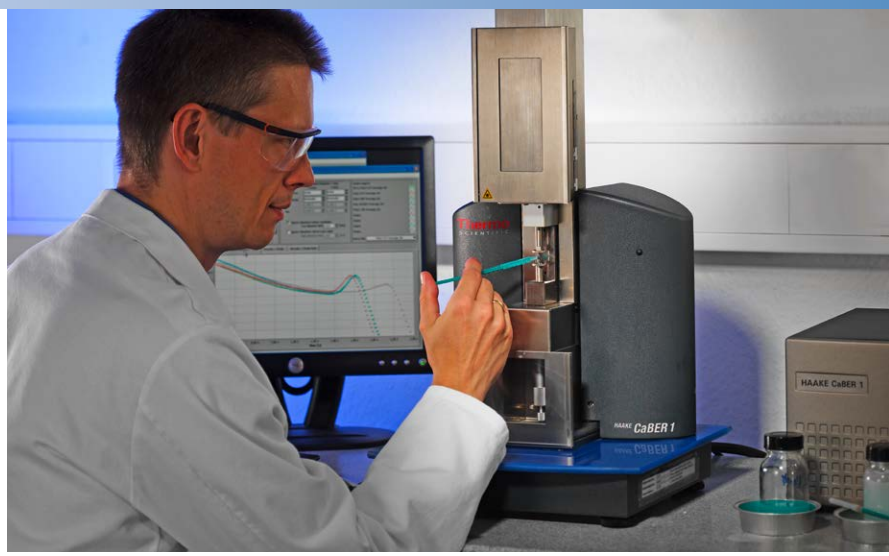
Thermo Scientific HAAKE CaBER 1

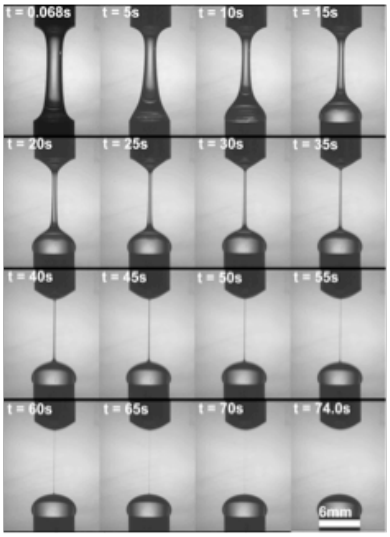
Analyzing and Quantifying Extensional Flow Properties



Complex flows that contain strong extensional flow fields occur in many industrial processes and applications. Some examples are coating flows, fiber spinning, spraying and printing as well as chewing and swallowing.

Materials that might behave very similar in steady shear or Oscillation can behave completely different in an extensional flow field. Hence, knowledge of the extensional behavior is crucial in understanding your fluids behavior towards a certain application or process. Knowledge you will only be able to gain via working with the Thermo Scientific HAAKE CaBER 1*, the only commercially available Extensional Rheometer for fluids on the market.

* The HAAKE CaBER was developed by Cambridge Polymer Group (CPG) based on the pioneering work of Russian scientists Entov, Rozhkov and co-workers in capillary break-up rheometry.



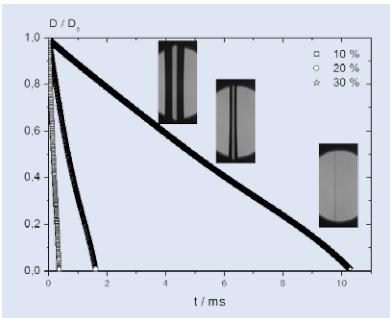
Filament thinning during HAAKE CaBER experiment

Principle of Operation:

A small quantity of sample is placed between two circular plates. The top plate is rapidly separated from the bottom plate at a user-defined speed, thereby forming a filament by imposing an instantaneous level of extensional strain on the fluid sample.

After stretching, the fluid is squeezed together by the capillary force imposing an extensional strain on the fluid. A laser micrometer monitors the midpoint diameter of the thinning fluid filament as a function of time.

