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● Visualization of capillary phenomena at the origin of "framing effect" of liquid coatings

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Abstract content

In many industrial applications, liquid coatings are used to add technical functionalities or esthetic properties to materials. Wet-processing application of these multi-components fluids may result in surface irregularities due to process or environmental conditions or coating characteristics when applied to substrates [1]. "Framing effect" is a coating defect due to capillary phenomena resulting in a liquid excess at the edges of coated substrate which can be troublesome in particular regarding visual perception. This study enables a deep understanding on liquid coating formation dynamics and more precisely on solutal and thermal phenomena involved during film formation. Recent studies consider liquid viscosity, film thickness as major parameters for framing effect formation [1]. Objectives of this study is to show that coating physicochemical properties have also an influence on it taking into consideration capillary effects and Marangoni-type material flow [2]. Film characteristics, surface topography as well as multi-physical aspect of evaporation process are taken into account to understand final coating topography and framing effect dynamics.This study has shown that solvent volatility and surface tension additives have a major influence on framing effect dynamics and therefore in its final topography. Dynamic deflectometry results allowed a comprehensive evidence of coating flow throughout evaporation process. Moreover, PIV study has been carried in order to perform instantaneous velocimetry measurements evaluation and visual characterization of fluid motion. It enabled an understanding on coating internal dynamics in relation to coating physico-chemical parameters. Correlation were also made between Marangoni number, calculated for each coating formulation and PIV results.

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References
[1] Sommer et al., "Investigation of Coating Liquid Layer Behaviour at Curved Solid Edges", Applied Mechanics and Materials 831, 2016, 126–143 [2] Abbasian et al., "Study on different planforms of paint's solvents and the effect of surfactants (on them)", Progress in Organic Coatings 49, 2004, 229–235

introduction on framing effet height and curvature

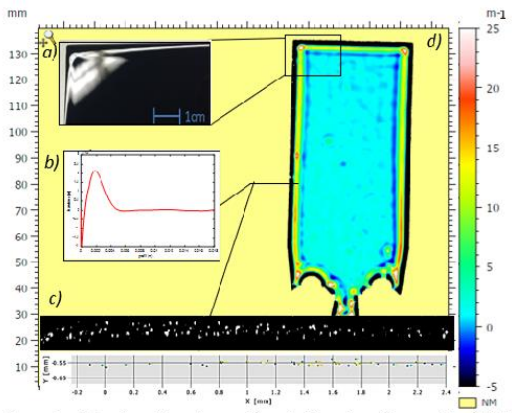

Figure 1 : a) framing effect picture, b) typical framing effect profile, c) PTV recording image and post-treatment, d) deflectometry curvature map