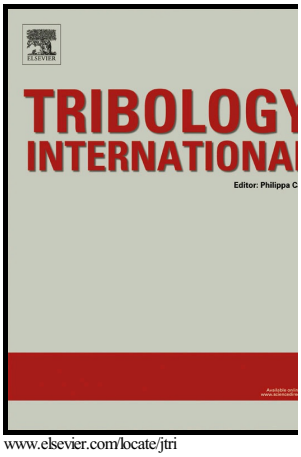

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On the friction behaviour of polymer greases

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Abstract

Non-additized batches of lubricating greases were tribologically characterized through traction coefficient and Stribeck curves at different operating conditions on a ball-on-disc test rig, ensuring that the contact was fully flooded. The tests were performed at constant load, but different operating temperatures while varying the slide-to roll ratio (SRR) or the rolling entrainment speed.

The results were correlated to the greases' formulation in terms of base oil viscosity, thickener and/or elastomer content. A relationship between the coefficient of friction (COF) of greases formulated with different thickener content was found and the thickener influence on the COF was addressed.

Keywords:
polymer greases, formulation, coefficient of friction, traction curves, stribeck curves

1. Introduction

The traction behaviour of lubricating oils is well documented [1, 2, 3, 4]. However, even for oil lubrication, two different approaches to predict the oil traction behaviour have been extensively discussed and no consensus was found yet [5, 6, 7]. One of the approaches defines the traction parameters by adjusting them in order to obtain the best numerical fitting with traction measurements [8, 9], while the other focuses on laboratory data and high pressure rheology measurements [10, 11, 12]. The end results are often very different.

The traction behaviour of lubricating greases is not yet well established, mostly because the properties of the active lubricant inside the contact are still unknown and therefore, it is still hard to predict the lubrication regime. More recently, with the investigation of the film thickness formation in fully flooded grease lubricated single-contacts [13, 14, 15], the thickener role and its influence on the film formation at low to moderate rolling speeds allowed for the better understanding of grease lubrication phases. However, there is still little published research related to friction generation on grease lubrication. It is frequent to describe the grease behaviour based on the properties of the base oil not only for predicting the COF but also for the film thickness, even though such assumptions often lead to wrong predictions [16, 17, 18, 19, 20], since the active lubricant properties at the inlet are unknown.

This work aims to investigate the COF of different formulated polymer greases under fully flooded conditions, while comparing their behaviour to a typical multi-purpose lithium thickened grease. These polymer greases are quite recent and their characterization and tribological behaviour are still poorly investigated. However, there are already a few works which describe these greases' rheological behaviour regarding formulation, thermal behaviour and base oil interaction [21, 22, 23, 24, 25].

In this work, tribological data of polypropylene-based greases is presented, analysing the influence of SRR, temperature, entrainment speed and grease formulation on the measured friction curves.

2. Materials and Methods

2.1. Tested Greases

Five greases were selected: M1, M2, M3, M5 and MLi. The greases' main properties specified by the manufacturer (Axel Christiernsson) are shown in Table 1. For more information regarding the methods used to characterize the tested greases, please refer to [26].

Experimental batches of polymer thickened greases were manufactured and processed so they should reflect the differences in their composition. In short: the samples have been melted and quenched in 1 kg batches using the same settings for each batch. The milling has been done in a colloidal mill where each grease has passed through the mill exactly the same number of times with decreasing gap size. The process was kept as uniform as possible.

All these greases were formulated with a base oil of the same nature: poly-alpha-olefin (PAO) with exception of grease MLi which was formulated with a mixture of two different grades of PAO and some ester (5% v/v) to

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