Modelling of the extraction processes for aerogel production

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Aerogels based on natural polymers have a high potential for different applications, especially for life science, due to their biocompatibility and sustainable source of raw materials. However, the production of such aerogels is still limited to the lab scale. The scale up of the corresponding processes requires deeper understanding of all process steps involved in the transformation of polymer-based hydrogels to aerogels. A reliable model allowing the adequate description and scale up of the solvent exchange and supercritical drying for this type of aerogels is still missing. Therefore the aim of this work is to build such a model taking into account the most relevant phenomena during the solvent extraction, such as diffusive and convective solvent flow during extraction steps; density change during the solvent exchange and supercritical drying; shrinkage of the gel; mutual solubility of the solvents involved at different pressure and temperature; geometry of the gel. The model is based on takes into account both the mass transfer and thermodynamic equilibrium data and helps to identify the optimal process conditions to minimize the gel shrinkage and the drying time. Based on the experimental data for alginate and protein aerogels, all relevant model parameter are estimated and the model is validated at different process conditions. Finally, recommendations for the optimal process conditions for certain aerogel types are given.

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