Wear and Friction Behaviour of PA12, PVDF, PEEK and PPS Polymer Tapes

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1. Introduction

The friction and wear behaviour of four polymeric tapes has been assessed for different loads, sliding speeds and counterface roughnesses under dry sliding conditions.

The polymers tesed were polyetheretherketone (PEEK), polyphenylene sulfide (PPS), poly(vinylidene fluoride) (PVDF) and polyamide 12 (PA12). A range of test methods have been used to obtain appropriate material properties which have been shown to have an effect on polymer wear. A tribometer with a pin-on-disc arrangement has been used for wear testing. Correlations between various material properties and wear behaviour have been observed and a comparison with existing wear models has been carried out.

2. Methods

Polymer samples have been tested against different grades of SiC abrasive grit paper using a Pin-on-disc tribometer. The friction force throughout testing has been continually monitored. A continuous depth sensing method has been used to measure the wear depth and mass loss has been measured following testing using a mass balance. Figure 1 shows a schematic representation of the pin-on-disc arrangement used.

Mechanical properties, which have been shown to have an impact on the wear resistance of polymers[1], have been experimentally measured. Tensile testing has been carried out on the tapes to obtain tensile properties. Nanoindentation has been carried out to obtain hardness measurements at the polymer surface. Differential scanning calorimetry (DSC) has been used to determine the glass transition temperature and crystallinity of the polymers.

Many wear models and predictive equations exist to describe the wear of polymers in terms of their material properties[2]. Several of the most prominent have been compared with the experimental data obtained and their suitability for the selected polymer tapes has been assessed.

The worn surfaces of the polymers have been observed using optical microscopy and wear processes have been identified. The formation of a transfer layer has also been assessed qualitatively.

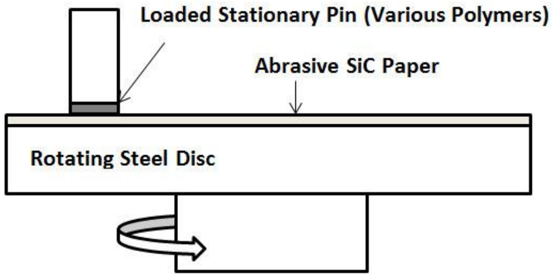

Fig.1 Schematic Representation of test set-up

3. Results

The materials have been ranked in terms of friction and wear performance for a range of conditions. PEEK showed lowest abrasive wear in all conditions, followed by PVDF, PPS and PA12 respectively.

All the materials showed a higher wear rate with greater applied normal load. The relationship between friction force and applied load was different for each of the polymers.

The wear rate increased in all cases with increasing abrasive grain size, but the magnitude of the effect was different for each polymer. All polymers showed a degree of material deposition to the SiC surface.

Predictions from existing polymer wear models have been compared to the experimental data and assessed. Under dry sliding conditions the ability of existing common wear models to predict wear rates accurately for different polymers with a large range of mechanical properties is limited.

4. References

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