Comparison of integral and local drying behavior of thin organic films on flat plates

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A common geometry for drying experiments is a flat plate which is horizontally arranged within a flow channel. Gas phase mass transfer determines the drying rate in the beginning. With increasing drying time the limitation of the diffusion in the drying film dominates the total mass transport coefficient. For an accurate interpretation of experimental data the local gas phase mass transfer coefficient and its variation on coated surface in flow direction has to be considered.

For this contribution, drying experiments with a polymer solution (polyvinyl alcohol and water as solvent) were carried out. Integral drying curves were received by measuring the weight loss of the drying polymer film. The Inverse-Micro-Raman-Spectroscopy was used to determine drying curves at one local position within the middle of the film. In addition, component distributions in dependency of the film height can be measured. Gas side conditions like gas phase temperature and gas flow conditions were kept constant at both experimental set-ups. Drying curves were calculated by a numerical simulation considering local gas phase mass transfer coefficients, diffusion limitations in the liquid phase and changes in the concentration boundary layer during the drying process (moving drying front). A comparison of numerical and experimental results confirms that this model approach is suitable to calculate local and integral drying curves on flat plates with high accuracy.