Accurate particle speed prediction by improved particle speed measurement and 3-dimensional particle size and shape characterization technique - DTU Orbit (07/12/2018)

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Accurate particle mass and velocity measurement is needed for interpreting test results in erosion tests of materials and coatings. The impact and damage of a surface is influenced by the kinetic energy of a particle, i.e. particle mass and velocity. Particle mass is usually determined with optical methods, e.g. laser light scattering, and velocity by the double disk (DD) method. In this article we present two novel techniques, which allow a more accurate measurement of mass, velocity and shape, and we later compare the experimentally obtained flow velocities of particles with a simulation that also includes the particle’s shape parameter, known as sphericity. Mass and sphericity are obtained from 3-dimensional data with an industrial X-ray computed tomography (CT) scanner. CT data can be used to accurately determine the volume-basis median of the particles (using the volume-equivalent particle diameter). Velocity is measured with a fast 2-dimensional particle imaging method using a pulsed LED. Good agreement of the measured and simulated particle velocity was found when including the sphericity from CT results. 2-dimensional optical particle size measurements in the jet of an erosion rig are compared with detailed 3-dimensional CT measurements and a low angle laser light scattering (LALLS) measurement system for six different samples of particles. It is shown that the particle volume or mass is usually overestimated by 16–22% when using 2-dimensional methods or LALLS. For CT allows additionally the surface-equivalent diameter to be calculated by using 2-dimensional projections of each particle, these results can be used to correct particle diameters measured with the particle imaging method using a pulsed LED.

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