Accepted Manuscript

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PII: S0301-679X(17)30316-X

DOI: 10.1016/j.triboint.2017.06.028

Reference: JTRI 4788

To appear in: *Tribology International*

Received Date: 12 April 2017

Revised Date: 7 June 2017

Accepted Date: 19 June 2017

Please cite this article as: Hammami M, Martins R, Abbes MS, Haddar M, Seabra J, Axle gear oils: Friction behaviour under mixed and boundary lubrication regimes, *Tribology International* (2017), doi: 10.1016/j.triboint.2017.06.028.

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Axle Gear Oils: Friction Behaviour Under Mixed And Boundary Lubrication Regimes

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Abstract

The chemical composition of the axle lubricants and the tribological characteristics of the tribofilms are probed using measurement of friction, wear and film characteristics. Additives blended in the lubricants justified the frictional behaviour under mixed lubrication regime while surface texture and the tribofilm properties have substantiated the friction behaviour of the lubricant under boundary lubrication condition for high-lubricant temperature. This work will provide a comprehensive overview of two lubrication aspects and their effects on the lubricants friction behaviour through experimental tests using an EHD2 ball-on-disc apparatus.

The effectiveness in friction reduction is shown depend on the ratio between what are defined as high- and low-friction species in the tribofilm.

Keywords: Mixed lubrication, Boundary lubrication, Additives, Tribofilms, Friction behaviour

1. Introduction

During the last 50 years, the automotive industry developed a very significant effort to constantly monitor and improve lubricants and reduce friction losses in engines and transmissions.

Starting in the 1980s, synthetic lubricants have played a crucial role in power train lubrication, specifically in the heavy-duty over-the-road segment. Ongoing changes in the passenger car and light-duty truck gear oil requirements are presenting new opportunities for synthetics for these applications also. Worldwide, synthetic gear lubricants are being recognized as useful components in the area of low maintenance and long durability in transmissions and axles [1].

For the automotive industry, improving efficiency of all vehicle components is a major challenge today. Although transmission systems show a high global efficiency, as in the case of axle transmissions efficiency, which is typically between 90% and 95%, depending on the type of vehicle and on the applied torque and speed, it is still possible to reduce energy losses by improving the lubricant formulation [2, 3].

The lubricant is directly related to churning losses, friction losses and traction losses. All OEM's struggle to recover each gram lost in the drive-line system and lubricants play a significant role in these losses. Therefore, new lubricant developments usually integrate an objective of fuel economy improvement [4].

Along with the strong drive towards better fuel economy, consumers have been demanding higher performance, requiring automotive lubricants with improved durability protection and lower operating temperature [5].

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