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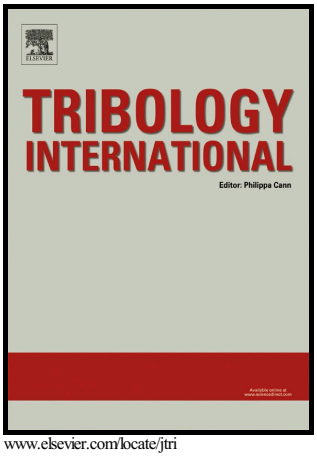

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Thermohydrodynamics of lubricant flow with carbon nanoparticles in tribological contacts

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Abstract

This paper deals with the tribological performance of carbon nanoparticles dispersed in polyalphaolefin PAO6 oil. Stribeck curves are obtained under various operating conditions, using a fully instrumented pin-on-disc tribometer under controlled conditions. A detailed multi-physics thermal fluid flow model with Lagrangian low concentration discrete solid phase and Eulerian multi-phase fluid with cavitation represented by modified Rayleigh-Plesset and vapour transport equation is presented. The numerical predictions under identical conditions to the experiments show good conformance with the measurements, and provide a fundamental understanding of the role of nanoparticles. Results show improved heat transfer from the contact with the presence of nanoparticles even at low levels of concentration. The analysis shows that this leads to higher lubricant viscosity, load carrying capacity and reduced friction. Furthermore, a resulting small region of cavitation at low volume fraction does not unduly affect the enhanced heat transfer of nanoparticles. This combined experimentation and detailed numerical analysis has not hitherto been reported in literature.

Keywords: Multiphase flow; Lagrangian model; Cavitation; Nanolubricant (Nanofluid); Sliding contact; Friction; Heat transfer

Nomenclature

A	Apparent contact area
C_c	Cunningham slip correction factor
d_p	Diameter of nanoparticles