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The degraded surface layer of a tyre tread: A numerical model combining discrete and continuum approaches

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Understanding the wear mechanisms of the tyre tread is a central issue regarding tyre performance, but is also pivotal in an environmental perspective. This topic is at the crossroads of several fields including tribology, surface engineering, granular physics and material science. It is indeed understood that wear implies the flow of a soft layer of divided matter within the contact interface: the so-called third body.

This understanding brings the notion of tribological triplet [1], which consists in considering all the flows of matter inside the contact, and their influence on the response of the system. To get a closer look at the *in situ* behaviour of these flows, several numerical methods have been proposed. The Multibody Meshfree Approach implemented in the code MELODY, in particular, appears promising [2]. This method allows to consider a significant number of solids in contact with large deformations, as might be expected for particles inside the contact.

Tyre wear particles are composed of an intimate mixture of rubber mix from the tyre tread, and minerals from the road. These facts have led Michelin to carry out several studies, in order to observe the effect of some parameters (minerals, road, rubber) on the wear rate. Moreover, SEM (Scanning Electron Microscopy) pictures have shown that the top layer of the rubber mix, is also composed of these minerals. This layer, which has a specific mechanical behaviour (compared to the bulk), is called the degraded surface layer. It has an interesting minerals pattern within its structure, which suggests a flow of minerals inside the rubber mix.

To study this mechanism, we proposed to apply the above method to an idealized case, a contact between a rubber mix specimen, minerals and an abrasive surface. The purpose of the numerical model is to find how minerals can migrate into the rubber mix, to study their kinematics and how they can affect macroscopic rheological quantities.

In this presentation, the numerical method and all the main assumptions will be presented, such as the choice to consider the specimen as a packing of a large number of cohesive and deformable bodies. An important focus on minerals kinematics will be made. In particular, the influence of key parameters, such as the contact laws, will be highlighted.

REFERENCES

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