SPRAYS FROM DROPLETS IMPACTING A MESH

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In liquid spray applications, the sprays are often created by the formation and destabilization of a liquid sheet or jet. The disadvantage of such atomization processes is that the breakup is often highly irregular, causing a broad distribution of droplet sizes. As these sizes are controlled by the ligament corrugation and size, a monodisperse spray should consist of ligaments that are both smooth and of equal size. A straightforward way of creating smooth and equally sized ligaments is by droplet impact on a mesh. In this work we show that this approach does however not produce monodisperse droplets, but instead the droplet size distribution is very broad, with a large number of small satellite drops. We demonstrate that the fragmentation is controlled by a jet instability, where initial perturbations caused by the injection process result in long-wavelength disturbances that determine the final ligament breakup. During destabilization the crests of these disturbances are connected by thin ligaments which are the leading cause of the large number of small droplets. A secondary coalescence process, due to small relative velocities between droplets, partly masks this effect by reducing the amount of small droplets. Of the many parameters in this system, we describe the effect of varying the mesh size, mesh rigidity, impact velocity, wetting properties, keeping the liquid properties the same by focusing on water droplets only. We further perform Lattice Boltzmann modeling of the impact process that reproduces key features seen in the experimental data.

ACKNOWLEDGEMENTS: This work is part of the Industrial Partnership Program Hybrid Soft Materials that is carried out under an agreement between Unilever Research and Development B.V. and the Netherlands Organisation for Scientific Research (NWO). A.M.M., D.D., and J.C. acknowledge the support by the Swiss National Science Foundation (Project no. 200021 175793). The computational resources were provided by the Swiss National Supercomputing Center (CSCS) under project number s823. The authors thank Emmanuel Villermaux for fruitful discussions.