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Microencapsulation by high-pressure spraying processes

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Microencapsulation of sensitive substances is applied in food, pharma or cosmetic industry to increase their shelf life or to form controlled release systems. In this study, microcapsules are produced from emulsions from two model substances by high-pressure spraying processes. Polyethylene glycol serves as continuous phase and rapeseed oil as disperse phase.

The mass fraction of the dispersed phase is varied between 0.1 and 0.3. Two spraying techniques are compared regarding their encapsulation efficiency. When using the particles from gas saturated solutions (PGSS) process, the emulsion is mixed with supercritical CO_2 at a pressure of about 8 MPa, before it is atomized and depressurized through a (single-path) hollow cone nozzle. When the emulsion is atomized with the help of a two-path nozzle, the CO_2 is not admixed to the emulsion under high-pressure conditions, but it is used to atomize the emulsion downstream of the nozzle. Both techniques have in common the expanding CO_2 which cools down rapidly after depressurization and freezes the formed (emulsion-) droplets to solid particles.

In the experiments, the emulsions are generated by a flat valve high-pressure homogenizer. The obtained particles are analysed for their total oil content (including the oil bound on the particle`s surface) and their encapsulated oil content as well. The latter is done after rinsing off the oil from the surface using heptane. A standardized sample preparation method is elaborated where the encapsulated rapeseed oil is separated from the shell of polyethylene glycol 6000. The separation is done in hot heptane to melt the particle`s shell and to dissolve the so released rapeseed oil. The amount of triglycerides, which are the main components of rapeseed oil, is quantified by HPLC.

In the experiments some small amount of emulsifier was added to guarantee adequate emulsion stability during processing. Emulsion stability was optimized and checked visually in lab-scale experiments resulting in a mixture of 87% Span 80 and 13% Tween 80.

In the presentation, both spraying processes are compared regarding the resulting particle morphology and encapsulation efficiency as well.