Praca dyplomowa inżynierska

Badania procesu mieszania w różnych typach mikromieszalników

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Introduction

Mixing of fluids is a very important operation used widely in chemical engineering. Modern world and tendency to save energy leads to the optimization of mixing, what is only possible, when the relevant physical phenomena are understood. Initially, the scientists were working to describe mixing only on a macroscopic scale. A lot of their discoveries could be applied later in investigations on micromixing, which is a fast developing field in research and development.

Purpose and scope of the work

The purpose of this work is to investigate the influence of micromixer building on mixing. The experimental part of this work was accomplished at the Institut für Mikroverfahrenstechnik (IMVT) in Karlsruher Institut für Technologie in Karlsruhe, Germany.
Scope of this work includes:

- Description of Iodide Iodate Reaction Method,
- Presentation of microstructeured devices for mixing,
- Measurements of pressure drops in several micromixers and optical densities of outlet liquids.

Microstructured mixers

Two series of mixer inlays were investigated: one with rising number of single mixers in a row and 1 mm long (1×1mm, 3×1mm, 5×1mm, 7×1mm) and the second series with one simple mixer but with rising length of the mixing chamber (1×1mm, 1×3mm, 1×5mm).

Design of the Process

The scheme of the set-up for the investigation of mixing processes in microstructured cyclone mixers is shown in Fig. 1.

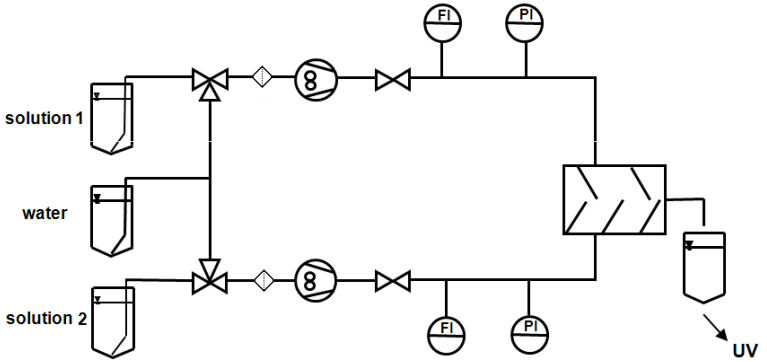

Fig.1. Scheme of experimental set-up

The solutions were pumped by two independently operated gear pumps through the mixer. Pump operating point could be changed by manipulating of the voltage from the computer. Pressure sensors measured the pressure upstream the mixer on-line, whereas the optical density was measured semiautomatically, ex-situ. For each steady state a few milliliters of resulting mixture were collected and put into quartz cuvette to be analyzed by spectrophotometer connecting with the computer. The results (i.e. absorbance spectra) were sending in digital form to dedicated software, where operator of the experimental setup determined the maximal value of the optical densities centered at a wavelength of 353 nm.

Cocnclusions

When the viscosity of feeding solutions were close to 1 mPa·s, mixing processes occurred very efficiently. The obtained results allow to assume, that mixing is completed in first cylinder (when series with rising number of single mixers is considered) and next cylinders make only additional pressure drop.
The length of the cyclone mixing chamber has a small influence on mixing process in low viscous media.
Viscosity plays more significant role in pressure drop in ‘longer mixers’ than in multiple mixers.
Despite the increasing of flow and pressure drop, it is impossible to mix more viscous media as well as water in these range of values, regardless of used mixer.