CaBER 1

Quantifying the extensional properties of fluids

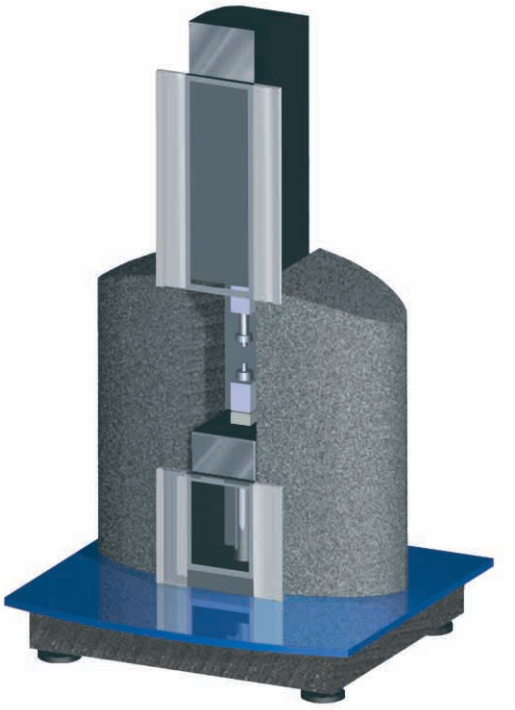
Thermo Material Characterization

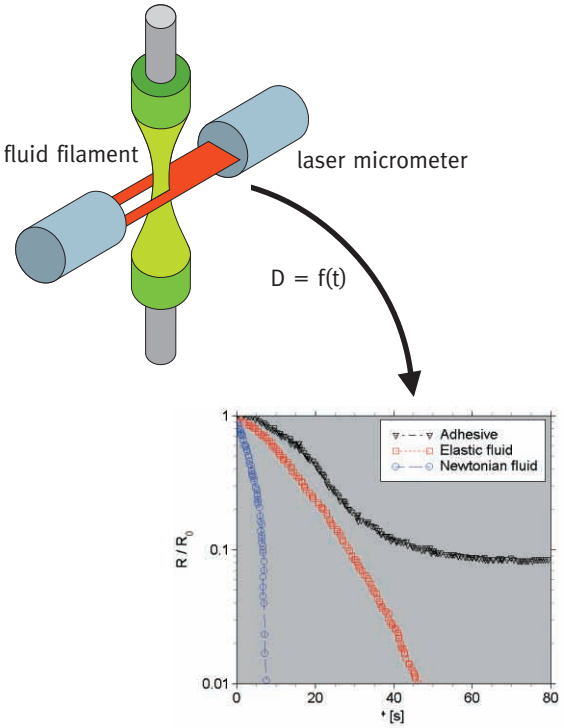
A Thermo Electron Company

Many different experimental techniques for measuring the elongational properties of non-Newtonian fluids have been developed over the last 30 years. All these techniques were difficult to operate, generated complex flows and therefore confusing results. As a consequence successful commercially available instruments did not exist. The CaBER™ 1 (system CPG*) is the first instrument to change this!

Applications

- Adhesives
  - measurement of tackiness
  - solvent loss or gain
- Food products
  - stringiness/strand formation
  - time to breakup
  - relaxation of doughs
  - elastic instabilities
- Consumer goods
  - filling of bottles
  - time to breakup
  - solvent loss
  - processability
- Industrial resins
  - relaxation time spectrum
  - constitutive modeling
  - spinnability
- Biomaterials
- Surfactants
- Associating polymers





Extensional Rheometry

Knowledge of the elongational behavior of fluids is important for both industrial and basic research purposes. Complex flows that contain strong extensional components occur in many industrial processes and applications. Some examples are extrusion flows, coating flows, contraction flows and fiber spinning flows. Most materials exhibit very different responses in an extensional flow compared to a shearing flow. The thinning and breakup of a fluid filament that is analyzed with the CaBER™ instrument provides valuable information about the material's physical properties that rotational rheometers simply can not provide!

