NON-NEWTONIAN AND THERMAL ELASTOHYDRODYNAMIC ANALYSIS OF THE TRACTION FLUID SANTROTAC 30

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ABSTRACT

A thermal and non-Newtonian fluid model under elastohydrodynamic lubrication conditions is proposed, integrating some particularities, such as the separation between hydrodynamic and dissipative phenomena inside the contact. The concept of apparent viscosity is used to introduce the non-Newtonian behaviour of the lubricant and the thermal behaviour of the contact into the Reynolds equation, acting as a link element between the hydrodynamic and dissipative components of the EHD film, independently of the rheological and thermal models considered. The Newton-Raphson technique is used to obtain the lubricant film geometry and the pressure distribution inside the EHD contact. The shear stresses developed in the fluid film are evaluated assuming the non-linear Maxwell rheological model. The surfaces and lubricant temperature distributions are determined using the simplified Houpert's method, applied to the inlet contact zone, and the thermal method proposed by Tevaarwerk is applied in the high pressure contact zone. The model is applied to the analysis of experimental traction curves of a traction fluid measured in a twin-disc machine, obtained for significant ranges of the operating conditions (maximum Hertzian pressure, inlet oil temperature, rolling speed and slide-to-roll ratio). The comparison between model and experimental traction curves showed a very good correlation.