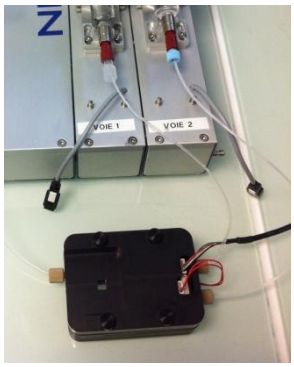
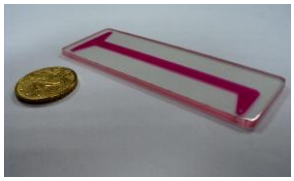
Sprayability of xanthan solutions





APPLICATION

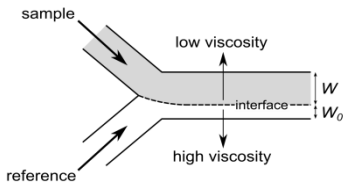
Consumer products, formulation

OBJECTIVE

Analyse the sprayability of xanthan solutions at high shear rates.

Microfluidic Rheometer Principle

A sample and a viscosity standard are introduced together in a microfluidic flow cell.



The interface position is simply related to the viscosity ratio between the sample and the reference. Images of the laminar flow are automatically acquired by an integrated microscopy system.

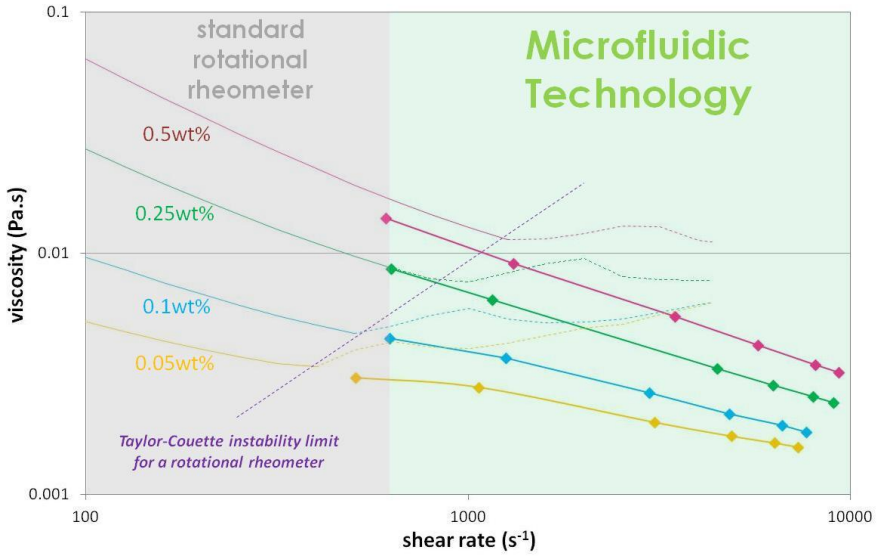
From these pictures, our software extracts the sample viscosity as a function of the shear rate (flow curve) using a patented method.

Many consumer products are distributed as sprays. To be sprayable, a formulation must fulfill some viscosity conditions that are conveniently adjusted using polymers. Accessing the rheological behaviour is therefore critical to predict sprayability. However, when pushed through a nozzle, the liquid product is submitted to shear rates much larger than the maximal value accessible using a rotational rheometer (limited to $10^3 s^{-1}$).

Using our microfluidic technology, fast and user-friendly viscosity measurement at very high shear rates (up to 10^5 s^{-1}) becomes possible. Using an in-line active mixer, flow curves as a function of concentration are automatically plotted, further reducing the analysis time.

Rheological analysis at high shear rates

Flow curves of xanthan solutions diluted in water at various concentrations are plotted in the graph below. Results obtained with a rotational rheometer and using our microfluidic technology are compared. The geometry of the microfluidic cartridge we chose for this measurement allows shear rates between 10^2 and 10^4 s^{-1}. Shear rates larger than 10^5 s^{-1} are accessible using another disposable plastic cartridge.



Both techniques are in good agreement. However, at shear rates below 1000 s^{-1}, the rotational rheometer faces a physical limit (the so-called Taylor-Couette instability, inducing liquid vortexes in the flow). On the other hand, our microfluidic technology enables:

- **High shear rates measurements up to 10^5 s^{-1}**
- **Fast and user-friendly analysis**

The total experiment duration to obtain these flow curves with our technologyis **24 minutes**, versus **4 hours** with the rotational rheometers.

- **High throughput screening of sample concentrations**

Plotting flow curves as a function of concentration is usually a labor intensive task, involving repetitive manual steps, prone to **experimental errors**. Our microfluidic technology enables an **automated formulation** step. Polymer concentrations can easily and accurately be adjusted, preventing experimental errors and considerably reducing the experiment duration.

Conclusion

Our microfluidic rheometer helps formulation by analyzing the sprayability of polymer solutions under very high shear rates, mimicking the flow though a nozzle. Furthermore, rheological analysis as a function of concentration is made faster (10x), easier and more accurate using an in-line active mixing module.

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