Testing the Flow Behavior of two Batches of a Ceramic Injection Moulding Compound

Rheology Application Notes

Problem

In this case when using an MFI-tester and a mixer sensor, no differences in the batches could be recognized although problems in the production occurred.

Test Aim

One can differentiate between two ceramic injection molding compound samples by surveying the flow curves provided by extruder capillary rheometer tests.

Test Equipment

- Computer aided torque rheometer Rheocord
- Single screw extruder sensor Rheomex 252
- 2:1 Screw
- Rod capillary die with d= 1.50 mm and l=30 mm
- Evaluation program: „capillary rheology“ software
- Circulator DC3-K20 for temperature controlling the extruder feeder

Test Condition

- Extruder temperatures:
  - feeder: 20 °C
  - 1st zone: 95 °C
  - 2nd zone: 110 °C
  - 3rd zone: 135 °C
- Die temperature: 135 °C

Test Run

The substance is plastified in the extruder. Then it is transported towards the die and pressed through the capillary. When varying the extruder screw speed, different shear rates occur.

The melt pressure in front of the capillary is measured using the pressure transducer. The connected balance gives the corresponding melt output automatically. After reaching constant pressure and melt throughput values the measuring procedure is started. The software then automatically triggers the next set drive speed.
Shear rate , shear stress and viscosity is calculated from the data measured.
The software automatically makes the necessary rheological correction according to Bagley and Weissenberg/Rabinowitsch.

Test Results

The diagram shows the results of the viscosity measurement of both substances. The graph displays the shear stress τ and the viscosity η above the shear rate $\dot{\gamma}$. The binder for this thermoplastic ceramic is based on a polyolefine base. Therefore, the curves show a shear thinning typical for polymers, i.e. a decreasing of the viscosity at an increasing shear rate. Substance 2 exhibits more shear thinning than substance 1. The measured values are very close at shear rates < 100 sec^{-1}, but they differ at higher shear rates. The viscosity value at 1000 sec^{-1} for substance 1, for example, is 42% higher than for substance 2. This explains why both substances cannot be differentiated using an MFI-tester and a mixer sensor. This shear rates are normally under 100 sec^{-1}. The extruder sensor allows measurement at shear rates like the ones occuring in the extruder or during injection molding.

Summary

The Rheocord system offers the possibility of quick and reliable measurement of flow properties of a polymer melt under conditions that come close to those in processing.

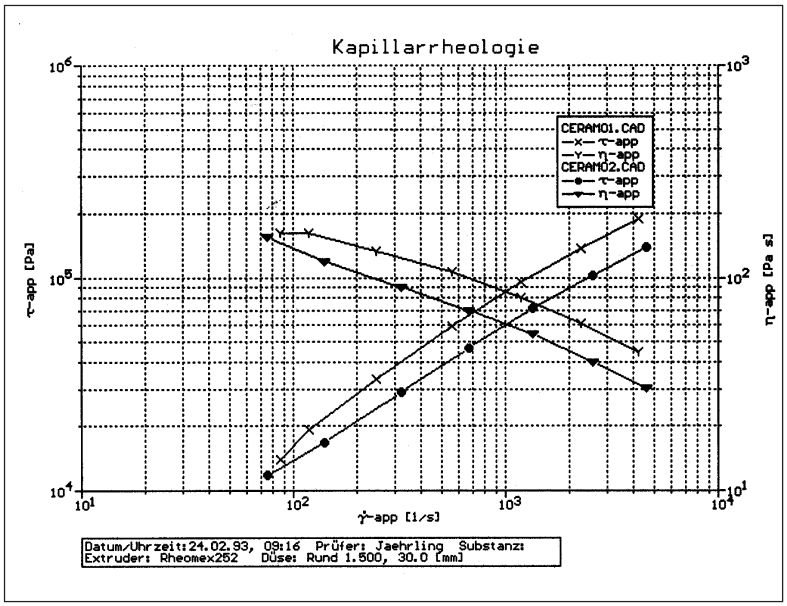

Figure 1

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