Mild to Severe Wear Transition of Ceramics

H.R. Pasaribu, J.W. Sloetjes and D.J. Schipper

Tribology Group, Faculty of Engineering Technology, University of Twente, The Netherlands

Abstract

The transition of mild to severe wear of ceramics depends on normal load, velocity, temperature, grain size, mechanical and thermal material properties. Several wear maps have been proposed in the past for instance Adachi et al. [1]. The transition of mild to severe wear is modelled using a mechanical severity index, based on the work of Hamilton [2] and a thermal severity index based on Ashby et al. [3]. Metselaar et al. [4] improved the thermal severity index using the temperature model of Bos [5]. The improved thermal severity parameter gives better results in the region where the transition is dominated by thermally induced wear.

The model, in order to predict the transition of mild to severe wear, can be can be simplified for the condition where the Peclet (P_e) number is larger than 2. Under these conditions, the maximum surface temperature due to frictional heating in dry sliding contact is moved from the center of the contact area ($P_e = 0$) to the trailing edge (P_e ? 2). Since the maximum tensile stresses due to mechanical loading occurs in the same region of the contact, it is assumed that for P_e ? 2 the maximum tensile stress due to mechanical loading and the maximum tensile stress due to thermal loading are coinciding in the trailing edge of the contact area. Based on this assumption, together with fracture mechanics, an improved combined mechanical and thermal severity relation can be derived. This model is verified experimentally and gives an improved prediction of the mild to severe wear transition of ceramics.

References

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Wear map of ceramics presented in logarithmic scale