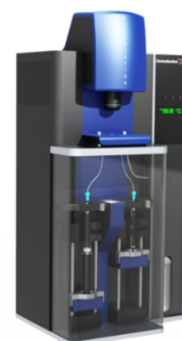


Mimicking real life behavior of common cosmetic products



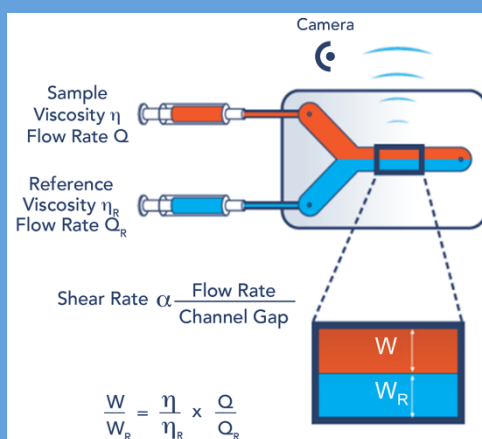
Introduction

The texture, practical application and final customer appreciation of many cosmetics are governed by their rheological properties. During the formulation and designing process, it is essential to consider viscosity dependence to shear rate applied when handling these products. Most are complex formulations that need to embrace various rheological behaviors depending on desired customer use. Current available technologies do not allow to fully study the behavior of home and personal care products as they are limited by accessible shear rates. Following table presents estimated shear rates for some common applications.

Application	Shear rate
Spraying	10^5 s^{-1}
Spreading on skin	10^4 s^{-1}
Rubbing	10^4 s^{-1}
Pouring	10^2 s^{-1}
Squeezing out of dispenser	10^3 s^{-1}

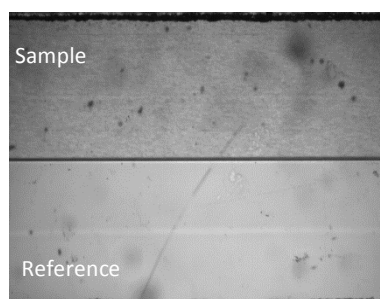
Reminder on the technique

FLUIDICAM RHEO uses a co-flow microfluidic principle to measure viscosity of various products. A sample and viscosity standard are introduced together in the microfluidic channel (typically 2.2mm X 150µm) where they undergo strong confinement. Applied shear rate is simply adjusted by a computer-controlled syringe pump. Under these conditions, the interface position is related to the viscosity ratio between the sample and the reference. Images of the resulting laminar flow are acquired thanks to an integrated camera and the viscosity of the sample is automatically extracted as a function of shear rate and plotted directly in the software giving a resulting rheological curve.

