ASSESSMENT OF PLAIN BEARING PERFORMANCE IN A HYDRAULIC PUMP USING HYDRODYNAMIC ANALYSIS

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ABSTRACT

Plain journal bearings are widely used in hydraulic gear pumps. In some engineering machinery applications, this type of pump has to deliver hydraulic fluid at high pressure, which results in very high specific loads on the bearings. The performance of these journal bearings plays an important role in the operation of such pumps. The bearings are used to reduce friction in the pump and also to help maintain the volumetric efficiency. The behaviour of the bearings has a significant influence upon the satisfactory operation and life of the pump. However, there is generally a lack of understanding of the behaviour of plain bearings in this application.

In this paper, the authors present a theoretical investigation of the hydrodynamic lubrication of the bearings in a high performance gear pump. This pump delivered fluid at a discharge pressure of up to 30 MPa. Figure 1 gives the diagrams of the loads exerted on the bearings for the driven and driving gear shafts during one loading cycle. The driven shaft bearing is subject to more severe working load. A sensitivity study of the bearing performance was carried out, which took into account effects of the pump speed, bearing clearance and lubricant temperature.

Because of the higher working load, the driven shaft bearing is shown to have thinner minimum oil film thickness at all conditions. Nevertheless, an increase in the pump rotating speed helps to improve the minimum oil film thickness of bearings of both shafts.

It was shown that the critical region of the bush is located towards the inlet port side of the gear pump bearings. During a loading cycle, the journal centre position is almost constant. As the pump speed increases, the locations of the higher pressures and thin oil film regions tend to move slightly in the direction of rotation, as shown in Figure 2. In contrast, an increase in the oil temperature moves the critical regions in the direction opposite to the journal rotation.

Figure 1. Load Diagrams of gear pump bearings with a discharge pressure of 30 MPa.

Figure 2. Effects of the pump rotating speed on the Performance of the journal bearing