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The application of flory-huggins-thermodynamics for industrial membrane manufacture via evaporative casting

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Evaporative casting is well known technique used for the industrial manufacture of macroporous membranes. Such membranes result from the demixing of a homogeneous casting solution. Common industrial casting solutions are quaternary systems which consist of a polymer blend, a solvent and two nonsolvents. The structure and the performance of the produced membrane are guided by the thermodynamic properties of the solution and the kinetics of the occurring mass and heat transfer phenomena.

The thermodynamic properties of polymer solutions are well described by the Flory-Huggins-Theory. In this work we combine Flory-Huggins-Thermodynamics with state of the art numerical methods in order to predict phase diagrams for ternary casting solutions as well as for quaternary solutions.

Particular attention has to be dedicated to the determination of the binary interaction parameters and we will present a conventional route that leads to these parameters. Furthermore, we describe the numerical set-up that has been implemented for the above mentioned prediction.

We also try to improve the Flory-Huggins-Theory with further information about the physical properties of the solver and the nonsolvers to make the Flory-Huggins-approach more precise.

Finely we will present some examples that demonstrate how one may combine the drying paths during the membrane formation process with the calculated phasediagram to predict the structure of the membrane.

Keywords: evaporativ casting, Flory-Huggins-Thermodynamic, phasediagrams, drying paths

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