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Development of EHD Analysis considering Running-in process for Engine Bearings

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EHD analysis has been utilized in the development of engine bearings, taking into account elastic deformation of the structure and solid contact. However, running-in process has not sufficiently considered irrespective of the importance for performance prediction. Greenwood-Tripp elastic contact model is used EHD analysis. In this model, solid contact is determined when the reference oil film thickness H_S, defined by the standard deviation of the summit roughness and the mean summit height, is H_S<4. Previous studies presented a wear progression model in which the contact threshold is constant. In such a model, the contact threshold of asperity is not updated with the wear progression, and there is a concern that the wear progression may continue.

In order to solve such issues, the model in which the surface profiles are updated with running-in process was considered. Figure 1 shows the flowchart of EHD calculatation with running-in process. First, the contact pressure distribution is obtained by inputting the initial roughness. The contact pressure is substituted into Archared's equation to calculate the truncation level. This truncation level is input to the modified sigmoid function shown in Fig. 1 to obtain the roughness parameters after running-in then roughness parameters is updated.

The function is a fitting curve based on result of bearing wear test. Figure 2 shows the relationship between the truncation level and the mean summit height δ_S. Trend of δ_S for each experimental conditions shows to be distributed as an S-shape. This finding indicates that the surface roughness changes can be represented by a functional equation with truncation level as an independent variable. A modified sigmoid function from typical S-shaped function was used as a fitting curve.

Figure 3 shows results of the truncation level calculated by the proposed model. The truncation level trends calculated by the proposed model shows a saturating trend with time in contrast to conventional calculations. The calculation results were in good agreement with the experimental results.

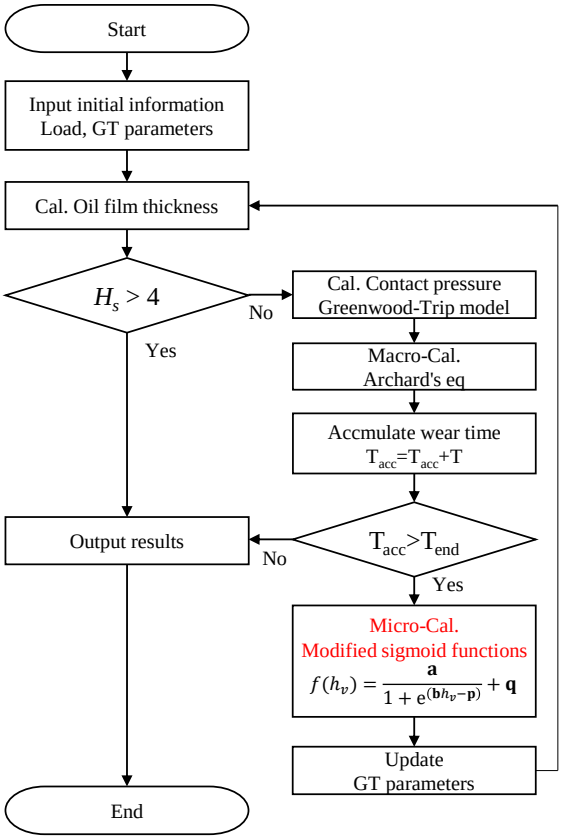

Fig.1 flowchart of EHD calculatation with running-in process

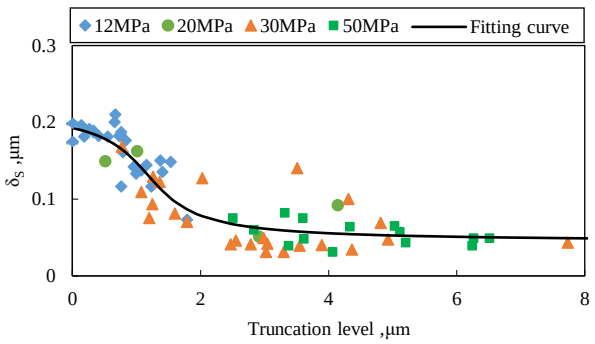

Fig. 2 Results of wear test and fitteing by sigmoid function

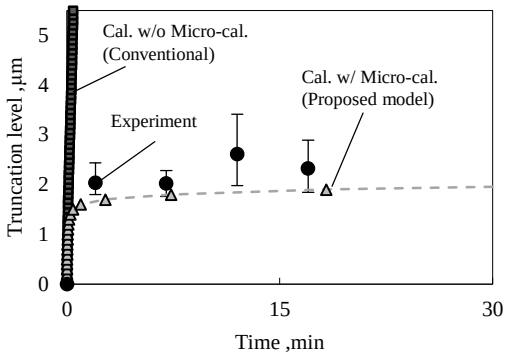

Fig. 3 Calculation and experiment of truncation level