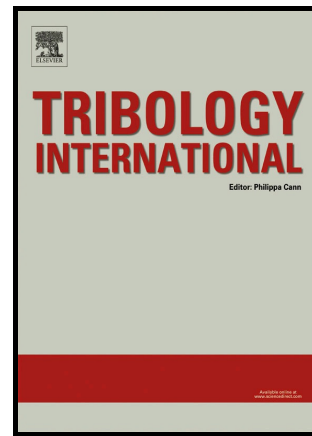


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Axle Gear Oils: Tribological Characterization Under Full Film Lubrication

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Abstract

The tribological properties of five axle gear oils are characterized. Three oils (75W90-A, 80W90-A and 75W140-A), available on the market and labelled as “Fuel Efficient”, were selected together with two candidate products (75W85-B and 75W90-B). Their viscosity, film generation and traction properties were measured for three different temperatures under full film lubrication regime.

The product formulation and the measured properties promote significant differences under full film lubrication. The film thickness is directly related with the Lubricant Parameter while the traction coefficient depends on the base oil and it decreases with the increase of Viscosity Index and the decrease of Piezoviscosity. So, new lubricants with lower viscosity but holding high VI and low Piezoviscosity are promising for this application.

Keywords: axle oils; tribological properties; film thickness; friction coefficient

1. Introduction

Fuel economy and emissions reduction are under the focus of governments, OEMs, and consumers, all demanding improvements. The Corporate Average Fuel Economy standards or the EU legislation, impose a limit of 95 grams of CO₂ per km by 2020 to light duty vehicle manufacturers on their car fleet. These are examples of the continuously tightening legislation with which the automotive industry has to deal. At the same time, consumers demand for increased performance and engine horse-power has increased 34% in the last decade [1, 2, 3, 4, 5, 6]. To match these contradicting requirements a huge pressure is put on vehicle efficiency at all levels. The efforts from automotive manufacturers resulted in improved aerodynamics, more fuel efficient high torque engines operating at lower rpm, energy saving gearboxes and smaller axles with lower ratios [1, 2, 6, 7].

The axle transmission is a key component of the vehicle powertrain. It is a very compact mechanical system, consisting generally of a hypoid bevel geared transmission, tapered rolling bearings, seals, shafts and an axle gear oil [8]. The axle transmission requires a very high reliability, since failures are not accepted by consumers [6, 9, 10]. The axle transmission has three functions: the first one is to receive the power from the engine (via the gearbox and propeller shaft) and to transfer it to the driving wheels of the vehicle; the second one is to provide an overall reduction of the transmission ratio, avoiding to do it in the gearbox, thus keeping the gearbox much smaller; finally, the third one is to enable the wheels to travel at different speeds while cornering, without losing drive. So the main task of axle transmission is to accomplish these functions as efficiently as possible, minimizing the mechanical losses [11].

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