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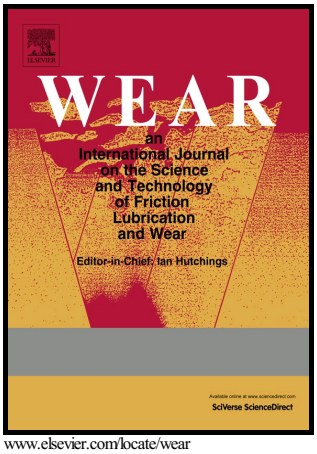

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Observation of the adhesive- and deformation- contribution to the friction and wear behaviour of thermoplastic polyurethanes

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Abstract

In this study unfilled and graphite filled thermoplastic polyurethanes (TPU) were investigated in tribological pin-on-disc tests. The two main frictional mechanisms, namely adhesion and deformation, were characterised by tribological tests. Measurements were performed at ambient air and under vacuum by varying the relative humidity, surface roughness of the counterparts (honed and polished) and ambient temperature (23°C and -30°C). Combined with qualitative microscopic analysis more knowledge was obtained about the differences and influencing factors related to the ratio between the two main components of friction of TPU. Furthermore, to support the development of a phenomenological model, the bulk material properties in terms of viscoelastic material parameters were determined both under cyclic loading in dynamic mechanical measurements in creep tests. Finally, the usage of a graphite filler influences the wear mechanisms under vacuum condition significantly. The results indicate that the ratio between the two frictional mechanisms is strongly influenced by the load, surface roughness, viscoelastic material behaviour and ambient conditions. The findings lead to a better understanding of the fundamental friction and wear mechanisms of injection moulded TPUs.

Keywords:
TPU, friction, wear, adhesion, deformation, vacuum

1. Introduction

The fact that elastomeric sealing materials are being introduced more and more into high-load applications (eg. wind-energy) shows that there is a need for improved materials along with the optimization of the sealing geometry [1]. For better component performance, a better knowledge about locally driven chemical, physical and mechanical behaviour of the materials is needed to understand the structure property relationship in the tribological context.

In the field of sealing materials, thermoplastic polyurethanes (TPU) have favourable properties related to processability via injection moulding as well as material properties and of course good tribological properties [2]. To improve the tribological performance, different filler strategies (improve stiffness and reduce friction and