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Experimental and numerical study of the contact between particles and microstructured surfaces covered with a liquid layer

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For the description of particulate processes, it is important to understand how the particles interact with the component surfaces involved in the process. Many processes like coating or agglomeration also incorporate liquids which influence the particle collisions. Modern manufacturing methods can be used to generate different surface morphologies affecting the behaviour of particles in contact with it. In this study these effects are investigated by an experimental approach using modified triboindenter tips supported by discrete element simulations coupled with resolved CFD.

For the direct measurement of forces acting on the particle when approaching a surface, the tips of a triboindenter were modified by attaching zirconium oxide particles with a diameter between 100 and 1000 µm to it. As contact partner titanium surfaces are used with different microstructures to investigate the effects of the surface morphology on the wet particle-wall interaction. Viscous forces caused by the fluid displacement during the approach of particle to the wall are measured directly with the indenter depending on the contact geometry and particle velocity.

As the asperities in contact are very small, it is difficult to fully depict the contact situation only by experiments. Therefore, simulations with the discrete element method are a helpful tool to understand the collision process. The contact of particles with microstructured surfaces is investigated depending on the individual contact situation considering the surface morphology. A Liquid layer on the surface is implemented into the simulation by a coupling of the discrete element method with computational fluid dynamics, showing how the surface morphology affects the interaction between the fluid and the impacting particle depending on the contact situation of the particle with the surface. The simulation results describe the influence of the microscale effects in the particle-wall contact on the dynamics of particle collisions.