TUE-T2-S5-R2

7th World Tribology Congress, WTC 2022
July 10-15, 2022, Lyon, France

The Identification of an Adequate Stressing Level to Find the Proper Running-In Conditions of a Lubricated DLC-Metal-System

Joachim Faller[1)*] and Matthias Scherge[1)]

[1)] Fraunhofer IWM MikroTribologie Centrum Rintheimer Querallee 2b, 76131 Karlsruhe, Germany
*Corresponding author: joachim.faller@iwm.fraunhofer.de

Using a tribometer equipped with a high-resolution wear measurement unit (RNT), the running-in of a diamond like carbon (DLC) iron spray coating contact was analyzed and optimized. The optimization comprised an initial parameter field with different load and speed levels to find key operation points. These points were used to compose a running-in parameter field. The analysis underlined the importance of identifying the adequate stressing conditions. With respect to our concept of the running-in corridor, a high-power running-in has to be preferred to obtain a tribological system with low friction, small wear and wear rate, high system stability, and low sensitivity.

Keywords: running-in; lubricated sliding; ultra-low wear; parameter field selection

1. Introduction

Until today there is no straightforward method to achieve a proper running-in of a tribological system (except for trial-and-error) [1,2]. This contribution therefor presents an analysis of a lubricated DLC-metal-system. Initial experiments served to identify the critical stressing levels, this means critical normal forces and/or sliding velocities that trigger significant responses of the friction and wear signal. These stressing levels are called key levels and were used to construct a dedicated running-in procedure.

2. Methods

Experiments were conducted on a pin-on-disk using a flat pin made from iron-plated aluminum and a DLC coated steel disk. The wear behavior was determined with a radionuclide wear measuring unit using a radioactively marked pin. The lubricant (fully formulated engine oil) was applied continuously to the disk. The experimental conditions are stated in table 1.

Table 1: Experimental conditions

oil temperature	80	°C
velocities	0.5-4.2	m/s
applied load	500/700/900/980	N
nominal pressure	26/38/48/52	MPa
level duration	4	h

3. Results and Discussion

Starting with an initial parameter field covering the velocity-pressure-plane (see figure 1) leads to an overall linear wear behaviour and significant decrease in COF during the single stress levels.

The identified key levels were combined to a new parameter field (figure 2) starting with high pressure and low velocity in order to achieve a high-power stressing of the tribological system. With this procedure, the significantly higher initial wear rates (150 nm/h) were reduced to around 5 nm/h after running-in along with a decrease in COF to 0.02.

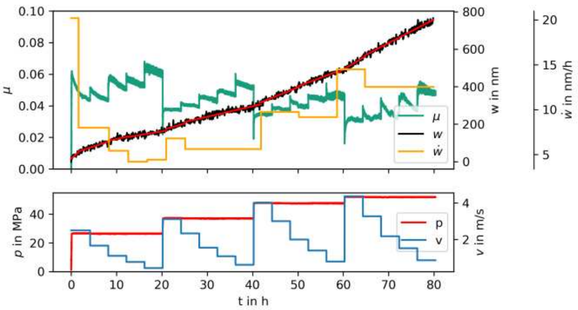

Figure 1: Initial parameter field with COF (green), wear (black) and linearized wear rate (yellow)

High-power stressing leads to a degressive wear behavior. High wear rates at the beginning are linked to a topographical running-in, while the slow decrease in COF with small wear rates is caused by tribo-chemical running-in. The latter is closely related to third body formation.
In order to achieve a successful running-in, high initial stress proves to be advantageous.

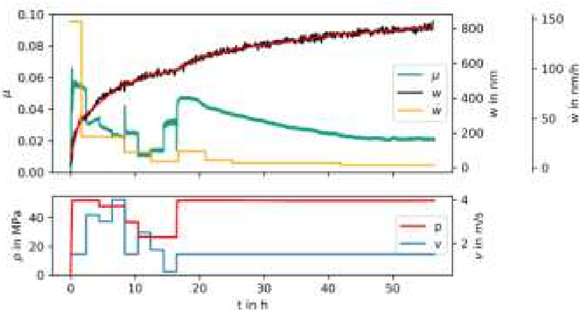

Figure 2: Derived parameter field with COF (green), wear (black) and linearized wear rate (yellow)

4. References

[1] Dowson, D.; Taylor, C.; Godet,M.; Berthe, D. (Eds.) The Running-in Process in Tribology; Butterworth-Heinemann: Oxford, UK, 1982; p. iv.
[2] Blau, P.J. Running-in: Art or engineering? J. Mater. Eng. 1991, 13, 47–53.