COINCIDENCE OF STEREOMETRIC AND TRIBOMETRIC STUDIES OF FRICTION PAIR COMPONENTS

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INTRODUCTION

Characterization of the surfaces of the friction pair components should include two parallel approaches: surface topography measurements (stereometric studies) and tribological tests (tribometric studies).

Stereometric studies allow determining the functional properties of machined surfaces (for parts after the technological process) and worn surfaces (for parts after the operational process). These studies include the determination of parameters and functions characterizing the surface topography. They are carried out with the use of various measuring instruments - contact and non-contact methods (from macro to nanoscale), and their results enable multi-scale analysis.

Whereas, tribometric studies establish the tribological properties of materials (tribological characteristics). These studies include recording changes in the friction coefficient and linear wear - next, the mean values of the friction coefficient as well as the wear intensity of the less durable component of the friction pair are determined.

The combination of these two approaches makes it possible to rationally solve research problems in the field of characterizing the surface topography of friction pair components. Thanks to this, it is possible to optimize the functionality of the tribological system.

MATERIALS AND METHODS

The subjects of studies and analysis were ceramic material used in conjunction with a polymeric material in friction pair: polymeric pin-on-ceramic plate. These types of materials are used e.g. in medicine.

The finishing process of ceramic parts included two operations - grinding (shape as well as a third dimension - height) and lapping (three treatments - after each treatment, different characteristics of the machined surface were obtained).

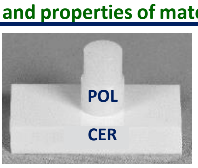
As the result of technological process for ceramic parts, three different kinds of surface topography (defined by Ra parameter, where $Ra_{(CER1)} > Ra_{(CER2)} > Ra_{(CER3)}$) were obtained.

The finishing process of the polymeric parts also included two operations - turning and polishing.

Materials – friction pair and properties of materials

CER

Density = 6.05 g/cm^3
Young's Module = 209 GPa
Poisson's ratio = 0.23

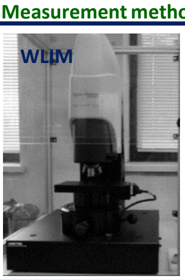


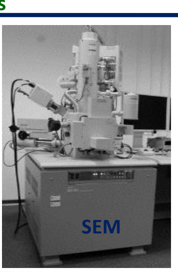
POL

Density = 0.937 g/cm^3
Young's Module = 0.660 GPa
Poisson's ratio = 0.46

Two measurement instruments were used to studies machined and worn surface topography: scanning electron microscope (SEM) and white light interference microscope (WLIM). The multi-scale analysis of surface topography of friction pair components was performed. The tribological tests were performed with used a tribological instrument (tribotester T-17) in the Ringer's solution. The tribological characteristics as friction coefficient and wear intensity of a polymeric component for three kinds of friction pair were obtained.

Measurement methods

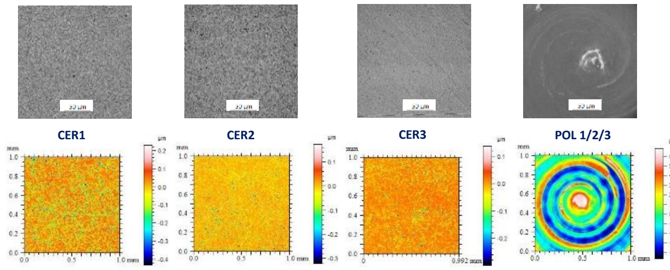




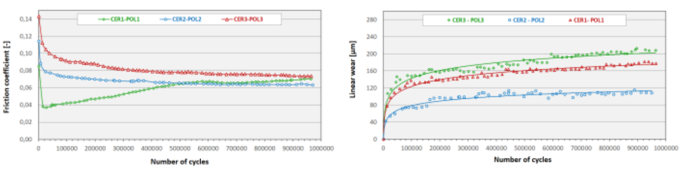
- load: 225 N
- medium temperature: 36.7±0.5ºC
- movement amplitude: 25.4 mm

RESULTS

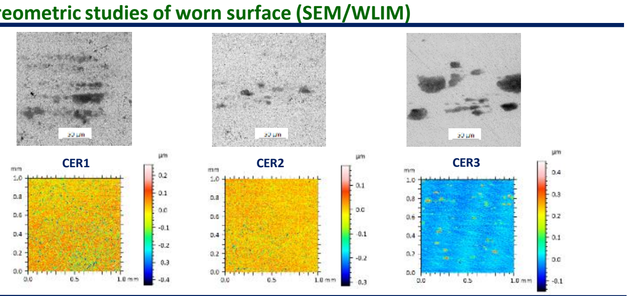
Stereometric studies of machined surface (SEM/WLIM)

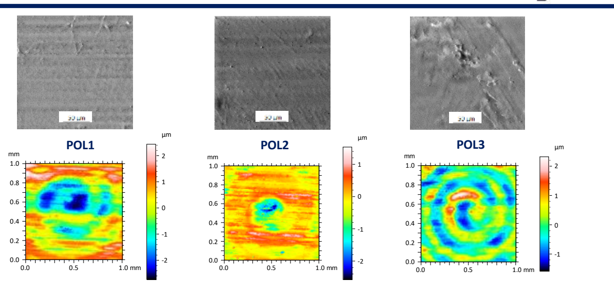


Tribometric studies – friction coefficient and linear wear



Stereometric studies of worn surface (SEM/WLIM)





CONCLUSIONS

There was a certain correlation between the machined surface established in the technological process, tribological characteristics, and the worn surface created during an operational process.

The surface topography of the ceramic parts (WLIM results) had a significant influence on the friction coefficient and linear wear of the polymeric parts. The wear products visible on ceramic surfaces (SEM results) were the consequent of wear mechanisms, including abrasive, fatigue and adhesive wear.

The coincidence of stereometric and tribometric studies showed that the best ceramic-polymer friction pair, in terms of the course of changes in the friction coefficient and linear wear of the polymeric component (wear intensity), was the pair CER2-POL2; the polymer wear intensity was the smallest and equal to 15.05 ± 4.0 µm/10^6 cycles).

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