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A novel model for predicting thermoelastohydrodynamic lubrication characteristics of slipper pair in axial piston pump

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Abstract

A novel thermoelastohydrodynamic (TEHD) lubrication model has been developed for slipper pair in axial piston pump. The model considers the interaction between elastohydrodynamic behavior and viscosity temperature effect. Deformation of the slipper is discussed as well as the distribution of oil film thickness, pressure and temperature. Effects of working conditions and slipper structure parameters on TEHD lubrication performance, such as film thickness, pressure, temperature, and leakage flow rate are investigated. The predicted temperature and film thickness show good agreement with measurements, while the pressure shows a reasonable distribution comparing with previous studies. The influence of load pressure and shaft rotational speed on the TEHD lubrication characteristics are illustrated which shows the elastohydrodynamic pressure should be balanced against the oil film temperature and pressure in optimized design of slipper structure parameters. Finally, the structure parameters of slipper, such as the slipper radius ratio and orifice length-diameter ratio, were optimized to improve the TEHD lubrication performance of slipper pair.

Keywords:

Axial piston pump, Slipper pair, Oil film, thermoelastohydrodynamic lubrication

1. Introduction

Axial piston pump is an important component in a hydraulic transmission system for high efficiency, power density, and structure compactness. Previously, a number of studies on fluid lubrication and noise reduction of axial piston pump considering multiple impact factors such as operating conditions, geometric parameters, and matching materials [1-2]. Nowadays, there are