Conference abstract PMS32

Examination of High Pressure Micro Systems by µPIV and CFD Simulations Regarding Abrasion, Particle Deposition and Stress Fields

T. GOTHSCH [1], S. BEINERT [1], J. H. FINKE [2], C. LESCHE [3], S. BÜTTGENBACH [3], C. MÜLLER-GOYMANN [2], A. KWADE [1]

[1] Institute for Particle Technology, Technische Universität Braunschweig, Braunschweig, Germany
[2] Institute for Pharmaceutical Technology, Technische Universität Braunschweig, Braunschweig, Germany
[3] Institute for Microtechnology, Technische Universität Braunschweig, Braunschweig, Germany

E-mail: t.gothsch@tu-bs.de (T. Gothsch)

Sci Pharm. 2010; 78: 659 doi:10.3797/scipharm.cespt.8.PMS32

The dispersion and emulsification in micro channels by high pressure have several characteristics which recommend these methods especially for pharmaceutical applications, e. g. the possibility to use very small educt batches, a narrow residence time distribution and a relatively accurate adjustment of the induced stresses with a good reproducibility. Due to the small dimensions “Cleaning In Place” (CIP) is easy to realize without a large loss of product or time and for high hygienic requirements even the possibility of disposable devices exists. Nevertheless deposits, which can lead to blockages, and the abrasion of the micro systems with the associated product contamination pose big challenges.

In order to determine the dispersion efficiency of different micro channel geometries, experiments with nanoparticle agglomerates were carried out. The results show that the dimensions as well as the geometries of the micro channels influence the dispersion efficiency, the appearance of blockages and the amount of abrasion. Especially areas with low velocities as behind rough edges or oversized in- and outlets run the risk of depositions. With computational fluid dynamics calculations (CFD) and flow measurements (µPIV) areas of low velocities or backflow which run the risk of depositions and the occurence of cavitation are identified and subsequently eliminated or minimized in optimized channel designs.

The CFD calculations are also conducted to get a better understanding of the stress field which leads to the dispersion or emulsification. The turbulent flow fields of the different micro channels were solved and used for a stationary particle tracking. Based on these particle pathes the impressed elongential, shear and turbulent stresses are calculated. The agglomerate size distribution measured after the dispersion experiments are compared to the calculated stresses to determine the mechanisms involved in the dispersion or emulsification.

The authors gratefully acknowledge the DFG for financial support within the DFG research group 856 “Mikrosysteme für partikuläre Life-Science-Produkte“ (mikroPART).