Karlsruher Institut für Technologie

Institute of Process Engineering in Life Sciences
Section I: Food Process Engineering
Prof. Dr.-Ing. Heike P. Karbstein

LVT Lebensmittelverfahrenstechnik

Pro3-Scholarship Project

for Miguel Angel Ballesteros Martínez

Thema: Flow investigations in an optically accessible air-core-liquid-ring (ACLR) atomizer by high-speed imaging.

Strömungsuntersuchungen in einem optisch zugänglichen Air-Core-Liquid-Ring (ACLR) Zerstäuber mittels Hochgeschwindigkeitskameraaufnahmen.

Liquid atomization is an important process step in many parts of food and chemical engineering. For instance, in spray drying processes a feed liquid is atomized into small droplets with narrow size distribution, prior to the drying step. In order to lower the total energy consumption of the process, it is aimed to increase the dry matter content of the feed liquid to a maximum extend. However, with rising dry matter contents, also the viscosity of most feed liquids rises drastically. This fact complicates the generation of small, uniform spray droplets. An approach to atomize high viscous liquids at comparably low energy inputs is the so-called air-core-liquid-ring (ACLR) atomizer (Stähle et al. 2017). This is an internal mixing pneumatic atomizer. In its mixing chamber, a compressed gas core is injected in the middle of the liquid flow by a capillary. This induces an annular flow pattern inside the exit orifice. Thus, a thin liquid ligament is exiting the orifice, which can disintegrate afterwards into small droplets. This atomizer design is based on the assumption, that resulting spray droplet sizes are directly dependent of the flow conditions inside the exit orifice of the atomizer, especially the thickness of the liquid lamella inside the orifice. It is supposed, that spray droplet sizes decrease with increasing gas pressure and decreasing thickness of the formed liquid lamella.

In his internship, Mr. Ballesteros shall investigate the influence of gas pressure, gas flow rate and liquid flow rate on the thickness of a liquid lamella inside the orifice of an optically accessible ACLR atomizer. Therefore, Maltodextrin solutions with different viscosities (up to 0.7 Pa·s) will be used in atomization experiments at the institute's atomizer spray test rig. Gas pressures between 4 and 8 bar will be used. Flow conditions inside the atomizer will be captured by a high-speed camera system. The images will be evaluated concerning mean thickness and temporal steadiness of the liquid lamella. Moreover, resulting spray droplet size distributions will be measured by laser diffraction (Malvern Spraytec). In the end, a better understanding of correlations between process parameters, flow conditions and spray droplet sizes is aspired.

Mr. Ballesteros will present the results of his internship project in the seminar of food process engineering. Three copies of the written project report have to be provided after the project.

Prof. Dr. -Ing. H. P. Karbstein
Begin: X.X.2018
Supervisor: Dr. Volker Gaukel, Marc Wittner

References

Stähle, Philipp; Gaukel, Volker; Schuchmann, Heike P. (2017): Comparison of an Effervescent Nozzle and a Proposed Air-Core-Liquid-Ring (ACLR) Nozzle for Atomization of Viscous Food Liquids at Low Air Consumption. In: *Journal of Food Process Engineering* 40 (1). DOI: 10.1111/jfpe.12268.