

Investigation of External Mass Transfer Effects in Supercritical Drying of Alcolgel Particles

İbrahim Şahin^{a*}, Erdal Uzunlar^b, Can Erkey^a

a Department of Chemical and Biological Engineering, Koç University, Istanbul, Turkey

b Department of Chemical Engineering, Izmir Institute of Technology, Izmir, Turkey

*isahin@ku.edu.tr

Organic aerogels in the form of particles are considered as promising materials for a wide variety of applications such as drug delivery, biosensing and food technology due their unique properties and biocompatibility [1]. Supercritical drying of wet gels to obtain aerogel particles by removing the pore filling solvent occurs via several mass transport mechanisms and is a crucial step to preserve the desired material properties such as high porosity, high surface area and low density. Models for predicting the kinetics of this process are very beneficial for design and optimization of industrial scale supercritical drying units. Previous studies on kinetics of supercritical drying have been generally limited to drying of inorganic gels in the forms of monoliths [2]. Therefore, there is a need to study the drying of wet gels in the form of particles. In this study, we investigated supercritical drying of alginate gel particles in a packed bed as a model system. Spherical calcium alginate hydrogel particles were prepared by dripping a 1.5 wt% aqueous alginate solution into a 0.2M aqueous CaCl₂ solution. The hydrogel particles were subjected to a stepwise solvent exchange procedure with ethanol before supercritical drying. The effects of operating conditions and gel dimensions on the drying kinetics were investigated in detail. Drying temperature, pressure and CO₂ flow rate were varied between 310 – 355 K, 85 – 170 bar and 2- 4 NL/min. A drying 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 CO₂ stream, and convection and axial dispersion of the solvent in the flowing stream was developed. By fitting the model to experimental data, a correlation for predicting external mass transfer coefficients for supercritical drying of spherical alcolgel particles at a wide range of conditions was developed. A good agreement between the experimental data and model results was observed using this correlation.

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References

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