17th International Colloquium Tribology. Solving Friction and Wear Problems, 19 – 21 January 2010, Stuttgart/Ostfildern, Germany

Impact of Laser Surface Texturing on Al-Si-Cu cylinder liners evaluated through TLA and nVCT

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1 Introduction

The use of laser ablation in order to texture the surface of piston rings appears since 2001 in the scientific community. However the advantages of texturing the cylinder liners surface are only presented in terms of reduction of the friction coefficient and wear volume at the test end [1]. This paper presents a technique based on partial thin layer activation (PTLA) to measure on-line the wear volume of an Al-Si-Cu cylinder liner while rubbing against a piston ring inside a component test tribometer. Through this technique different surface finishing methods such as Laser surface texturing (LST) and traditional honed liners are compared.

2 LST Procedure

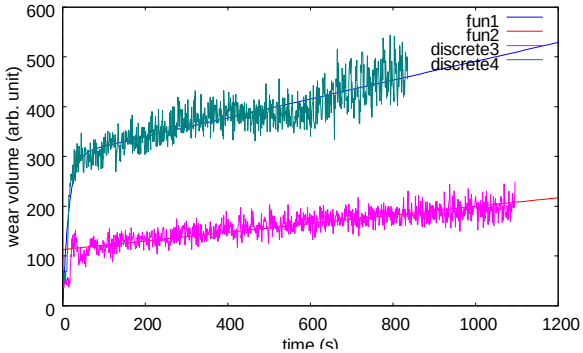
The cylinder liner samples were textured using a Nd:YAG pulsed laser with a wavelength of 1.06 µm, pulse frequency of 15 kHz and a nominal power of 12.8 W (at 40 kHz). The ablated spherical micro-dimples, characterized using a tip profilometer, had a depth of 6.1 ± 1.1 µm, a diameter of 66.6 ± 5.4 µm and a dimple areal density of 8.7± 1.5.

3 Irradiation Procedure

The PTLA requires activating a part of the surface and the first layers below of the investigated material by a charged particles beam. Aluminum (~80% in mass in the cylinder composition) was irradiated with a 24MeV beam of Helium3; the resulting nuclear reaction is the following: $^{nat}Al(3He,x)^{22}Na$. Nanoidentation was used to ensure that no changes happened on the samples surface due to LST and PTLA.

3 Wear Test

The prepared specimens were hence tested in the SRV component test tribometer [2]. The couple cylinder liner – piston ring was put in reciprocate sliding with a small stream of lubricant flowing in the contact zone and bringing the removed wear debris to the radiation detector where the activity is measured and hence converted to wear volume. This on-line technique permits the evaluation of the removed wear volume and hence the wear rate during the different phases of the wear mechanism (i.e. running-in and steady state)as shown in Fig.1. Differences in the steady state wear rate caused by different surface finishing methods are detected.



The authors want to thankfully acknowledged to the support of the European Commission through the project MRTN-CT-2006-035589 WEMESURF.

4 References

[1] Golloch, R., Merker, G.P., Kessen, U., Brinkmann , S., “Benefits of laser-structured cylinder liners for internal combustion engines”, 14th International Colloquium Tribology, Esslingen, Germany, Vol.1, 2004, 321-328

[2] E. Corniani, et al., TLA and wear quantification of an aluminium–silicon–copper alloy for the carindustry,Wear(2009), doi:10.1016/j.wear.2009.02.007