OPTIMIZATION PERFORMANCE OF PLAIN JOURNAL BEARINGS WITH PARTIAL WALL SLIP ZONE

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Hydrodynamic Lubrication; Modelling in tribology; Coating; Wall Slip

ABSTRACT
Coatings have been widely used in bearings nowadays due to its helpfulness to improve the tribological performance, prolonging the serving life. For heavily loaded hydrodynamic journal bearings under high speed, wall slip is easier to occur at solid-fluid interfaces for some hydrophobic coatings of lubricants. It will decrease the bearing load carry capacity for the full slip configuration on the bushing, but an appropriate partial slip zone could improve the performance of the bearing [1]. In this work, in order to optimize the partial slip zone for heavily loaded bearing conditions, an isothermal hydrodynamic model considering wall slip occurring at oil-bushing interface is built. Two-Component Slip Model is used to calculate slip velocity. The optimal slip parameters are chosen by considering the effects on the hydrodynamic behavior, such as hydrodynamic pressure, load bearing capacity, flow rate, friction/friction torque.

MODEL AND RESULTS
In order to shape the slip zone, we define three coefficients of $\alpha=B_s/B_1$, $\lambda=L_1/L_{s1}$, and $\gamma=L_{s1}/L$ as shown in Fig.1. Note that B_1 is the length from attitude angle φ to the minimum film thickness position. Dimensionless pressure is $P=p/(\mu\omega/\psi^2)$. μ is fluid viscosity, ω is shaft velocity, $\psi=C/R$. Usually, in order to improve the bearing performance, α is less than 1. The present model is validated by the data in Ref.[2]. Fig.2 shows the effects of coefficient α on the hydrodynamic behavior with the constant parameters of eccentricity ratio ε=0.5, length to diameter ratio L/D=0.8, λ=0.5 (β=3.64°), γ=0.8. The pressure distribution is obviously affected by the relative slip zone length. Fig.3 shows for α=0.85, the partial slip zone can best improve the load bearing capacity with a gain of about 6%. For this configuration, the friction coefficient can be reduced by 7%.

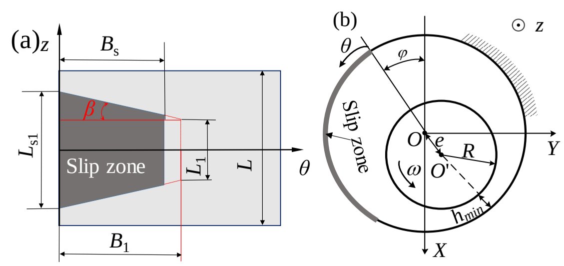

Fig.1 The slip zone at fluid-bush interface

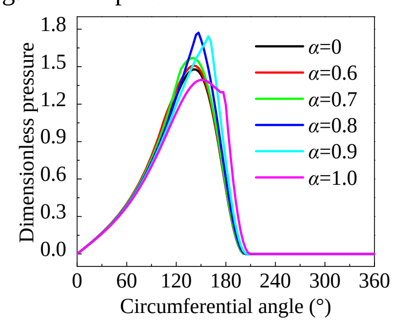

Fig.2 Mid-plane dimensionless hydrodynamic pressure

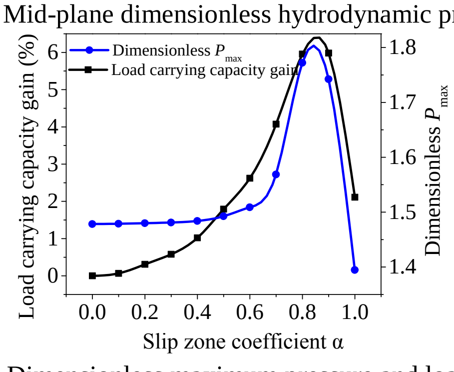

Fig.3 Dimensionless maximum pressure and load gain versus the relative slip zone length

CONCLUSIONS AND PERSPECTIVES
Furthermore, the effect of slip zone is largely influenced by working conditions of journal bearings. We will further analyze and discuss the influence of partial slip zone characteristics with bearing operating conditions. The optimal results would provide a good introduction for future experimental study.

REFERENCES
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[2] Lv, F, and Rao Z. et al, Tribo Int.,109,2017, 390-397.