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Correlations between Wear Rate and Energy Dissipation Mechanisms in a Ti6Al4V–WC/Co Sliding Pair

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Abstract : The prediction of the wear rate of rubbing pairs has attracted the interest of many researchers for years. It has been recently proposed that the sliding wear rate can be inferred from the calculation of the energy rate dissipated by the tribological pair. In this paper some of the dissipative mechanisms present in a pin-on-disc configuration are discussed and both analytical and numerical calculations are carried out. Three dissipative mechanisms were studied: First, the energy release due to temperature gradients within the solid; second, the heat flow from the solid to the environment, and third, the energy loss due to abrasive damage of the surface. The Finite Element Method was used to calculate the dynamics of heat transfer within the solid, with the aid of commercial software. Validation the FEM model was assisted by virtual and laboratory experimentation using different operating points (sliding velocity and geometry contact). The materials for the experiments were Ti6Al4V alloy and Tungsten Carbide (WC-Co). The results showed that the sliding wear rate has a linear relationship with the energy dissipation flow. It was also found that energy loss due to micro-cutting is relevant for the system. This mechanism changes if the sliding velocity and pin geometry are modified though the degradation coefficient continues to present a linear behavior. We found that the less relevant dissipation mechanism for all the cases studied is the energy release by temperature gradients in the solid.

Keywords : degradation, dissipative mechanism, dry sliding, entropy, friction, wear
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