PIV-measurements for an optimal reactor design and operation in liquid multiphase systems

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HIGHLIGHTS

• PIV-measurements in thermomorphic organic solvent system at high pressure and around 90°C in a stirred tank reactor with limited optical access
• Determination of influence of solvent system and pressure on the hydrodynamics

ABSTRACT

In the development of an optimal reactor design for the hydroformylation of long-chain alkenes, the hydrodynamics are very important. Because of the difficult reaction conditions, as a toxic thermomorphic organic solvent system, high pressure and high temperature, and the limited field of view in the stirred tank reactor, the measurements are not an easy task. In this work, comparative PIV measurements were executed to find out if the substitution with water at ambient pressure provides similar results and thus simplifies the measurements for an optimization of the geometry.

For this purpose PIV measurements have been performed in a stirred tank reactor under reaction conditions (organic solvents, high pressure, high temperature) and with water at different pressure levels. As expected, the pressure has had no influence on the hydrodynamics, which was expected as liquids are assumed as of the incompressible liquids. Also, and this is much more interesting, the solvents does not have a significant influence on the flow structures, although density and viscosity are rather different. Therefore, further experiments for the validation of the theoretical reactor modelling can be carried out in a model reactor, completely built out of glass, with water filling and at atmospheric pressure. This reduces immensely the level of complexity, and allows the examination of new reactor concepts with much lower effort, at much higher possible precision. A complete hydrodynamic characterization will be possible, opening the door for optimization of the resulting hydrodynamic field and for detailed comparisons with numerical simulations.