The Influence of Injection Pockets on the Performance of Tilting-Pad Thrust Bearings - Part II: Comparison Between Theory and Experiment

This is Part II of a two-part series of papers describing the effects of high-pressure injection pockets on the operating conditions of tilting-pad thrust bearings. The paper has two main objectives. One is an experimental investigation of the influence of an oil injection pocket on the pressure distribution and oil film thickness. Two situations are analyzed: (i) when the high-pressure oil injection is turned off and (ii) when the high-pressure injection is turned on. The other objective is to validate a numerical model with respect to its ability to predict the influence of such a pocket (with and without oil injection) on the pressure distribution and oil film thickness. Measurements of the distribution of pressure and oil film thickness are presented for tilting-pad thrust bearing pads of approx. 100 cm² surface area. Two pads are measured in a laboratory test rig at loads of approx. 1.5 MPa and approx. 4.0 MPa and velocities of up to 33 m/s. One pad has a plain surface. The other pad has a conical injection pocket at the pivot point and a leading-edge taper. The measurements are compared to theoretical values obtained using a three-dimensional thermoelastohydrodynamic (TEHD) numerical model. At the low load, the theoretical pressure distribution corresponds well with the measured values for both pads, although the influence of the pocket is slightly underestimated. At the high load, large discrepancies exist for the pad with an injection pocket. It is argued that the discrepancies are due mainly to geometric inaccuracies of the collar surface, although they may to some extent be due to the simplifications employed in a Reynolds equation description of the pocket flow. The measured and theoretical values of oil film thickness compare well at low loads and velocities. At high loads and velocities, discrepancies grow to up to 25%. This is due to the accuracy of the measurements. When using hydrostatic jacking the model predicts the start-up behavior well.