ABSTRACT

In digital tribology at the microscopic scale, the discrete element method (MED) is the most used tool to model the different mechanisms of the friction contact with the third solid body. The modeling of the rheology of the third solid body used by this method, has been widely used in recent research to study and understand the multi-physical phenomenology (mechanical, thermal, electrical, physicochemical ...) of contact.

In this context, we have illustrated in this present work a numerical study on the thermo-mechanical behavior by using the method of discrete elements (MED). This study focuses on the modeling of local friction between particles of the third body, heat generation and its diffusion by conduction. We made a two-dimensional numerical model (2D) adapted to the possibilities offered by the experimental device "Tribo-Gral", to simulate the different thermo-mechanical greatness such as: flow velocity and volume temperature of the third body. This modeling is implemented within the used platform LMGC90, which is based on the NSCD approach (Non-Smooth Contact Dynamics Method).

To enrich the study of the thermo-mechanical response of the third solid body, we made an extended parametric study on the influence of the nature of the third body, the applied tribological solicitations (shear rate and normal pressure), the cohesion between the particles of the third body, as well as the simulation time on the thermo-mechanical behavior of the third body.

Due to the lack of experimental validation of our model by the experimental device " Tribo-Gral " which is under construction, we have made other types of two-dimensional numerical model: Couette and rotating drum, where the obtained results are compared with similar results verified in other researches.

The analysis of the obtained results show that the thermo-mechanical response of the third solid body depends on the configuration of the model, the nature of the volume, the interaction laws, the simulation time, as well as the applied tribological solicitations.

Keywords: numerical tribology, rheology of the third solid body, discrete element method (DEM), LMGC90, heat generation, conduction heat transfer, NSCD, experimental apparatus Tribo-Gral, thermo-mechanical behavior.