

DROPLET BREAKUP IN HOMOGENEOUS AND ISOTROPIC TURBULENCE

F Toschi, TU/e

Turbulent emulsions are key to many natural and industrial processes alike. In presence of an external flow, droplets undergo deformation, breakup and coagulation. In a turbulent flow, breakup of droplets larger than the Kolmogorov scale is influenced by the interplay between surface tension and turbulent fluctuations. The ratio of the two forces can be expressed in terms of the Weber number

$$We(d) = \frac{\rho d u_d^2}{\sigma}$$

where d is the droplet diameter, the velocity difference is estimated on the size of the droplet diameter and surface tension, σ , and density of the fluid, ρ , are also involved. The maximum droplet diameter that does not undergo breakup was estimate by Hinze as:

$$d_{max} = 0.75 \left(\frac{\rho}{\sigma} \right)^{-3/5} \varepsilon^{-2/5}$$

We study the breakup of droplets in a stationary homogeneous and isotropic flow. We consider droplets with the same density of the transporting fluid. The droplets and the fluid are numerically modeled by means of a multicomponent Lattice-Boltzmann method. The turbulent fluid is sustained through a large scale stirring force. Parameters were chosen to keep the radius of stable droplets larger than the Kolmogorov scale while the interface thickness was kept smaller than the Kolmogorov scale. Panels in figure 1 shows droplet deformation and break-up at different times during the simulation. At dilute droplet concentrations we could verify the Kolmogorov-Hinze criteria as well as measure the full probability distribution function of droplets radii in the statistically stationary phase.

The three snapshots show how an initially spherical droplet deforms and breaks when turbulence is switched on.



REFERENCES

1. F. Toschi, P. Perlekar, L. Biferale, and M. Sbragaglia, Droplet breakup in homogeneous and isotropic turbulence, arXiv:1010.1795.

The plot shows the time evolution of the droplet count in a turbulent flow. The inset shows representative droplets configuration at different times.



