Effect of rheological characteristics of non-Newtonian liquids on liquid curtain stability

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Curtain coating is one the preferred methods for high-speed precision application of single layer and multi-layer coatings in industry. Despite the extensive variety of applications of curtain coating, its operation is challenging and uniform coating is only obtained in a certain range of operating parameters, called the *coating window*. The two main physical mechanisms that limit curtain coating are the breakup of the liquid curtain, below a critical flow rate, and the catastrophic event of air entrainment, which occurs above a certain web speed. The rheological characteristics of the coating liquid play an important role on these mechanisms, but the fundamental understanding of the effect of rheology is still not complete.

In this work, we analyze the relative importance of shear and extensional viscosity on both curtain breakup and instability of dynamic wetting line (i.e. air entrainment). Aqueous solutions of polyethylene oxide (PEO) and polyethylene glycol (PEG) of different molecular weights were used as model liquids to obtain fluids with different levels of extensional thickening behavior. It was found that the extensional viscosity has a large stabilizing effect on the stability of liquid curtain. The extensional viscosity of viscoelastic models also enhances the stability of the dynamic wetting line by delaying the onset of air entrainment and the onset of heel formation. Hence the extensional

viscosity can enlarge the coating window in successful curtain coating.

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