The Capillary Breakup Extensional Rheometer (CaBER™)

The CaBER™, built by ThermoHaake, was developed by Cambridge Polymer Group (CPG) based on the pioneering work of Russian scientists Entov, Rozhkov and co-workers in capillary breakup rheometry. The CaBER™ system is an easy-to-use extensional rheometer for examining polymer solutions, suspensions, melts, adhesives, emulsions and a variety of other materials.
The CaBER™ system can be used as an analytical instrument, or as a quality control tool. With a footprint of 40 x 34 cm, the CaBER™ is small enough to fit in a fume hood or to be used on a benchtop in the lab or on the plant floor.

*) CPG = Cambridge Polymer Group

for more information see:
www.thermo.com/caber

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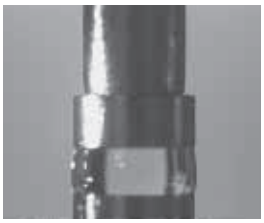




Glycol stretched in the CaBER.

Principles of Operation

A small quantity of sample (< 1 ml) is placed between two circular plates. The top plate is rapidly separated from the bottom plate at a user-selected strain rate, thereby forming an unstable fluid filament by imposing an instantaneous level of extensional strain on the fluid sample. After cessation of stretching, the fluid at the mid-point of the filament undergoes an extensional strain rate defined by the extensional properties of the fluid. A laser micrometer monitors the midpoint diameter of the gradually thinning fluid filament as a function of time. The competing effects of surface tension, viscosity, mass transfer and elasticity can be quantified using the model fitting analysis included in the software. The automated experimental analysis and model comparison provides rapid determination of the following parameters: Viscosity, surface tension, elasticity, relaxation times and filament breakup time.

Specifications

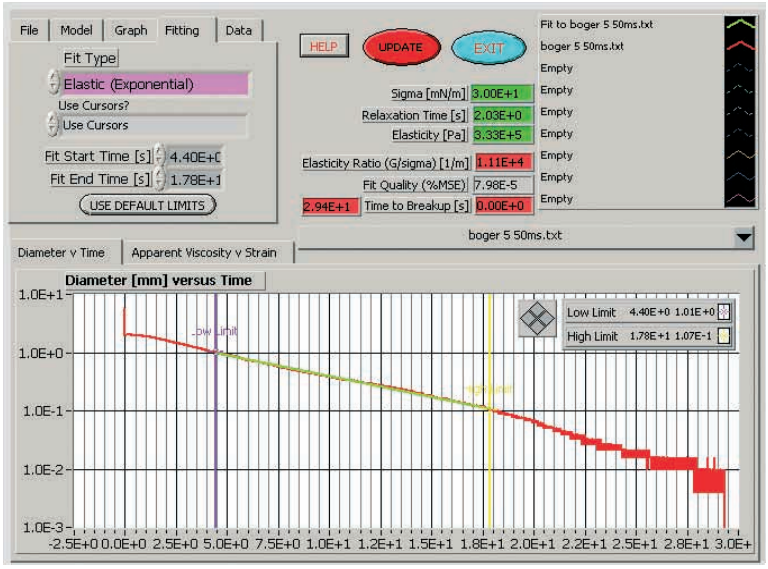
- Hencky strains: up to $\varepsilon_0 = 10$
- Strain rate range:
  Imposed strain rate $0.01 < \dot{\varepsilon}_0 < 300\ s^{-1}$
  Fluid strain rate: $10^{-5} < \dot{\varepsilon}_0 < 10\ s^{-1}$
- Shear Viscosity range: $10\text{-}10^6$ mPas
- Plate diameter:
  $4 < D_{plate} < 8$ mm, standard = 6 mm
- Temperature range: 0 - 80 °C
- Diameter resolution: 10 µm
- System response time: 10 ms
- Dimension (instrument only): 40 x 34 x 60 cm

Software

- Windows 95/98/NT/2000/XP compatible software
- Range of models for parameter extraction
- Data export to ASCII file

Features

- Completely computer controlled
- Easy to operate
- Easy sample loading and cleaning
- Class 1 laser micrometer
- Linear motor drive with variable speed
- Automatic repeated testing
- Closed temperature-controlled sample chamber
- Exchangeable geometries
- User defined strains
- Small sample volume (< 1 ml)



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