The relevant extensional parameters of a given fluid, i.e. extensional viscosity and extensional relaxation times can then be quantified.



Normalized filament diameter during HAAKE CaBER experiment for PDMS mixtures

Thermo SCIENTIFIC

SRC Spectra Research Corporation
Toll Free : 1-866-753-4433 www.spectraresearch.com

Application Solutions

Food

No matter if you are formulating food products or designing specific food additives, understanding the extensional flow properties is key to success as they play a major role in a wide range of applications and processes present in food industry.

No matter if you need to understand specific processing steps like pumping or filling of a fruit juice or the mouthfeeling of a polymer stabilized yoghurt during oral processing, the HAAKE CaBER provides you with quick and reliable results.

Those results in regards to your product's extensional behavior can then be correlated directly with its performance towards described processes, like i.e.:

- Chewing
- Coating
- Pumping
- Swallowing
- Spraying
- Filling

Petroleum

Due to its very distinct chemical composition, every crude oil behaves differently towards flow fields occurring at various upstream processes in a wide range of temperatures. Extensional flow fields are present during exploration and recovery as well as during transport.

Here the knowledge of the extensional properties of your crude as well as the individually composed additives you are dealing with is key to success, no matter if you need to manage an oilfield, operate a pipeline at top performance or design supporting fluids for the petroleum industry.

Minimizing cost while keeping the performance at an optimum level is of utmost importance, no matter if you are dealing with:

- Crude Oil
- Dispersions
- Surfactant Solutions
- Emulsions
- Polymer Solutions

Inks and Coatings

In most industrial coating techniques like spraying, curtain coating, or blade coating, strong extensional flow fields occur. Accordingly, not only shear but also extensional flow properties of the corresponding complex formulations have to be investigated intensively with respect to processing or application properties like i.e. droplet formation, misting, atomization or curtain stability.

- Curtain Coating
- Spraying
- Misting
- Offset Printing
- Droplet Formation

SRC Spectra Research Corporation
Toll Free : 1-866-753-4433 www.spectraresearch.com

No matter if you are interested in emulsions, solutions or dispersions, the visco-elastic properties determining a food behavior towards the described applications and processes, of course, depend strongly on its formulation.

Polymer or protein additives, as well as solid particles that you introduce to your food products in order to perform a certain task like i.e. stabilizing or gelling, that enhance the customers' perception have a strong influence on the visco-elastic response towards described extensional flow fields.

Food products where the extensional flow properties have a pronounced impact of its industrial and oral processing behavior are:

- Dairy Products
- Beverages
- Condiments
- Pastries
- Chocolates and Sweets

No matter if you are involved in enhanced oil recovery (EOR), polymer flooding or drag reduction, adding polymers, solids or surfactants will change the visco-elastic behavior of either your crude oil or supporting fluid towards extensional flow fields.

This very behavior has to be custom-tailored towards optimum performance in extensional flow fields occurring during flow through porous media and pumping for a wide range of fluid types and applications like i.e.:

- Polymer Flooding
- Surfactant Flooding
- Displacement Fluids
- Retention Fluids
- Drag Reduction

Independent, if you are working with low visco-elastic, waterborne coatings or high visco-elastic printing pastes, your product will show significant differences in its processability, depending on its formulation.

Understanding the relation between extensional flow behavior and composition of your product is the key to your success.

- Water-borne/ solvent-borne Coatings
- Printing Inks
- Inkjet Inks
- Adhesives

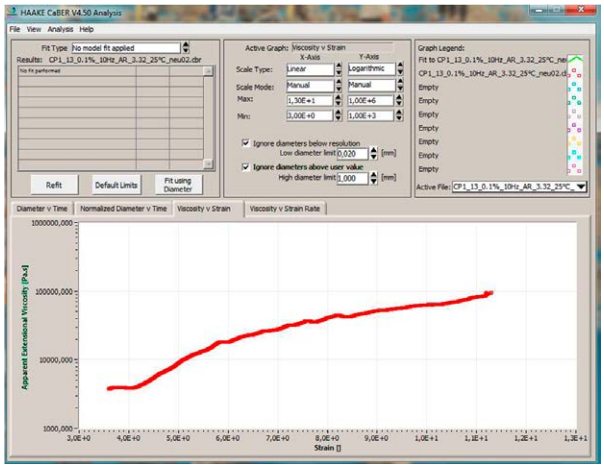
Combined Methods:

