Revisiting polymer tribology for heavy duty application

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Abstract

Polymers are frequently considered as a candidate material for heavy duty tribological applications. Standard tribological testing for such applications may result in unrealistic tribological properties in terms of wear mechanism, transfer film formation and friction coefficient etc. Thus the present research aims to explore the tribological behaviour of currently available neat polymers under heavy duty loading condition. In this background, nine different polymers (PAI, PEI, PC, PPSU, PA6, PET, PPS, PVDF, and UHMWPE) of amorphous and semi-crystalline groups were chosen from engineering and high performance grades. Large scale reciprocating sliding wear tests with 5050mm contact area were used. Considering heavy duty loading condition, the operational parameter were idealised at 10 kN normal force and 50mm/s sliding speed. From the test results the polymers are classified into three groups based on the wear mechanisms and the transfer layer characteristics observed from the counterface. Group 1 did not persist any transfer layer (PC and PEI), whereas Group 2 materials (PET, PPS, PPSU and PAI) has lumpy discontinuous transfer layer and finally Group 3 materials evidenced uniform thin transfer layer. Clear signs of three body abrasionwere evidenced in Group 1material which is due to the absence of transfer layer and also from the large loose debris. Poor adhesion of inhomogeneous lumpy transfer layer in Group 2 showed an intermediate wear rate. Based on the wear and friction performance, the Group 3 materials (PVDF, UHMWPE and PA6) are proposed as the candidate materials for heavy duty tribological application. In regards to the transfer layer thickness and wear mechanisms at large scale testing, the present observations showed incomparable results with the literature. This research concludes that the revisit to polymer tribology at high load condition has indicated the difference in wear mechanism and the corresponding tribological characteristics in large scale testing. As a future work multi-scale testing is an absolute must for the complete understanding of tribological characteristics w.r.t a specific material.

Keywords:

Heavy duty testing
Polymer tribology
Transfer layer
Amorphous polymer