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On the impact of micropitting on the friction coefficient of a lubricated contact: experimental investigations at different scales

Thomas Touret[1)*], Christophe Changenet[1], Jérôme Cavoret[2)], Fabrice Ville[2)]

[1)] Univ Lyon, ECAM Lyon, INSA-Lyon, LabECAM, F-69005, Lyon, France
[2)] Univ Lyon, INSA-Lyon, CNRS UMR5259, LaMCoS, F-69621, France
*Corresponding author: Thomas.touret@ecam.fr

To investigate alternative method for health monitoring in geared system, the impact of micropitting on the friction coefficient of lubricated surfaces is investigated. Experiments are driven on two different scales: (i) firstly on the contact scale in order to accurately assess the impact of micropitting on friction coefficient ; (ii) secondly, on the scale of a geared system, in order to verify that this impact remains significant when gear friction is not the only source of power losses.

Keywords: Micropitting, Friction coefficient, Twin Disc machine, FZG test rig.

1. Introduction

Micropitting is a common failure for mechanical systems with gears made of hardened steels. As industry aims at optimizing these systems, they therefore operate under more severe conditions which may increase the frequency of failures such as micropitting. Thus, health monitoring is a relevant technology for future system.

As literature considers that micropitting modify surface aspects and thus roughness, it can be expected that this phenomenon changes friction coefficient and then power loss in a geared system.

Two experimental procedures are performed in order to study this correlation. Each of them investigates the problem at a different scale. Firstly, a twin disc machine is used in order to study the correlation between micropitting and friction for controlled contact conditions [1]. Secondly, an FZG test rig is exploited in order to quantify the impact of micropitting on power losses for a full scale geared system [2].

2. Experimental approach

2.1. Friction coefficient investigations at contact scale

The proposed approach is based on a two phase cycle: (i), a twin-disk fatigue test rig is used to generate micropitting on a specimen; (ii), another twin-disk machine is then used to measure the friction coefficient generated by this specimen. Traction curves are derived from those measurements. Before each characterization phase, surfaces are analyzed and roughness features are measured.

This cycle is repeated in order to increase micropitting magnitudes and to quantify its impact on friction coefficient of a lubricated contact.

2.2. Power losses investigations at geared system scale

Similarly to twin disc tests, a FZG test rig was also used in a two phase cycle: (i), fatigue phase is performed to develop micropitting on gear flanks; (ii), characterization phase is performed to measure total power losses. Before each characterization phase, tooth surfaces are analyzed to measure micropitted areas and roughness features.

In order to gradually increase micropitted surfaces on gear flanks, this two phase cycle is repeated with increasing loading during the fatigue phase. Therefore, the correlation between micropitting magnitude and power losses can be investigated on a geared system.

3. Results and discussions

The proposed two-scale investigation allows characterization of micropitting impact on the friction coefficient of a lubricated contact.

Contact scale investigation shows that a clear relationship between micropitting magnitude and friction coefficient evolution can be measured. [1]

The second investigation, at the scale of a geared system, shows that it is possible to measure significant power loss variations due to surface evolutions along the fatigue cycle as presented in Figure 1 [2].

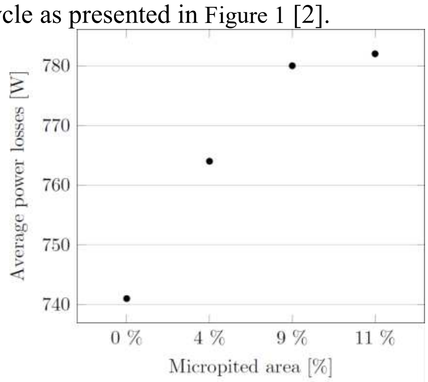

Figure 1: Power losses variation for the geared system [2]

This test also shows that the influence of other surface modifications, such as wear, has to be taken into account in order to correlate micropitting and power losses variations.

4. References

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