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Friction and wear mechanisms of castor oil with addition of hexagonal boron nitride nanoparticles

Yongnan Wang[1], Zhenping Wan[1]*, Longsheng Lu[1], Zhihui Zhang[2], Yong Tang[1]

[1]School of Mechanical and Automotive Engineering, South China University of Technology, Guangzhou 510640, China

[2]Key Laboratory of Bionic Engineering, Ministry of Education, Jilin University, Changchun 130022, China

*Corresponding author：zhpwan@scut.edu.cn

Abstract: The friction properties of castor oil with the addition of hBN nanoparticles (nanofluid for short) and its wear resistance enhancement mechanism are investigated regarding the oil film thickness and lubrication regime resulting from changes in the viscosity of the nanofluid. The nanofluid with 5 wt% hBN additive leads to a 21.74% increase in the friction coefficient but a 55.05% improvement in the wear quantity at low load and high speed because of higher viscosity and larger oil film thickness. At a high load and low speed, the friction regimes turn into boundary lubrication owing to lower viscosity; a 30.2% decrease in the friction coefficient and a 51.74% improvement in the wear quantity for nanofluid with 1 wt% hBN additive are achieved.

Keywords: friction and wear; nano-hBN; viscosity; castor oil

1 Introduction

With the growing awareness of environment protection, environmentally friendly and biodegradable lubricants have drawn increasingly more attention. Castor oil, a product of solar energy and a recycled material, has many advantages over mineral oil, including lower volatility, better inherent lubricity, higher viscosity index, and better fire resistance. Hence, castor oil has attracted considerable interest for use as a base oil in biodegradable lubricants [1]. In addition, castor oil has been used as a base stock for environmentally friendly lubricants in grinding [2], high-speed