EVOLUTION OF BUBBLES POPULATION IN A TURBULENT PIPELINE FLOW DUE TO THEIR COALESCENCE

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Bubbles play a major role in many technological processes in chemical, metallurgical and oil and gas industries; and, in many situations, knowledge of and ability to control the bubble size distribution would enable optimizing the outcome of the given process. The size of a bubble is determined by numerous factors, including but not limited to the following: pressure and temperature of the liquid, rate of bubble dissolution, presence of surfactants, flow regime and pattern. In addition, bubble interactions resulting in their break-up or coalescence play an important role in the bubble population evolution.

In the present work, we concentrate on the effect of only one factor, the coalescence, on the evolution of the population of bubbles in a turbulent pipeline flow. The study is carried out through numerical simulations using a combination of continuum and discrete models coupled with the population balance technique [1]. It is based on performing numerical simulations of a representative volume of the system separately, and obtaining information about the micro-processes taking place within the simulation domain (binary collision frequencies between all species, dispersion rates). Several different combinations of species (i.e. bubble size distributions) are used in order to cover the possible states of the system evolution. This information, in the form of the source term function, is then incorporated into a continuous population balance model. Since the simulations are performed on a reduced domain, instead of using the complete physical domain of an industrial application, the current methodology allows studying industrial-scale problems with commonly available computational resources. The effect of the probability of coalescence on the bubbles population evolution along the pipeline will be demonstrated.

References

[1] Y. Leonenko, O. Vinogradov and L. Braverman, "Using discrete simulation of microprocesses in disperse phases in analyzing multiphase flows with reactions", *Chem. Eng. Science*, 60, 1565-1574, 2005

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