2nd Workshop on Inverse Problems in Rheology and Related Experimental Techniques

Badenweiler, Germany
May 9th - 11th, 2001

The second Workshop on Inverse Problems in Rheology and Related Experimental Techniques took place in Badenweiler in May 2001. It was organized by Christian Friedrich from the Freiburger Materialforschungszentrum (University Freiburg, Germany) in collaboration with Christian Bailly from the Catholic University of Louvain-la-Neuve, Belgium. The objective of the workshop was to bring together theoretical and experimental rheologists, who are dealing with the questions of describing and predicting rheological data and their relation to the structure of their systems. The main topics of the second Workshop were the following:

- Inverse problems and the determination of linear viscoelastic spectra
- The interconversion of rheological data into molecular mass distributions
- The determination of a measure for long-chain branching in polymers from rheological data
- The extension of the accessible frequency and time range of rheological measurements

In the first session on inverse problems and the determination of linear viscoelastic spectra J. Honerkamp and T. Roths (Freiburg) gave general introductions into the regularization method as a tool for solving ill-posed problems of the determination of relaxation spectra from rheological data. A critical review on the general purpose of relaxation spectra for data fitting or the check of a molecular theory was given by A. Ya. Malkin (Moscow, Russia). H. H. Winter (Amherst, USA) compared continuous and discrete relaxation time spectra and presented their correlation with respect to a generalized relaxation pattern of linear flexible polymers. In the presentation of K. Thomas (Averystwyth, United Kingdom) relaxation time spectra differing in the number of modes were presented for a series of viscoelastic systems.

The second session dealt with the interconversion of rheological data into molecular mass distributions of linear polymers and vice versa. B. Anderson (Canberra, Australia) presented the relaxation modulus as the important material function that relates the molecular mass distribution to the relaxation time spectrum. A comparison of two rheological models for the description of polydisperse polymers was given by F. Leonardi (Pau, France), who discussed

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a model with a single exponential kernel function as well as one based on molecular dynamics with tube length fluctuations and renewal effects. The conclusion of E. van Ruymbeke (Louvain-la-Neuve, Belgium) with respect to the interconversion of experimentally determined molecular mass distributions into dynamic moduli is that the Des Cloizeaux kernel function in association with the double reptation model is able to deliver a good quantitative agreement between theory and data. By constraining the molecular mass distribution to a generalized three parameter exponential function M.R. Nobile (Fisciano, Italy) avoids the ill-posedness of interconverting rheological data into molecular mass distributions. A linear differential constitutive equation based on an energy concept is derived by T. Borg (Kuoppa-aho, Finland) for the determination of molecular mass distributions of polymers from rheological measurements and vice versa. A critical review on the accuracy of size exclusion chromatography and molecular mass sensitive detectors for the analytical determination of the molecular mass distribution of linear and long-chain branched polymers was presented by D. Lilge (Ludwigshafen, Germany).

The third session covered aspects of long-chain branched polymers. The application of the Caley tree to industrial highly long-chain branched LDPE (low density polyethylene) was analyzed by J. C. Majeste (Saint Etienne, France). A modified Pom-Pom model was proposed by G. Peters (Eindhoven, Netherlands) for the description of long-chain branched polymers. Peters also showed applications of this enhanced Pom-Pom model for the description of well defined rheometric shear and elongational flows as well as flow properties in complex geometries. Similarities between the dynamic-mechanical flow properties of physical and chemical gels and those of long-chain branched polyethylenes in a certain frequency regime were observed by C. A. Garcia-Franco (Baytown, USA). The organizer, C. Friedrich, proposed the normalized van Gurp-Palmen plot as a tool for the characterization of long-chain branched polymers exhibiting a unique relaxation pattern in comparison to linear polymers.

In the last session experimental methods for the extension of the time and frequency range were described, as well as some special developments for structure analysis in bicomponent systems. R. Davies (Aberystwyth, United Kingdom) presented the experimental virtual gap rheometry method for the determination of relaxation time spectra from wave dispersion data. For the extension of the frequency range of dynamic-mechanical experiments to low values the creep recovery experiment in shear was suggested by C. Gabriel (Erlangen, Germany). For the extension into the high frequency regime several experimental setups like torsional resonators and shear quartzes as well as a newly developed vibrational technique were described by W. Pechhold (Ulm, Germany). Ultrasonic wave propagation was shown to be useful for the process control in polymer processing by D. Lellinger (Darmstadt, Germany). J. Läuger (Stuttgart, Germany) and H. Hilbig (Karlsruhe, Germany) presented papers on recent developments for the improvement of temperature control and measurement accuracy in shear rheometers. The

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accurate measurement and quantitative description of non-linear viscoelastic properties of polymeric systems were subjects covered by D. van Dusschoten (Mainz, Germany) and P. Fischer (Zürich, Switzerland). In the first one large amplitude step shear oszillations were analyzed using the Fourier-transform method. The second presented the Giesekus model for the description of non-linear properties of surfactant solutions. The investigation of the time-dependent morphology of polymer blends using rheometry and online light scattering was covered by W. Gronski and J. Wang (Freiburg).

The atmosphere of the Workshop was dominated by interesting discussions between the experimental and the theoretical rheologists. Both parties learned about the special problems of the different approaches. As is obvious from the contributions the meeting in Badenweiler was an international workshop. About 50 participants stayed in a friendly health resort. On the second day dinner was followed by wine degustation and folklore from the Black Forrest.

The third Workshop on Inverse Problems in Rheology and Related Experimental Techniques will be organized by Professor Carrot at the University Jean Monnet in Saint Etienne, France. The prospective date of the meeting will be May 2003.

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