Combined Numerical and Experimental Investigation of Surface Textured Journal Bearings

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1. INTRODUCTION

In recent times reducing lubricant viscosity has been advocated in order to mitigate viscous frictional losses in engines. This trend has run contrary to the progressively increasing engine operating temperatures and conjunctional loading such as with turbo-charging. These operating conditions often result in the conventional journal bearing design being inadequate for the intended purpose. The implementation of textured features to the journal bearing surface provides the opportunity for improved in bearing performance in terms of load carrying capacity as well as reduced frictional power loss. The paper presents a combined numerical and experimental approach in the study of role of surface texturing in bearing performance.

2. METHDOLOGY

The experimental test rig comprises a journal bearing of 98 mm diameter from a production 12-speed transmission (Figure 1). The oil is supplied through an oil feed hole located within the bushing at a controlled flow rate and pressure. The bushing is instrumented with a PZT transducer of 5 MHz (Ultrasound) centre frequency and a thermocouple for measurement of lubricant film thickness and bushing surface temperature respectively.

A transient multi-phase solution of Naiver-Stokes equations with conservation of mass and momenta for each phase is presented. Bearing geometry comprising of the feed hole on the bushing and its circumferential oil groove is created using the ANSYS design modeller. The geometry is spatially discretised using a mesh comprising of hexahedral elements. A sliding mesh is incorporated into the model in order inclusion of texture features. The effect of these on the bearing's pressure distribution and load carrying capacity are obtained, including the effect of induced pressure perturbations.

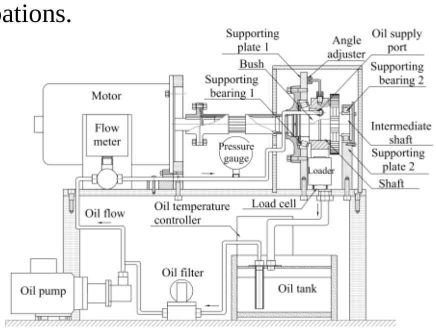

Figure 1: Experimental test rig

3. RESULTS

The predicted generated pressure distribution in figure 2 conforms closely to the experimental test rig results. The CFD model provides prediction of pressure distribution, flow field and frictional losses. The numerical results highlight the underlying lubrication mechanism with textured surfaces improving the journal's tribological performance. The results also show that texture pattern, geometry and distribution also affect the bearing's performance.

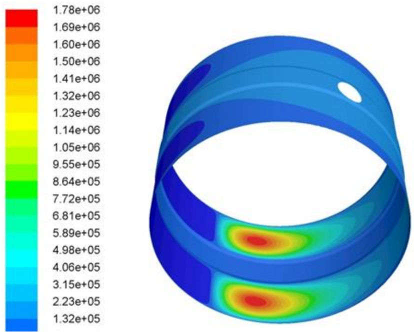

Figure 2: Pressure distribution (Pa) on bushing surface