An experimental study of droplet-particle collisions

130. AN EXPERIMENTAL STUDY OF DROPLET-PARTICLE COLLISIONS

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When spray drying a liquid slurry such as milk, collisions between droplets, partially dried particles and completely dry particles are important because coalescence, agglomeration and breakup events influence the size and morphology of the produced powder. When modelling such a spray drying process, it is therefore important to be able to predict the outcomes of individual binary collisions. Both binary dry particle collisions and binary droplet collisions have individually been thoroughly researched over the years due to their widespread occurrence. The importance of understanding binary particle-droplet collisions has been emphasized more recently, but available studies are limited. To produce and record particle-droplet collisions, an experimental setup that enables synchronized release of both a particle and a droplet was used. One single hanging droplet was released from above onto a particle that initially was held in place by vacuum suction. A high speed camera was synchronised with the setup, and recorded the collisions. Image files were then analysed in Matlab to find velocities and sizes of the particle and droplet before and after impact. The contrast of particle and droplet against the illuminated background was a key factor in succeeding with this. Different collision outcomes were identified as either agglomeration (merging), where the whole droplet would stick to the surface of the particle, or a stretching separation (breaking), where the droplet collides with the particle in an oblique position and stretches out until a part of the droplet detaches from the liquid sticking to the particle. The formation of satellite droplets, i.e. droplets with a radius significantly smaller than the leaving droplet was also detected. The relation of these collision outcomes to impact conditions such as Weber number and impact parameter was reviewed and put into regime maps.