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Investigation on grease contribution to ball bearing torque by tribological and rheological tests and prediction of low torque performance – WTC 2021, Lyon -

Christelle Vacher[1)*] and Marc Paquien[1)]

[1)] NTN-SNR Roulements – Research and Innovation Department – Annecy, France
*Corresponding author: christelle.vacher@ntn-snr.fr

Tribo-rheological tests have been developed to understand grease lubrication process and to evaluate grease contributions to bearing energy loss. It is shown that flow behavior inside the bearing can vary depending on grease components. Viscous drag force was evaluated with a rheometer whereas rolling/sliding resistance was measured on a tribometer. A series of greases with different thickener, base oil type and viscosity have been characterized by tribo-rheological tests. Correlation made with wheel bearing energy loss on WLTC give new opportunities to predict grease flow behavior and low torque performance by simple laboratory tests.

Keywords: tribology, rheology, grease, ball wheel bearing, low torque

1. Introduction

More than 90% of bearings are grease lubricated. To improve bearing efficiency, a good performing grease gives low friction throughout its lifetime. Therefore, it is important to understand grease contribution to torque in order to predict friction performance by tribo-rheological characterizations.

2. Methods

Twenty fully formulated greases for automotive wheel bearings have been tested. They are composed of five different thickeners with synthetic or mineral based oil having a kinetic viscosity from 30 to 272 cst to cover a wide range of flow properties.

2.1. Rheological measurements

For grease flow behavior study, the greases were tested on an Anton Paar rheometer (MCR502S) with a rolling bearing assembly (RBA) (Figure 10). 6204 bearings were half-filled with the test-greases.

Figure 1: Rolling Bearing Assembly system on MCR502S rheometer used for grease flow behavior study

2.2. Tribological measurements

The MTM (Mini Traction Machine) rig was employed for friction tests. This rig uses a ball-on-disc configuration with a continued supply of lubricant to the contact. Traction curves were performed to determine grease shearing torque contribution under high load.

2.3. Component test: wheel test rig

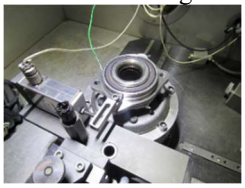

Figure 2: Wheel bearing on friction functional test bench

A functional test bench is used to measure entire wheel bearing friction. Chamber temperature and speed profile are relevant of application, compliant with Worldwide Harmonized Light Vehicle Test Procedure (WLTP).

2.4. Results

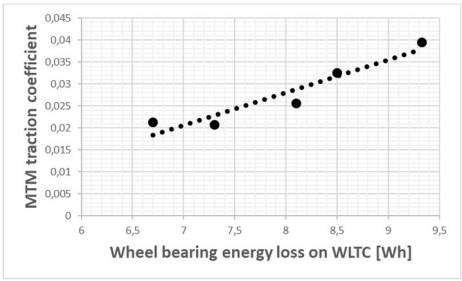

Figure 3: Good correlation between entire wheel energy loss on WLTC and MTM traction coefficient at 40°C

3. Discussion

3.1. Identification of flow behavior by tribological tests

No direct correlation was found between RBA torque and wheel bearing rig according to WLTP. However, RBA test can be useful to study grease flow behavior inside the bearing and to estimate viscous drag force and rolling resistance.

3.2. Correlation between traction coefficient and grease torque performance

A good correlation was found between friction coefficient measured on MTM traction curve and wheel bearing torque recorded during WLTP. So, greases rolling/Sliding viscous resistance seem to be the predominant contribution to torque in wheel bearing.

4. References

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