Tribological behaviour of polymer filled with nanoparticles at various testing scales

Nowadays, high potential polymers have been applied as structural materials in the aerospace, automotive and chemical industries. Nevertheless, new high performance applications can be established with the appropriated combination of polymer and nanocomposites fillers; thus providing lower weight alternatives to metallic materials. The research is focused to address the understanding of the wear behaviour of high performance thermoplastic materials and to identify the possibilities to enhance the mechanical properties, wear resistance at large scale test rig. All investigations will be done on high performance PEEK polymers unfilled and filled with nanocomposites.
Reciprocating sliding test have been performed in PEEK polymer and PEEK with nanocomposite using flat-on-flat configuration and medium scale tribotester (MSF) under different contact pressures (4, 8, and 10 MPa) and two speeds (20 and 50 mm/s), respectively. It has been found that friction and wear of the PEEK polymer filled with nanocomposites presented low friction but high wear resistance with increase the contact pressure and the speed. Post-mortem analysis will be carried out by means of scanning electron microscopy (SEM) and X-ray Diffraction (XRD) on the worn and counter surfaces to determine the compatibility of the contact bodies, transfer film formation and the type of wear debris in the sliding interface. An analytical wear model will be developed with different test parameters and the obtained results.
Wear and friction results obtained at large and small scale experiments are going to be compared, introducing a macroscopic geometrical scaling parameter in an attempt to match both steady-state sliding conditions. Special attention will be given to the sliding stability during the running-in period under high contact pressures. It should be verified if large-scale tests at extremely high load conditions can be equivalent with small scale tests at high sliding velocities and temperature.

2-lines summary

The PhD aim is to compare the friction and wear behaviour of PEEK polymers unfilled and filled with nanocomposites on small and large scale wear experiments.