Cambridge Polymer Group

Droplet Breakup Aids Fluid Processing

Summary

Coating flows are complex rheological processes, involving shear and extension in the deposition region. However, many of the issues with reliable fluid deposition occur after the deposition where fluid stringing or misting can substantially limit the ultimate processing speed and product quality. Understanding the basic breakup kinetics of the deposited fluid can lend substantial insight into the mechanisms of the coating process and control and improve the manufacturing process.

Description

Deposition of fluid often involves pumping and then a rapid retraction of the nozzle which results in a liquid bridge that is dramatically stretched away from the coating surfaces. In this condition, the dominant forces in the fluid are surface tension, which acts to "pinch off" the liquid bridge, and the extensional viscosity, which resists this force. A mismatch between the forces and the deposition timescales can result in long-lived filaments that impact surface finish and coating stability.

The Capillary Breakup Extensional Rheometer (CaBER®) directly probes the balance between the extensional viscosity and the surface tension acting on the filament and can elucidate not only deposition processes but coating flows, as well as the properties of foods, inks and consumer products.

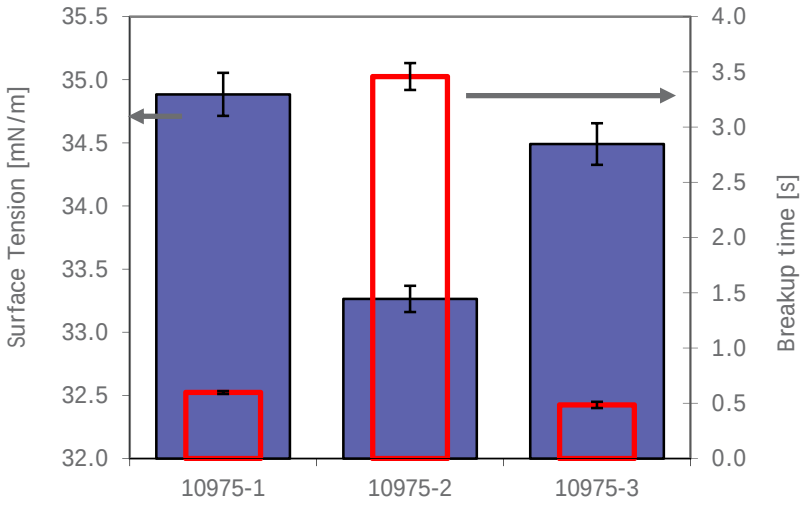
Key Points

Spraying, coating, filling and pumping are all influenced by this poorly characterized property

Extensional viscosity can also be used as a diagnostic tool in medicine since the rheology of physiological fluids is strongly influenced by dissolved proteins

Analysis

Deposition of elastomer on circuit board fab line showed 'tailing' with some lots. Surface tension and filament breakup rheometry showed significant differences in 'good' vs 'bad' lots. Lower surface tension lead to increased breakup time of filaments. Extensional viscosity dominates bridge breakup kinetics. Understanding extensional rheology helps clarify many unexpected observations.



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