A FINITE ELEMENT TRANSPOSITION OF THE THIRD BODY CONCEPT TO PREDICT THE MAXIMUM WEAR DEPTH IN FRETTING WEAR

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ABSTRACT

Fretting is a surface load which is defined by two bodies in contact which experience small amplitude oscillatory movements. Fretting generates invariable damage process being wear and crack mechanisms. Depending on the loading conditions, normal pressure, displacement amplitude … different damage can be found. Wear is one important limitation to the lifetime of engines, gears or simply coatings.

To predict this lifetime, FEM simulations are generally used [1] but the third body or debris are rarely taken into account [2]. In this research work, we proposed an experimental campaign of test to characterize the occurrence and the evolution of the third body in the contact. We investigated a cylinder/plane contact, respectively made of 100C6 and 35NCD16. Numerous parameters were studied like cylinder radius, normal load sliding displacement and cycle number. Wear volume and maximum wear depth of the counterparts were systematically compiled. A simple method based on adequate superimposition of worn surface profiles allowed the estimation of individual cylinder and plane friction energy wear rates and quantification of third body thickness embedded in the interface. A local approach of third body law introduced by Fillot et al. [3], expressing the local height of wear and the local proportion of worn height transferred to the third body in function of local solicitation is proposed. From this model and in range of test, constants were found for the material couple. The Fillot's model describes debris like a fluid driven by source flow and wear flow which characterize respectively the detachment of particle from the bodies in contact and ejection of particles from the contact. This various quantitative variables were introduced in a coupled Matlab-Python-Abaqus algorithm where the local approach of Fillot's third body model was considered.

Quantitative comparison with experimental and numerical results confirmed the interest of this local approach of this new strategy (Fig. 1). The prediction of wear volume, wear shape and third body quantity were well estimated and allowed a better prediction of maximum wear depths compared to usual surface wear simulation without third body consideration.

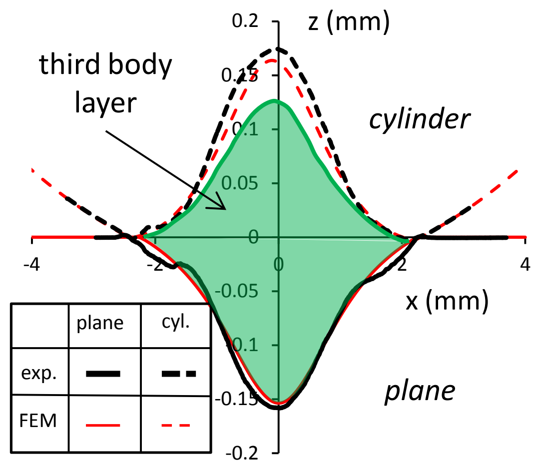

Fig.1 Comparison between experimental and FEM simulated worn fretting profiles for 40,000 cycles, 600 N load and 50 µm sliding displacement.

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