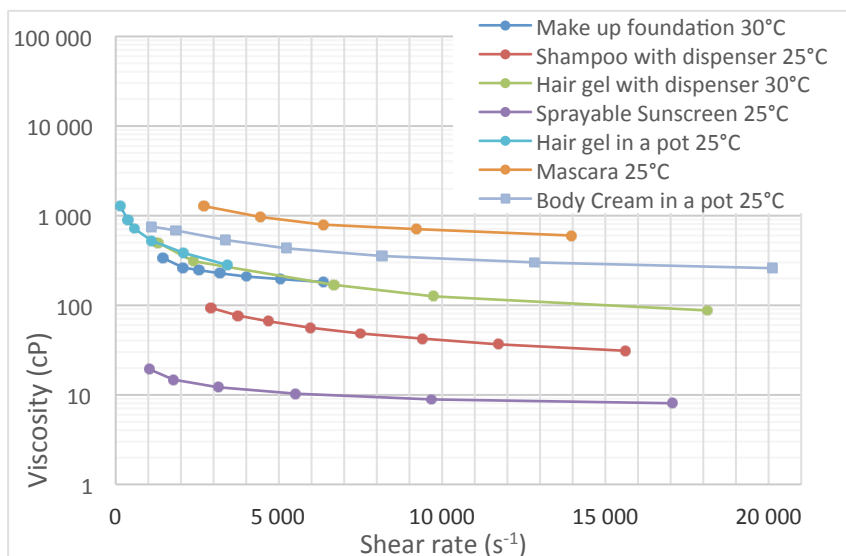


Experimental results

Several cosmetic products (hair gel, shampoo, sunscreen, make up foundation) were tested at wide shear rate ranges (500 to 20 000 s^{-1}). Samples were simply introduced into adapted syringes which later were clipped to the syringe holders and images (example below) were acquired at each shear rate.



1) Comparing flow curves of various cosmetic products



The most thick formulations are the ones which present the highest viscosities: mascara, body cream, or hair gel. All are well shear thinning and thus can be measured with Fluidicam even at high shear rates. Also, as expected shampoo that need to flow easily out of tube and sunscreen, that is to be sprayed, present lower viscosities.

Fluidicam requires less than 4mL of sample and less than 5min for each flow curve and allows to achieve high shear measurements.

Fig 1. Viscosity of various cosmetic products as a function of shear rate

2) Spraying properties of various sunscreens

The efficiency of a sunscreen lays, among others, with its faculty to spread evenly on the skin surface. In a spray, this complex creamy formulation must pass through a narrow nozzle and thus, be subjected to high shear rates. Understanding rheological behavior at high shear rates can help identify good formulations at early stages of development.

Several sunscreens have been tested, all are creamy formulations with sun protection factor 50. It can be noticed that different brands present slight variations in viscosities. Brand B is highly viscous at very low shear rates, which can be an indication of good stability. It also presents obvious shear thinning behavior. Both Brand A and B have similar behavior at high shear rates, but Brand A seems to keep the liquid aspect even at low shear rates. Brand C – lower price range – seems to be more liquid at high shear rates.

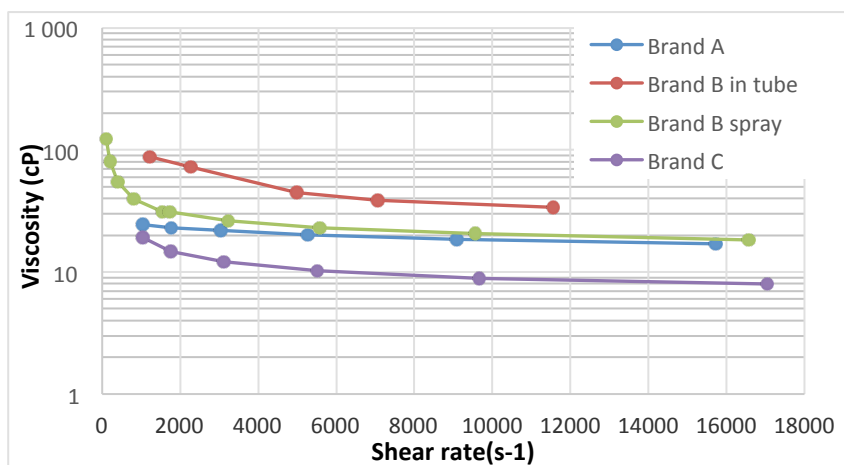


Fig 2. Viscosity of different sunscreen formulations as a function of shear rate (25°C)

Conclusions

Simplicity and easiness of the technology make viscosity analysis time and sample saving. This micro channel configuration allows analysis at strong confinement which replicates real life behavior of everyday cosmetics. FLUIDICAM RHEO allows very good repeatability even at high share rates. In addition, as the instrument operates at flow, no additional sampling is required to replicate the measures.

Key Benefits

- FAST and SIMPLE – Single click set-up experiment for shear rate and temperature screening
- ACCURATE – Continuous comparison to a reference solution
- LOW SAMPLE VOLUME – Less than 1 ml of sample usually consumed

