Praca dyplomowa inżynierska

Investigations on Nano particle precipitation in micro structured mixers

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Introduction

Microprocess engineering is a new approach towards enhanced realization of mass, heat and momentum exchange processes through reducing the characteristic lengths of devices into the range of mili- or micrometers. Inside a microchannel the flow regime is usually laminar, what helps to completely characterize heat and mass transfer problems. Microreactors are commonly continuous flow reactors, with mixing time in range of milliseconds which gives advantage over traditional batch reactors. Channels can be curved or can contain diagonal baffles which enhance mixing through deformation of the liquid.

Task description

The aim of this study was to examine the process of Poly(ε-caprolactone) (PCL) nano particle precipitation via solvent displacement in microengineered devices. All experiments were performed at Institut für Microverfahrenstechnik (IMVT) in Karlsruhe Institut für Technologie in Karlsruhe, Germany.
Scope of this work includes:

- Description of polymer nano particles use for pharmaceutical purposses
- Discussion about solvent displacement and particle size measurment method
- Production of Poly(ε-caprolactone) nano particle solutions in microcyclone mixer and measurment of particle size using dynamic light scattering.

Cyclone Micromixer

Microstructured cyclone mixer was manufactured at IMVT. To the mixing chamber (d=0,5 mm, L =2,5 mm, Fig. 1) lead two parralell inlets. Through those inlets are pumped: water (anti solvent) and polymer solution in acetone. During the contact in the chamber solubility of Poly(ε-caprolactone) decreases and nano particles are formed.

Design of the Process

Schematic representation of Poly(ε-caprolactone) precipitation process and mixing chamber of micro cyclone mixer is shown in Fig.1:

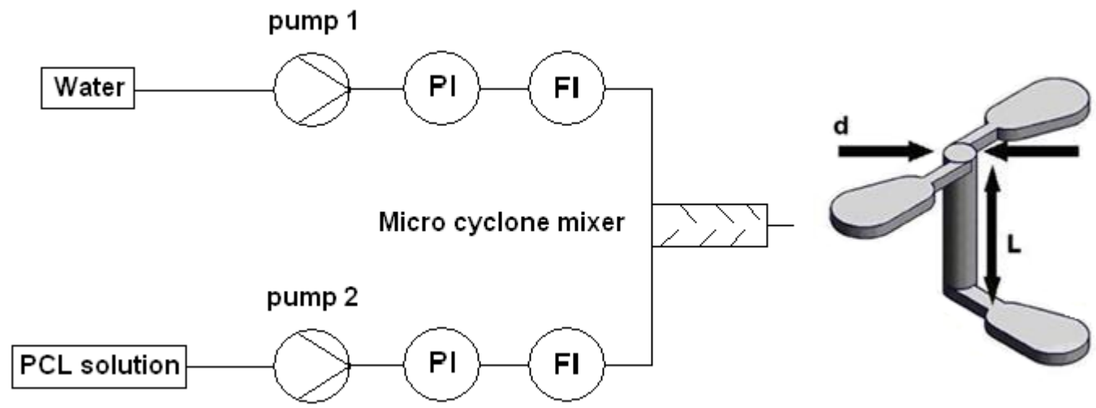

Fig.1. Scheme of experimental set-up and mixing chamber of micro cyclone mixer

Two phases contact inside mixing chamber of the micro cyclone mixer. Nano particles of Poly(ε-caprolactone) are being formed. Final product is collected to the glass bottles. Four different outlet concentration of polymer, three different flow rates and four different water(anti-solvent) to acetone (solvent) had been investigated. Particle size of the obtained solutions was measured in Beckman Coulter, Delsa Nano C Particle Analyzer using Dynamic Light Scattering method.

Conclusions

Experimental results show that total volume flow rate through the mixer does not significantly influence size of obtained poly(ε-caprolactone) nanoparticles in microcyclone in a continuous process. The factors which influence size of nanoparticles are outlet concentration of polymer nanoparticles in solution. Increasing outlet concentration results in increase of nanoparticles size and anti-solvent to solvent content. Increasing outlet concentration results in increase of nanoparticles size. Increasing Anti-solvent content results in decrease of nanoparticle size. Micro cyclone mixer is suitable for nanoprecipitation of poly(ε-caprolactone) . Obtained particles were also monodisperse.