THE EFFECT OF MICRO-EHL AT ASPERITY SCALE ON THE SIMULATED STRIBECK CURVE OF CONFORMAL CONTACT MIXED LUBRICATION

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Mixed Lubrication; EHL; Modelling in tribology; Conformal contact

ABSTRACT

The experimental work of the conformal contacts such as plain bearings have proved that the flat-on-flat surface can form a hydrodynamic effect under lubricated condition. Various numerical models have been developed and tried to explain the mechanism of such hydrodynamic effect. Stochastic models take the average of roughness on the lubricated tribo-pairs. The output of stochastic models are average pressure distribution, film thickness distribution, and average fluid flow of the lubricated gap, which are quite difficult to be verified by experiments. In contrast, the deterministic models can predict parameters which are easily to be measured such as the coefficient of friction (COF).

In the previous deterministic models developed for conformal contacts, the fluid regime and asperity contact regime were calculated separately [1]. The coupled effect of fluid and asperities was ignored. This effect also can be defined as micro-EHL at asperity scale. In this paper, the effect of micro-EHL at asperity scale is included in the modelling of conformal contact mixed lubrication. Published Stribeck curve results about thrust bearings with plain surfaces [2] are used to verify the proposed model. The results obtained based on previous model are also compared with the experimental results and the simulated results by the proposed model considering the micro-EHL effect at asperity scale.

Fig.1 shows the simulated Stribeck curves with and without the effect of micro-EHL at asperity scale and the experimental results reported in Reference [2]. Fig.1 also shows the percentage of contact load in the applied load. The plots clearly illustrate that only the simulated Stribeck curve with the effect of micro-EHL at asperity scale matches very well with the experimental results. And the corresponding contact load ratio significantly decreases with the increase of speed. Without the effect of micro-EHL at asperity scale, the deterministic models can't correctly predict the Stribeck curve, and the corresponding contact load ratio decreases slowly compared with the results obtained with the effect of micro-EHL at asperity scale.

In this paper, the effect of micro-EHL at asperity scale on the simulated Stribeck curve of conformal contact mixed lubrication was addressed. The results proved the significant role of the micro-EHL at asperity scale in the mechanism of forming load capacity under conformal contact mixed lubrication.

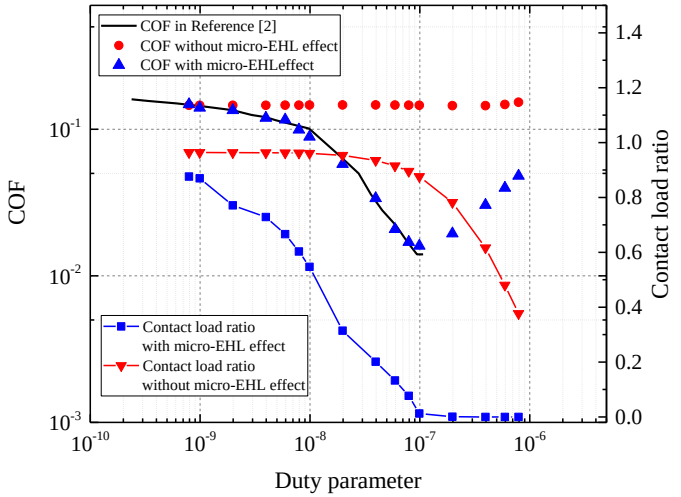

Fig.1 Comparison of simulated and experimental Stribeck curve and contact load ratio results with and without the micro-EHL effect at asperity scale

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REFERENCES

[1] Minet, C., Brunetiere, N., and Tournerie, B., ASME. J. Tribology, 2011, 133(0422034), 2011.

[2] Lebeck, A.O., ASME. J. Tribology, 109, 1, 1987, 189-195.