NANOSTRUCTURED BIOGREASE PERFORMANCE TO WHEEL/RAIL CONTACT APPLICATION

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Green tribology; NanoTribology; Wear; Biogrease

INTRODUCTION

Two methods promote the lubrication of the wheel/rail interface. One is responsible for lubricating theinterface of the wheel flange/rail gauge corner at the high rail to reduce the wear of the wheel flange, and the other lubricates the interface of the wheel tread/top of rail at the low rail to prevent the corrugation growth [1]. In the first interface, it is desirable to adopt a lubricant that promotes a lower friction coefficient as much as possible, like greases. The majority reported studies investigating biogrease lubrication is focused on rolling bearings applications, which significantly differ from rail lubrication. This study aims to investigate nanostructured biogreases that act
in the wheel/rail interface.

METHODS

Four greases were formulated (coded by NbioA and NbioB, the greases added to hybrid nanoparticles, and BioI and BioII, the greases without nano additives) from a nano base oil produced. It was made with a hybrid of iron and titanium oxide nanoparticles synthesized in situ in vegetable oil by pulsed laser technique. The biogreases were characterized by physical, chemical, and tribological analysis.

The tribological tests were performed by Pin-on-disc lubricated tests performed on a PLINT TE67 tribometer. Also, commercial grease was used as a comparison. The pins and discs were manufactured with rail and wheel materials: the AAR grade class C disc forged wheels (340 HB) and the pin from the pearlitic steel (370 HB) rail. Each tribological pair slid at 0.1m/s of speed and 34 rpm under 24.6N for the 3600s at room temperature. The wear track radius was 28mm. The end of the pins was rounded to 3.975mm radius, avoiding possible edge effects and lack of parallelism in pin-on-disc contact. The wear volume of the discs was obtained using a tridimensional surface analyzer (Talysurf CLI 100, Taylor Hobson) and optical microscopy of the pins. The in wear rate (Q) was calculated, and the wear mechanisms were investigated by SEM, EDS, and Raman spectroscopy.

RESULTS AND DISCUSSIONS

The friction coefficient (behavior and average) shows similar results around 0.1±0.03 by all biogreases developed and the commercial grease (Fig.1).

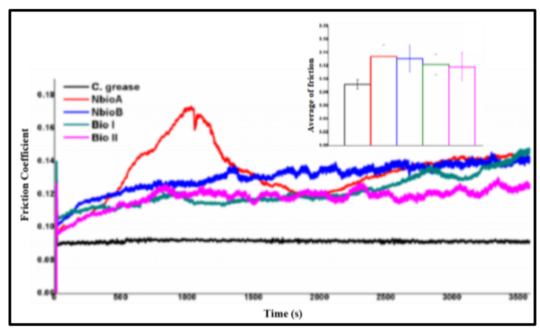

Fig.1 Friction coefficient exhibited by the samples.

On the other hand, the results of wear of the pin- Q (Tab.1) point to the anti-wear property exhibited by all formulations concerning the commercial grease, with a more significant reduction for the BioI and NbioA formulations.

Table.1 Pin wear rate (Q) calculated (*Q = wear volum of the pin/slid distance).

Result	Bio I	Bio II	NbioA	NbioB	Grease
Q ($10^{-6}mm^3/m$)	2.38	14.5	13.2	25.1	27.1

REFERENCES

[1]Almeida, L. P. et al., "Study of sliding wear of the wheel flange -Rail gauge corner contact conditions: Comparative between cast and forged steel wheel materials" Wear 432–433 (2019) 102894.