TECHNISCHE UNIVERSITÄT DRESDEN

Institut für Strömungsmechanik, Professur für Strömungsmechanik

Vortrag

Physical modeling and numerical simulation of multiphase flows

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Many flows encountered in food processing and other engineering fields are composed of multiple components. Important factors affecting the mass- and momentum transport of mixtures include the physicochemical and microstructural characteristics of the individual components as well as their degree of mixability.

In the first part of this talk, I will present a new phase-field model that can account for all these factors. We utilized the generalized bracket approach of nonequilibrium thermodynamics as the modeling framework. The phase behavior is controlled by the non-random-two-liquid (NRTL) equation. The OpenFOAM implementation of our new model can reliably simulate fully immiscible, partially miscible, and fully miscible systems, as verified by comparison with in-house microfluidics experiments.

In the second part of this talk, I will focus on the modeling and simulation of the bread kneading process. Bread dough is a complex material whose mechanical properties are intermediate between those of a viscous liquid and those of an elastic solid. Because of its elasticity, the mixture overcomes the gravitational forces during kneading, i.e., it moves towards the rotating rod and climbs along with it. To account for the so-called rod-climbing effect, we combined the OpenFOAM volume-of-fluid solver with the viscoelastic White-Metzner model. Our results give valuable insight into the various processes taking place inside the dough and on its surface (e.g., incorporation of air into the matrix, dough pocket formation and breakup). The mixing performance of the kneader may be enhanced by utilizing a more highly curved spiral arm or two spiral arms similar to hand kneading.

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