Journal of Visualization, Vol. 11, No. 1 (2008) 4

Portfolio Paper

Breakup Patterns for Binary Drop Collisions

Testik, F. Y.* and Young, D. M.*
* Dept. of Civil Engineering, College of Engr. and Sci., Clemson University, Clemson SC 29634, USA. E-mail: ftestik@clemson.edu
Received 7 August 2007 and Revised 22 October 2007

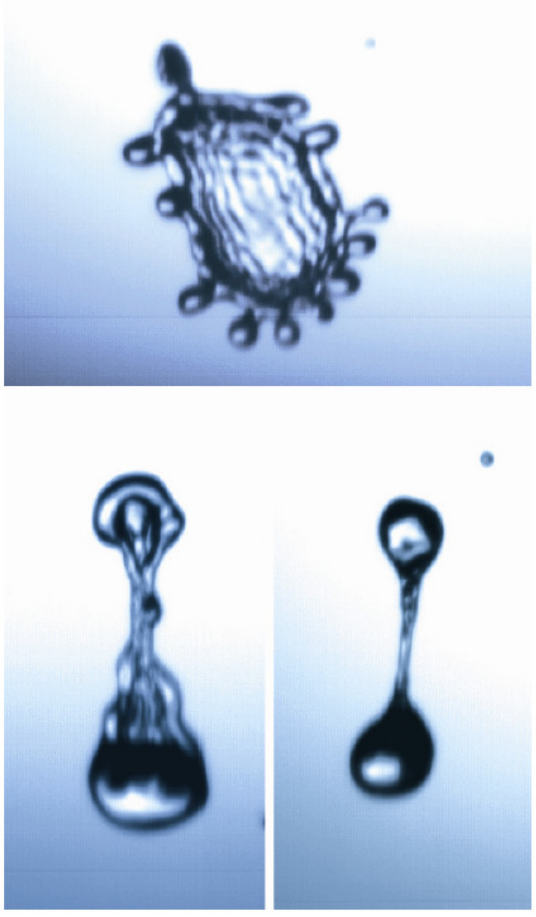

Fig. 1. Disk (top image), sheet (bottom-left image), and neck (bottom-right image) breakup patterns for binary drop collisions. In the experiments, drops are generated by the breakup of water jets formed by the flow of pressurized water through two hypodermic needles. These needles are oriented such that binary drop collisions are produced in the focal plane of a high-speed camera recording at 500 frames per second. The camera is pointed towards a light source and the drop collisions take place between the camera and the light source. The detailed description of this visualization technique is given by Testik et al. (2006) [1].

Colliding drops may breakup if sufficient energy is supplied to overcome the surface tension forces. There are three distinct breakup patterns primarily observed: disk, sheet, and neck breakups (Fig. 1; for details see Testik and Barros, 2007) [2]. In disk breakup, colliding drops temporarily coalesce and a disk of water begins to spread out from the point of impact. During this process, increased drag force acting on the disk-shaped water body causes a rapid deceleration. Once the disk reaches its maximum extent, the outer fringe sheds drops and then the entire disk gradually disintegrates into a relatively large number of fragments. In sheet breakup, the smaller of the colliding drops tears off one side of the larger drop. Subsequently, the bulk of the large drop starts rotating about the point of impact, while an extending film or sheet of water forms from the impact area. The small drop often disappears in this sheet and the large drop becomes strongly distorted. The disintegration of this sheet forms a number of fragments. In neck breakup, a water neck joining the two colliding drops forms due to a glancing contact. The smaller of the drops does not appear to affect the larger drop, except in the immediate vicinity of the point of contact. After separation, the large and small drops are still substantially intact, but fragments form as a result of the breakup of the neck.

References :. (1) Testik, F. Y. et al., Atmospheric Sciences, 63-10 (2006), 2663-2668. (2) Testik, F. Y. and Barros, A. P., Reviews of Geophysics, 45-2 (2007), Art No. RG2003.