

# Kinetics of Supercritical Drying for Production of Aerogel Particles: Effects of Process Parameters and Gel Properties

Organic aerogels in the form of particles are getting increasing attention for development of a wide variety of products for drug delivery, biosensing, nutrition and adsorption [1,2] due to their unique properties such as high porosity, high surface area, low density and biocompatibility. Moreover, organic aerogels can be synthesized from a variety of starting materials like natural polymers and proteins. Therefore, their properties can be adjusted depending on the desired area of application. The most important step in the production of aerogels is supercritical drying of wet gels by which the pore filling solvent is removed by supercritical CO<sub>2</sub> via several mass transport mechanism preserving the open pore network and desired material properties. Development of a model for the kinetics of this process is very useful for design and optimization of industrial scale supercritical drying units for production of aerogel particles. Previous studies on kinetics of supercritical drying have mostly focused on the drying of inorganic gels in the forms of monoliths [3]. Therefore, there is a need to study the drying of wet gels in the form of particles. In this study, kinetics of supercritical drying of several organic gel particles in a packed bed was studied. Spherical hydrogel particles were prepared by the dripping method. The hydrogel particles were subjected to a stepwise solvent exchange procedure with ethanol before supercritical drying. The effects of gel properties such as porosity, density and material chemistry on the drying kinetics were investigated in detail. The effects of process parameters including drying temperature, pressure and CO<sub>2</sub> flow rate were varied between 310 – 355 K, 85 – 170 bar and 2- 4 NL/min for drying of different organic gel particles. A mathematical model which takes into account diffusion of the solvent inside the pores, external mass transfer of the solvent from the surface of the gel particles into the flowing CO<sub>2</sub> stream, and convection and axial dispersion of the solvent in the flowing stream was developed. A good agreement between the experimental data and model results was observed. Finally, simulations were performed using the developed model for scale-up and optimization purposes.

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## References

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