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Wear Performance of SLM Fabricated 1.2709 Steel Nanocomposite Reinforced by TiC-WC for Mould and Tooling Applications

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Abstract : Wear phenomena is critical in injection moulding processes, causing failure of the components, and making the parts more expensive with an additional wasting time. When very abrasive materials are being injected inside the steel mould's cavities, such as polymers reinforced with abrasive fibres, the consequences of the wear are more evident. Maraging steel (1.2709) is commonly employed in moulding components to resist in very aggressive injection conditions. In this work, the wear performance of the SLM produced 1.2709 maraging steel reinforced by ultrafine titanium and tungsten carbide (TiC-WC), was investigated using a pin-on-disk testing apparatus. A polypropylene reinforced with 40 wt.% fibreglass (PP40) disk, was used as the counterpart material. The wear tests were performed at 40 N constant load and 0.4 ms-1 sliding speed at room temperature and humidity conditions. The experimental results demonstrated that the wear rate in the 18Ni300-TiC-WC composite is lower than the unreinforced 18Ni300 matrix. The morphology and chemical composition of the worn surfaces was observed by 3D optical profilometry and scanning electron microscopy (SEM), respectively. The resulting debris, caused by friction, were also analysed by SEM and energy dispersive X-ray spectroscopy (EDS). Their morphology showed distinct shapes and sizes, which indicated that the wear mechanisms, may be different in maraging steel produced by casting and SLM. The coefficient of friction (COF) was recorded during the tests, which helped to elucidate the wear mechanisms involved.

Keywords : selective laser melting, nanocomposites, injection moulding, polypropylene with fibreglass
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