Even for the most demanding applications, i.e. cosmetic emulsions, the HAAKE CaBER 1 can deliver meaningful results via optionally probing for additional information simultaneously.

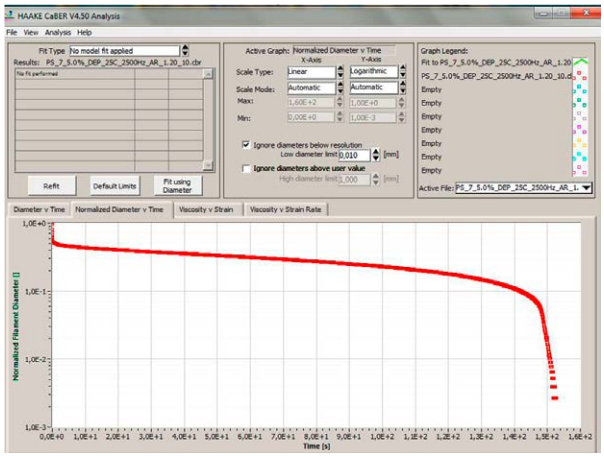
Simultaneous Force Measurement*:

In order to get a deeper understanding of the macroscopic material properties of your product towards an extensional deformation, like i.e. tackiness, the HAAKE CaBER 1 can detect normal forces that arise in the fluid filament during the stretching process. The measurement of the normal forces is achieved by utilizing a highly sensitive and fast piezoelectric force sensor.

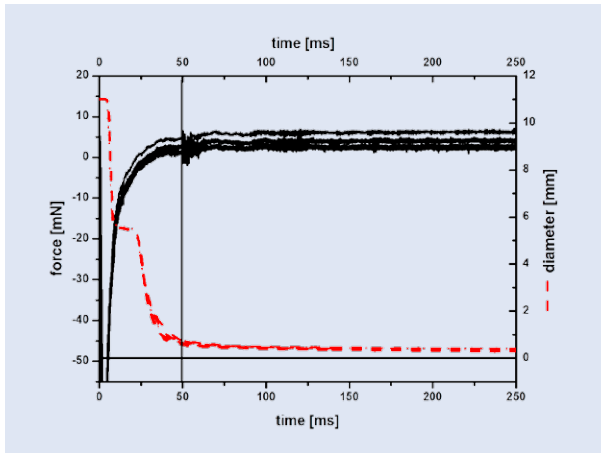
* This normal force option has been developed in cooperation with Prof. Dr. Manfred Wilhelm, Karlsruhe Institute of Technology (KIT), Institute for Chemical Technology and Polymer Chemistry, Polymeric Materials, Karlsruhe/Germany



Apparent extensional viscosity as a function of strain for a viscoelastic polymer solution



Filament diameter versus time for a viscoelastic polymer solution



Force evolution and filament diameter as a function of time in a HAAKE CaBER experiment

Application Support

We provide comprehensive product and application solutions and our application specialist team is on hand to answer your questions.

Selected Product Information:

- V-204 Optimization of the filling process of shampoo sachets with the HAAKE CaBER 1
- V-206 The influence of thickeners on the application method of automotive coatings and paper coatings – HAAKE CaBER 1
- V-208 Correlation of misting during printing with extensional rheological investigations on offset printing inks with the HAAKE CaBER 1
- V-211 Optimizing and forecasting the filling behavior of coatings with the HAAKE CaBER
- Further information on request

Looking for something else? Contact us!
info-mc.de@thermofisher.com

thermoscientific.com/mc