removal by the lubricant under various applied loads on the bearing. Preliminary temperature and pressure data is shown in Fig. 2 for applied loads between 5 kN and 30 kN. At each measurement position, both temperature and pressure can be seen to increase at greater loads. Further analysis of the data allows mapping of regions of high and low heat transfer of the lubricant.

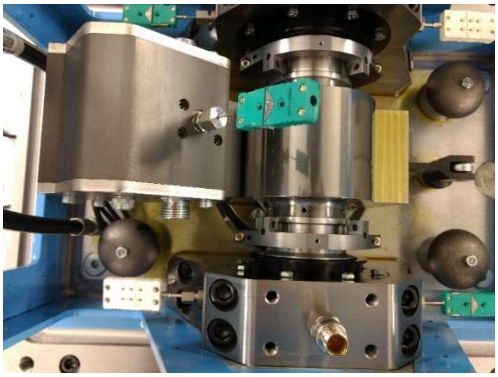

Fig.1 Experimental test rig

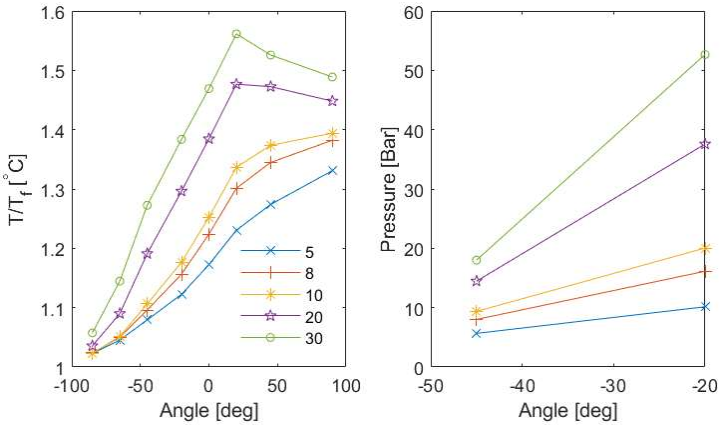

Fig.2 Effect of applied load on temperature and pressure while operating at 2000 rpm.

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