

Wear Resistance and Mechanical Performance of Ultra-High Molecular Weight Polyethylene Influenced by Temperature Change

Authors : Juan Carlos Baena, Zhongxiao Peng

Abstract : Ultra-high molecular weight polyethylene (UHMWPE) is extensively used in industrial and biomedical fields. The slippery nature of UHMWPE makes this material suitable for surface bearing applications, however, the operational conditions limit the lubrication efficiency, inducing boundary and mixed lubrication in the tribological system. The lack of lubrication in a tribological system intensifies friction, contact stress and consequently, operating temperature. With temperature increase, the material's mechanical properties are affected, and the lifespan of the component is reduced. The understanding of how mechanical properties and wear performance of UHMWPE change when the temperature is increased has not been clearly identified. The understanding of the wear and mechanical performance of UHMWPE at different temperature is important to predict and further improve the lifespan of these components. This study evaluates the effects of temperature variation in a range of 20 °C to 60 °C on the hardness and the wear resistance of UHMWPE. A reduction of the hardness and wear resistance was observed with the increase in temperature. The variation of the wear rate increased 94.8% when the temperature changed from 20 °C to 50 °C. Although hardness is regarded to be an indicator of the material wear resistance, this study found that wear resistance decreased more rapidly than hardness with the temperature increase, evidencing a low material stability of this component in a short temperature interval. The reduction of the hardness was reflected by the plastic deformation and abrasion intensity, resulting in a significant wear rate increase.

Keywords : hardness, surface bearing, tribological system, UHMWPE, wear

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