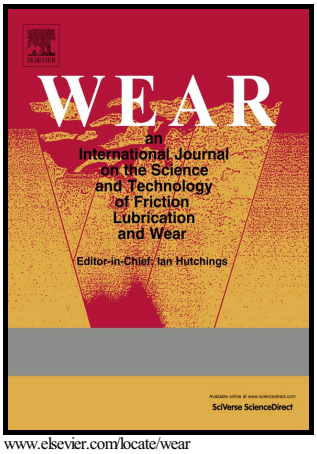

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Tribological performance of aromatic thermosetting polyester (ATSP) coatings under cryogenic conditions

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Abstract

Thin polymeric coatings are excellent candidates for extreme dry sliding conditions, where oil lubricants and greases are ineffective. Earlier research demonstrated that ATSP-based coatings with a thickness of approximately 30 μm exhibited excellent wear resistance and low friction coefficient (COF) at high temperatures up to 260 °C. In this work, we investigate the tribological performance of ATSP-based coatings under cryogenic conditions, with temperatures as low as -160 °C in a ball-on-disk experimental configuration (AISI 316 stainless steel ball vs. polymeric coating deposited on cast iron). This work complements the tribological performance map of this coating from cryogenic to high temperature conditions. The experiments showed that under an initial Hertzian contact pressure of 110 MPa, ATSP coatings exhibited unmeasurable "zero" wear, and the COF increased with decreasing temperature, with a peak value at -100 °C. Under higher contact pressures of 139 MPa, at -160 °C, there was a transition point where the COF dropped notably. Further investigation revealed that this favorable transition is due to the development of a polymer transfer film on the ball counter surface. For comparison, a commercial bearing grade PEEK-based coating was also tested under similar conditions. Scanning Electron Microscopy/Energy-dispersive X-ray spectroscopy was utilized to explain the coatings tribological performance.

Keywords

Polymer Coating; Cryogenic; Wear; Friction