A continuous approach to the aerogel micro-particle production via the emulsion-gelation method

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Aerogel

Due to their large surface area, aerogels can be efficiently used in the development of functional food and in pharmaceutical formulations as carriers for minor components and active ingredients [1,2]. A wider range of potential applications in gas treatment, humidity control and other areas can also be foreseen. To fulfil requirements of many potential applications aerogels should be often prepared in the form of round (micro)particles of a specific size.

Emulsion-gelation method

The idea that a gelling system (sol) may be shaped into spherical particles underlies the so-called emulsion gelation method. In this process the gelation reaction takes place in a continuous phase (oil) that is immiscible with the sol. With the appropriate emulsification device the sol droplet size can be controlled and tuned before triggering (chemically or physically) the gelation in emulsion. The resulting gel particles of micrometer sizes (0.5 – 200 µm) should be recovered, solvent exchanged and supercritical dried to yield aerogel micro-particle.

Continuous emulsion-gelation process

Even though the emulsion-gelation has been extensively used at lab-scale for various system (*e.g.* alginate, chitosan, starch, silica [3–7]), little has been done to bring the production capacity up. To address this problem, we propose a continuous emulsion-gelation process where an in-line rotor stator machine produces the emulsion and the gelation is triggered by adding a crosslinking solution in-line. The process parameters were identified and related to phenomenological models of the various process steps to improve our understanding and to facilitate the scale-up.

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[1] K.S. Mikkonen, K. Parikka, A. Ghafar, M. Tenkanen, Trends Food Sci. Technol. 34 (2013) 124–136.
[2] I. Smirnova, P. Gurikov, Annu. Rev. Chem. Biomol. Eng. 8 (2017) 307–334.
[3] E.E. Hassan, R.C. Parish, J.M. Gallo, Pharm. Res. 9 (1992) 390–397.
[4] C.A. García-González, J.J. Uy, M. Alnaief, I. Smirnova, Carbohydr. Polym. 88 (2012) 1378–1386.
[5] M. Alnaief, M.A. Alzaitoun, C.A. García-González, I. Smirnova, Carbohydr. Polym. 84 (2011) 1011–1018.
[6] V.S.S. Gonçalves, P. Gurikov, J. Poejo, A.A. Matias, S. Heinrich, C.M.M. Duarte, I. Smirnova, Eur. J. Pharm. Biopharm. 107 (2016) 160–170.
[7] M. Alnaief, I. Smirnova, J. Supercrit. Fluids 55 (2011) 1118–1123.