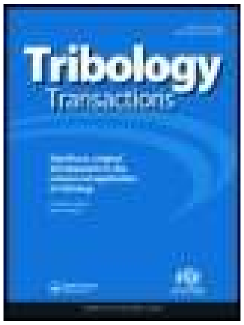

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Effect of addition of tertiary-butyl-hydroquinone into palm oil to reduce wear and friction using four-ball tribotester

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Abstract

Replacing mineral oil with vegetable oils as lubricants continues to attract interest, due to their environmentally-friendly characteristics and ease of disposal. However, one disadvantage can be low thermal-oxidative stability. The purpose of our research is to investigate ways in which oxidation can be contained by combining palm oil with a phenolic antioxidant. A homogeneous mix of palm oil and tertiary-butyl-hydroquinone was found to exhibit satisfactory antioxidant properties and reduce wear and friction. Superior mineral engine oil was used to benchmark the performance.

Keywords: palm oil, tertiary-butyl-hydroquinone, anti-oxidants, lubricant, tribology

1. Introduction

The potential use of palm oil as a universal lubricant has been studied for many years [1-6]. However, identifying the optimum characteristics to make it a viable substitute for mineral oil, continue to be explored. Although mineral oil has molecular properties that enable it to be widely used as a lubricant, palm oil has some advantages due to the growing demand for more eco-friendly products [7-9].

A bio-lubricant, such as palm oil, would be an acceptable alternative for various applications, particularly if oxidisation and constraints caused by the impact of temperature on the pour point and viscosity can be controlled [10-12]. To develop an improved molecular structure and increase the potential for industrial uses of palm oil, combining it with antioxidant components has proved promising [13,15].

The purpose of controlling oxidation is to retain the effectiveness of the boundary lubricant film that results from the fatty acid molecules. The ratio of palm oil to antioxidant can potentially have an impact on its performance as a lubricant [2,9,15,16]. The ratio of 450 ppm was selected to give a sufficient COF and wear scar diameter (probably smaller than the other). A range of improvements in performance with the addition of an antioxidant have been documented for butylated hydroxytoluene, tertiary-butyl hydroquinone, and ascorbyl palmitate [17,18]. Inclusion in a palm oil lubricant will affect the reaction of double bond unsaturated molecules with active oxygen molecules [19,20].

Although palm oil contains tocopherols which are bio-antioxidants, it is still susceptible to attack by oxygen molecules. Comprehensive research has already identified the effectiveness