INVESTIGATING THE INFLUENCE OF FLAKE-SHAPED PARTICLES ON THE FRICTIONAL BEHAVIOR OF MATERIALS

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ABSTRACT

One scenario that can occur during sliding is the detachment of particles due to adhesive forces. The influence of particle shape on adhesive wear is a significant aspect of tribology, affecting not only the wear process but also the overall system behavior. This work focuses on developing a model accounting for surface roughness as well the shape of third-body wear debris, for their influence on the frictional behavior of the entire system.

In real-world scenarios, rough surfaces engage at the summits of asperities. Previous research, as indicated by Aghababaei et al. [1], suggests that particle formation is likely when the per-asperity energy ratio $\frac{E_{el}}{E_{ad}}$ exceeds unity. Building on this insight, we have developed a computational model employing the Boundary Element Method (BEM) in Fourier space [2]. This model efficiently addresses the rough contact problem, incorporating plastic flow during sliding, as described in [3]. The model allows creation of a particle from each contacting area when the energy ratio criterion $\frac{E_{el}}{E_{ad}} > 1$ is met. To investigate how the sphericity of particles impacts the debris-surface interactions (friction and wear formation), we assume that the created particles are ellipsoidal particles, with varying sphericity. Such wear-surface interactions are accounted by coupling with Discrete Element Method (DEM) dynamics.

A key advantage of our method lies in its integration of DEM simulation with BEM. This dual approach allows us to effectively solve the contact problem while tracking the particles created during the process. The possibility to create wear debris during sliding is, to our best knowledge, a first attempt of the kind. Our approach offers new measures of the evolution of real contact area, friction coefficient, and surface roughness changes. For instance, we have observed that the shape and size of the particles, in conjunction with surface roughness significantly influence the distribution of contact pressure. The complex dynamics of the wear particles, which may become trapped and squeezed between the two sliding surfaces, are crucial considerations in understanding sliding friction transient conditions.

REFERENCES

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