7th World Tribology Congress, WTC 2022
July 10-15, 2022, Lyon, France

Tribological behavior of HexTool on itself under plane-on-plane gross-sliding fretting condition using local surface analysis

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Keywords: fretting damage, CFRP, local surface characterization

1. Introduction

The objectives of this research is the study of the tribological response of carbon fiber reinforced polymer composite material (HexTool M61) on itself under gross-sliding fretting condition. This material is mainly used as a mold material for composite materials curing with a thermal tolerance up to 180°C. When machined, the material presents an anisotropic surface (Fig1.C), with multi-directional fibers orientation zones (in and out of plane).

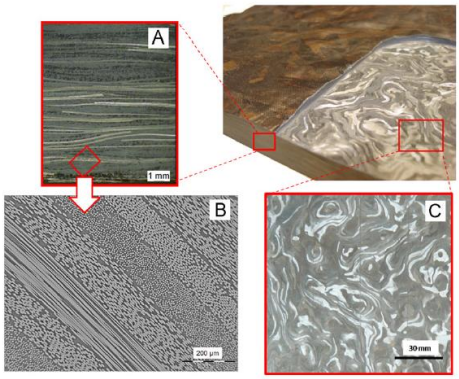

Figure 1: Raw HexTool material (top corner), and close-ups on the local anisotropic fibres/matrix structure [1].

An original aspect of this research is to consider a fretting contact between HexTool composite specimens in a plane-on-plane configuration with a large area of contact (10x10 mm^2). The influence of the main contact parameters on the tribological behavior is analysed at a both a global and a local scale.

2. Methods

2.1. Experimental tests

CFRP composites specimen were tested in plane-on-plane gross-sliding fretting conditions for 10^6 cycles.

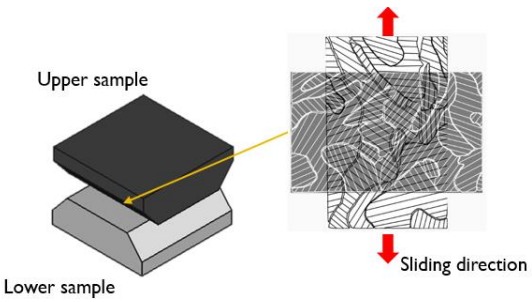

Figure 2: HexTool fretting samples (left) and schematic top view of the local surface analysis approach for fibers orientation (right).

Full image and surfometry measurements were made before and after tests to allow the identification and localization of each individual contact combination cases. 3 different normal loads were tested (100-200-320N).

2.2. Results analysis

The global parameters studied were the evolution of the friction coefficient, the wear volume and evolution of the contact area (using pressure paper measurements). They were related to the local analysis of the fibers orientation (relative to each other and to the sliding direction), the fiber/matrix ratio, the surface damage (SEM analysis) and the local wear volume (comparative surfometry analysis).

Some very specific friction behavior were identified compared to bibliography sources [2], that will be explained through the local analysis tools implemented, taking into account the evolution of the contact conditions and the material layers damage during the test.

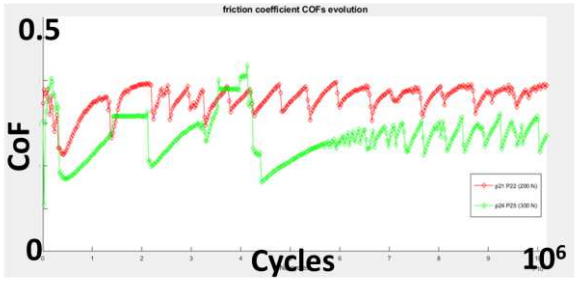

Figure 3: Friction behavior during 10^6 cycles gross sliding fretting tests under 200 (red) and 300N (green) load.

3. References

[1] Grégory Chardon, Olga Klinkova et al., "Characterization of friction properties at the work material/cutting tool interface during the machining of randomly structured carbon fibers reinforced polymer with Poly Crystalline Diamond tool under dry conditions", Tribology International,Volume 81,2015,Pages 300-308,

[2] S. Terekhina et al., "Contact fatigue and wear behaviour of bismaleimide polymer subjected to fretting loading under various temperature conditions", Tribology International, Volume 44, Issue 4, 2011, Pages 396-408