ECFP

Extensional Rheology for process optimisation and formulation characterisation

Extensional rheology contributes to our full-suite of rheological characterisation capabilities at Edinburgh Complex Fluids Partnership

Context

Complex and non-linear flows surround us in our everyday lives in foods, cosmetics, cleaning products, pharmaceuticals, fuels and cement mixing, to name a few. Studying the rheological properties of complex fluids is therefore of great interest for many commercial applications. The flow behaviour of a large range of complex fluid flows of industrial interest display mixed kinematics with regions of shear and elongation. Rheological characterisation is often limited to pure shear flows, neglecting the important role of extensional deformation. At ECFP we study both shear and extensional rheology and how these both contribute to processing and product performance.

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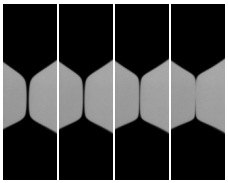
Process Optimisation

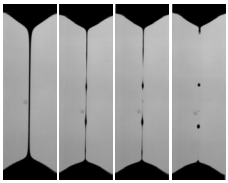
Formulations can behave differently in response to changes in processing conditions. Extensional rheology has proved crucial to understanding the flow of inks at different printing speeds.

Low Speed: V=0.02m/s



Time

High Speed: V=0.2m/s



Time

At low speeds the filament formation and breakup as an "unfirm" filament, increasing speed leads to droplets formation. Droplets can then lead to printing defects as misting and ink accumulation, decreasing printing quality.

Product characterisation

Often, we come across topical formulations that do not feel great when applied onto the skin. One undesirable sensory property is "stickiness". Understanding why a formulation is perceived as sticky and how to overcome that is important.

Stickiness can be a result of a formulation forming tiny threads between two distinct skin surfaces that take a noticeably long time to break. This behaviour is related to the extensional rheology of the sample, driven by the elastic properties of a fluid, which in turn are driven by formulation choices including polymer concentration and molecular weight.

Email: ecfp-info@ed.ac.uk
Telephone: +44 (0)131 650 5883
www.edinburghcomplexfluids.com

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