SURFACE TEMPERATURE VARIATIONS WITH TIME IN FRETTING CONTACT OF POLYMER FILMS

M. R. GHASEMI, M. J. FUREY, B. VICK
Virginia Polytechnic Institute and State University, Department of Mechanical Engineering, Blacksburg, Virginia 24061, USA; e-mail: bvick@vt.edu

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ABSTRACT

In an experimental study of the fretting behavior of thin polymeric films on steel, it was observed that depending on the polymer and conditions (e.g., film thickness, load, frequency), the apparent real areas of contact varied considerably with time, often in a complex way. For example, in several cases, break-up of a single initial circular area of Hertzian contact into several smaller areas was followed by coalescence into a single or few areas. Furthermore, periodic bursts in surface temperatures were noted. The experiments were conducted using polymer films deposited on AISI 52100 polished steel balls in contact with an oscillating sapphire disk 1 mm thick. Measurements consisted of (a) photo/video records of the contact region using a Leitz-Wild Photomacroscope, (b) IR radiation through the sapphire disk using a Barnes infrared microscope, (c) instantaneous friction, and (d) surface damage.

More recently, a general three-dimensional transient solution was developed using classical Green's functions for calculating the surface temperatures generated by friction. It can be applied to both unidirectional and oscillating contact. Results are presented to show how the number and size of the contacts affect the thermal time constant.

Using examples of contact area and friction variations with time in the fretting studies, comparisons were made between theory and experiment. Although the results show reasonably good agreement, more work is needed to explain the phenomena based on adhesion, visco-elastic, and thermo-elastic considerations. The unique behavior of each polymer under these conditions shows the complexity of this problem.