Modeling and Simulation of Dispersions in Turbulent Flows

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The aim of my **Bachelor's thesis** is the modeling and simulation of the mixing process of two immiscible fluids in a stirrer. Since the flow behavior of those fluids is assumed to be turbulent, the Navier-Stokes equation is extended to the so-called Reynolds-Averaged-Navier-Stokes equation (RANS) in order to describe the flow field in the stirrer. This approach leads to an unclosed system of partial differential equations (PDEs) which can be closed using the k-ϵ turbulence model.

The main interest of this work is the modeling of the second, immiscible dispersed phase which is assumed to be surrounded by the first fluid. Therefore, a population balance equation (PBE) is derived in order to describe the drop-size distribution of the second fluid. A numerical algorithm to solve the PBE is given by the Quadrature Method of Moments (QMOM). The coalescence and breakage of drops during the mixing process are modeled via integral terms which appear as source terms of the PBE.

In my talk I will focus on the mathematical modeling of describing the dispersed phase in a turbulent flow field. Furthermore, I present a numerical algorithm which solves the PDEs for a simplified two-dimensional stirrer. The implementation is validated by numerical test calculations with different Reynolds numbers.

My Bachelor's project was supervised by Jan Heiland and Professor Volker Mehrmann.

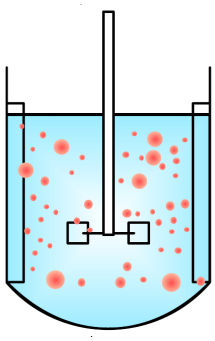

Figure 1: Modeling and Simulation of the Mixing Process in a Stirrer