

Applications for the Rheology Solutions OnLine Rheometer



An innovation in rheometry, the Rheology Solutions OnLine Rheometer (OLR) measures the flow properties of fluids within the process pipe.

“We see how quickly
through the colander
The wines will flow;
on the other hand,
The sluggish olive-oil
delays; no doubt,
Because, tis wrought
of elements more large,
Or else more crook’d
and intertangled.”

LUCRETIVS (96 - 55 BC)
FROM “OF THE NATURE OF THINGS”

The OLR delivers fast, accurate results with a single measurement over a range of frequencies. Its simple geometry and stainless steel construction allow for easy cleaning-in-place (CIP).

ONLINE RHEOMETER

Currently most industrial rheology measurements are made using capillary viscometers and vibrating probe viscometers. Viscometers only measure viscosity and given that the majority of process materials are viscoelastic (exhibit both viscous and elastic behaviour) it is important to measure both of these factors in order to fully analyse the flow properties.

Most common viscometers and rheometers operate at a single frequency (or shear rate) at any one time. In order to measure over a frequency range a frequency sweep is undertaken by increasing the frequency one step at a time and measuring the rheological properties. This can be time consuming and is not recommended for dynamic systems (rapidly changing or flowing).

The importance of measuring the rheological properties of a fluid over a range of frequencies is shown (right) in the graph of the complex viscosity as a function of frequency for viscoelastic toothpaste

compared with Newtonian oil. These data were measured using the

RHEOLOGY SOLUTION'S OLR.

The toothpaste and the oil exhibit very different flow properties but if they were measured at a single frequency of 10 Hz they would appear to have identical values of complex viscosity. The online rheometer can quantify the viscoelastic flow properties of a process fluid over a range of frequencies (generally 1 – 100 Hz) in a very short time making it an ideal instrument for real time industrial process control.

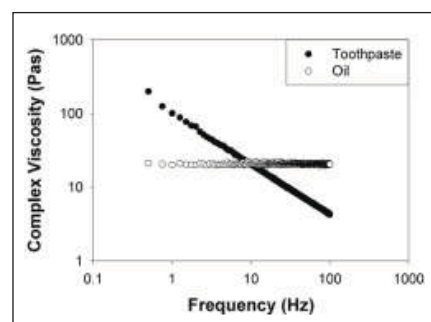


Figure 1: Complex viscosity as a function of frequency of toothpaste (•) and oil (◦)

APPLICATIONS

The simple and robust design of the OnLine Rheometer makes this instrument suitable for

a wide range of industrial applications. Some of these applications are discussed below.

LUBRICATING GREASES

Lubricating greases are rheologically complex materials. They are required to provide a protective barrier under extreme operating conditions.

Figure 2 shows the complex viscosity as a function of frequency for an extreme pressure grease as measured by the OLR. The decreasing viscosity with increasing frequency (or shear rate) is known as "shear thinning". This behaviour is an essential characteristic of greases in order to facilitate lubrication at high frequencies during the high speed movement of the lubricated surface. When the surfaces are at rest the viscosity of the grease increases providing a protective barrier.

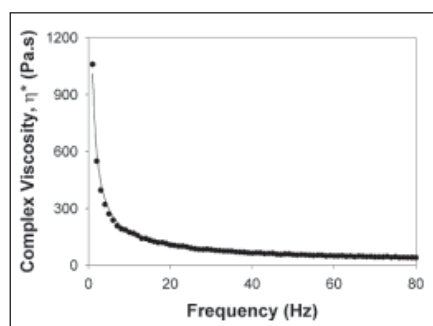


Figure 2 Complex viscosity as a function of frequency of extreme pressure grease.

INKS AND PAINTS

Many inks and paints are subject to harsh application procedures, the success of which depends on the rheological properties of the fluids.

Lithographic inks are used on a printing press for the production of magazines and newspapers. The ink is applied to a printing plate and transferred to a roller and then to the paper. This is an extremely fast process and the rheological properties of the ink must be such that the ink spreads easily onto roller and is transferred to the paper without bleeding or tearing the paper.

When paint is applied to a surface via a spray gun it needs to flow easily out of the nozzle but thicken and harden when it comes in contact with the surface without running or sagging.

With these liquids, characterisation of viscoelastic properties can be the key to effective production process control.

FOODSTUFFS

Bread: The elasticity of bread dough influences the texture of the final bread product.

Chocolate: The viscosity of melted chocolate must be well controlled to allow flow into moulds without difficulty or effective dipping of coated confectionary.

Food Sauces: Many food sauces contain bio-polymer-based gums (Guar gum, Locust bean Gum, etc) to manage the flow properties and add texture. A bottle of one of these typical sauces, when inverted will not dispense the sauce quickly, until the bottle is shaken (applying a higher shear rate to the sauce) and the sauce thins and flows.

HOUSEHOLD

The quality and usability of many household items including toothpaste, shampoo, laundry liquids and cosmetic creams depend on their rheological properties. By controlling these properties during the manufacturing process using an instrument such as the OLR, the product quality can be tightly controlled.

OTHER APPLICATIONS

Other potential applications of the OLR include the processing and manufacture of petroleum products and bio-polymers.

the **OLR** *keeps your process in line*



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