A COMPARATIVE NEWTONIAN AND THERMAL EHL ANALYSIS USING PHYSICAL LUBRICANT PROPERTIES

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INTRODUCTION
Thermal Newtonian solutions of the EHL line contact problem are proposed using the properties of lubricants recently measured by Larsson, et al. [1]. Based on this new set of data, the objectives of this study is to examine in detail the influence of the changes in specific heat and thermal conductivity of the lubricant within the contact.

LUBRICANT PROPERTY
Each physical property; namely, density \( \rho \), viscosity \( \eta \), specific heat \( c_p \) at constant pressure, thermal conductivity \( \lambda \) and thermal expansivity \( \beta \) is expressed independently as a function of temperature and pressure. In this report the lubricants are assumed to be Newtonian fluids of mineral oils, polyalphaolefins and polyglycols.

NUMERICAL ANALYSIS
To account for the variations of temperature and physical properties across the film, the complete two-dimensional energy equation was considered [2]. The overall numerical strategy was integrated into a multigrid algorithm to accelerate the convergence of the solutions.

RESULTS AND DISCUSSION
Figure 1 illustrates the temperature distributions for the complete (all physical properties are expressed as a function of temperature \( t \) and pressure \( p \)), simplified \([\rho(p) \text{ and } \eta(t, p)]\) and \(<\lambda>\) \([\rho(p), \eta(t, p) \text{ and } \lambda(p)]\) models. The temperature difference between the mid-film and wall-surface temperature calculated with the 'complete' and \(<\lambda>\) models is smaller than the difference with the 'simplified' model. Large values of thermal conductivity enhance the diffusion of heat generated in the conjunction through the solid walls. The reduction in the temperature difference observed is, therefore, caused by an increase in the thermal conductivity due to high pressure.

Figure 2 indicates the influence of the surface mean velocity \( u_m \) on the temperature at centre of Hertzian contact. As \( u_m \) increases, the large viscous dissipation yields and the differences in the \( T_c \) solutions become more noticeable. In addition, the marked differences at both the mid-film and surface temperature increase.

CONCLUSIONS
The results reveal that temperature is significantly affected by the changes in heat conductivity in the high-pressure region of the contact. By contrast, the variations in specific heat with temperature and pressure are small and have less impact on the lubricated conditions of the contact and thus can be neglected.

REFERENCES