UNIVERSITI TEKNOLOGI MARA

OIL FILM BEHAVIOUR IN HYDRODYNAMIC LUBRICATION OF JOURNAL BEARING

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Faculty of Mechanical Engineering

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This thesis presents an integrated investigation of various aspects of hydrodynamic lubrication in a journal bearing. Hydrodynamic journal bearings are critical power transmission components used to carry high loads in different machines applications. In machine design, it is essential to know the true or expected operating conditions of the bearings. These operating conditions can be explored in laboratory using a specific test rig. In the present study, the hydrodynamics lubrication behaviour in a journal bearing has been investigated. The work described is based on the direct measurement of temperature, pressure, frictional force and ultrasonic reflection coefficients from a fluid interface using longitudinal and shear transducers. Measurement of temperature profile in hydrodynamic lubrication journal bearing has been investigated for different conditions later compared to predicted values from effective temperatures. In this study effective temperatures were calculated by two different methods using (1) Raimondi and Boyd charts and (2) inlet and outlet temperature values. From the results obtained, it was found that speed, load, oil inlet supply pressure and oil groove locations have affected the temperature profiles to some extent. In other investigation, measurements of pressure profiles in hydrodynamic lubrication in journal bearing were plotted. Predicted maximum pressure from Raimondi and Boyd charts were obtained for comparison purposes. Theoretical pressure profiles by short-bearing and long-bearing approximations were computed. It was found that the experimental maximum pressure is higher compared to the predicted value. In another investigation, an ultrasonic method was deployed to map thickness profile around the journal bearing. A purpose built transducer using a longitudinal wave was used to obtain the reflection coefficient from the lubricant layer. The thickness profile obtained in converging section agrees well with classical hydrodynamic predictions. In the diverging section, transformation from reflection coefficient values to oil film thickness is no longer valid due to the presence of a second phase, air. This caused the reflection coefficient values tend to 1. In measurement of viscosity around bearing circumferential, a shear wave was deployed to obtained reflection coefficient from the lubricant layer. A different plug was used for the purpose built transducer. Viscosity values were calculated using Spring Model for thin layer and Bulk Model in thick layer. It was observed that viscosity in operating journal bearing differ from the values obtained by effective temperatures.

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