

A Study on Seizure Prediction of Engine Plain Bearings Using EHL Analysis

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Journal bearings are widely used in various machines, including automotive engines. However, seizure still occurs in practical applications, and clarification of the mechanisms leading to seizure remains an important issue for improving reliability. Conventionally, seizure in experiments has been identified by a rapid increase in bearing temperature or friction torque, while numerical evaluations have often employed threshold values of PV factor or film thickness ratio (λ). Recent advances in Elasto-Hydrodynamic Lubrication (EHL) analysis have enabled the evaluation of seizure-related phenomena based on a wider range of physical quantities. Previous studies by the authors' research group have identified several events that may trigger seizure. One such study directly observed the oil supply line during seizure tests and captured the reverse flow of bubbles from the sliding interface immediately before seizure occurred. In the present study, this phenomenon was reproduced using EHL analyses.

The calculations were performed using AVL EXCITE R2024.1. The bearing temperatures measured during the seizure tests were applied as thermal boundary conditions for the oil film temperature calculation. Temperature-dependent Young's modulus and lubricant viscosity were used according to the local calculated temperature, and the pressure-viscosity effect of the lubricant was considered.

Under high-speed conditions, positive pressure was maintained at the oil feed port under non-seizure conditions, whereas negative pressure below atmospheric pressure occurred under seizure conditions. As shown in Fig. 1, the axial volume flow was directed from the oil feed port toward the bearing edges under non-seizure conditions but reversed toward the oil feed port under seizure conditions. The results suggest that the gas-liquid interface at the bearing edge can be drawn toward the oil feed port by the negative pressure. Such intrusion may cause starved lubrication by reducing the supply of liquid lubricant to the sliding interface, thereby decreasing load-carrying capacity and leading to seizure.

The results suggest that starvation caused by gas-liquid interface intrusion may be one of the mechanisms leading to seizure.

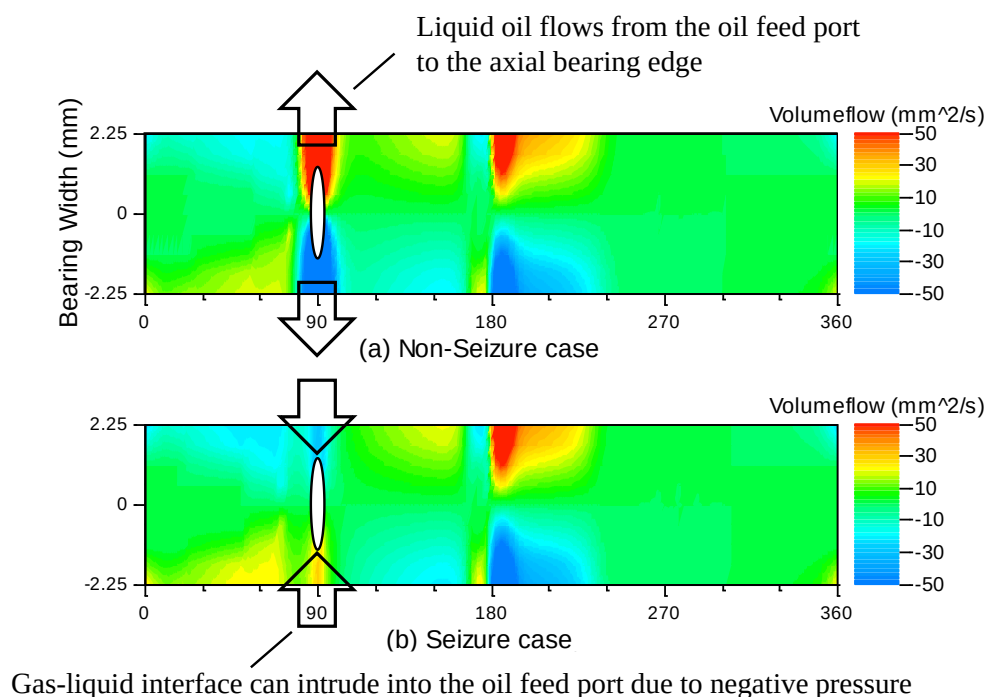


Fig.1 Axial volume flow under high-speed conditions