

WORKSHOP
"RHEOLOGY AND PROCESSING OF POLYMERS"

June 19, 2005
LEIPZIG, GERMANY

In connection with the 21st annual meeting of the polymer processing society (PPS-21) the pre-conference workshop "Rheology and Processing of Polymers", organized by the German Society of Rheology, took place at the PPS-21 conference site "The Westin" in Leipzig on Sunday, June 19, 2005. This workshop was the second of its kind following the workshop on "Rheology of Multiphase Systems" held in April 2004 in Berlin. With these workshops the German Society of Rheology wants to offer a new way for communication amongst German rheologists at a time which sees European and international activities growing. Prof. Dr. H. Münstedt (University of Erlangen-Nürnberg) and Prof. Dr. W. Mielke (Federal Institute for Materials Research and Testing – BAM) organized a meeting that gave a profound insight into the rheological basis for polymer processing covering the whole spectrum of processing technologies like extrusion, injection moulding or calendaring and a broad variety of polymeric materials like thermoplasts, elastomers and polymer composites. Around 30 people from all over Europe joined the workshop including newcomers in the field of rheology as well as participants already working in this area. This number was just the right basis for lively and fruitful discussions.

Seven speakers from universities and companies presented their results and ideas to a highly interested and competent audience of representatives from academic institutions, industrial companies, instrument manufacturers and national laboratories. The 40 minutes presentations followed by 10 minutes for discussion offered the possibility to go into detail of a subject and to intensively discuss a topic.

Prof. Dr. H. Münstedt, chairman of the German Society of Rheology, opened the workshop. He referred to the successful launch of the new series of annual workshops last year in Berlin, and emphasized the outstanding character of this kind of seminar which offers the possibility to broaden and intensify the rheological knowledge in a more focused way than it would be feasible at big events like the European Conferences on Rheology. He took the opportunity to thank Prof. Dr. H.-J. Radusch, head of the organizing com-

mittee of PPS-21, for the kind invitation to hold the workshop just before the PPS session on rheology. After his welcome the participants were asked to introduce themselves and to state their expectations. This procedure eased the way to get into contact with each other.

The first lecturer Dr. M. Schmidt from Bayer AG (Germany) spoke about the usefulness of neural networks for the prediction of shear viscosity functions. He introduced the software tool Design- and Processing Properties (DPP) which is used by Bayer Material Science for the prediction of part properties during processing and for application. In this software they implemented neural networks, which are effective tools for the identification and prediction of multidimensional correlations. The software can be used for the prediction of shear viscosity functions and modeling of the influence of temperature, molecular structure and fillers on the viscosity function.

Prof. Dr. H. Münstedt from the University of Erlangen-Nürnberg (Germany) talked about the role of elongational rheology in predicting some aspect of the processing behavior of polymer melts. He showed that a homogeneous sample deformation in uniaxial elongational experiments due to a pronounced strain hardening correlates with a better film homogeneity of blown polyethylene films and a homogeneous wall thickness of thermoformed beakers from polypropylene. He explained that the pronounced strain hardening behavior and thus the homogeneous samples deformation is referred to the presence of long-chain branches within the polymer melts. This led to the conclusion, that elongational rheology can make a substantial contribution to optimize the molecular structure of polymers for processes with prevailing elongational components.

Prof. Dr. M.H. Wagner from the Technical University of Berlin introduced the Rheotens Test. This is a very suitable method to investigate the elongational behavior of polymer melts under process conditions. Using the Rheotens Test it is not only possible to determine the melt strength and drawability which are relevant for many processing operations, but also to calcu-



late the apparent elongational viscosity, from which further interpretations with respect to the molecular structure are possible.

Prof. Dr. R. Schnabel from the University of Halle-Wittenberg (Germany) talked about modeling of the calendering process on base of rheological data. He gave an overview over existing models and how they can be used to describe the velocity field in the calender, the non-isothermal behavior during cooling and the biaxial stretching which is often combined with a calendering line.

The afternoon session was opened by Dipl.-Ing. M. Kurte-Jardin from the University of Paderborn who talked about the influence of the wall-slippage on the processing characteristics in a single-screw extruder. Wall-slippage occurs for some polymers above the so-called critical shear stress and leads to a significant change of the material throughput in the extruder. By the use of different models the influence of wall-slippage on the flow behavior in the extruder channel is analyzed and compared to the well-known flow behavior in case of wall-adherence.

Prof. Dr. G. Heinrich from the Leibniz-Institute of Polymer Research Dresden took the audience into the world of elastomers. He showed that rheology plays also an important role in the processing of high-performance elastomers for tire applications. Especially the rheological behavior of different filled elastomers in combination with the dynamic-mechanical testing is used to optimize the composition of the elastomers and their tire performance.

The seminar closed with a lecture of Dipl.-Ing. K. Skrodolies from RWTH Aachen. He talked

about the rheology of fibre reinforced composites and its use for process simulation. Polymer melts filled with long fibres of a length between 4.5 to 50 mm are formed into to complicated shapes by compression moulding. For the process simulation a detailed knowledge about the rheological behavior of the filled polymers in shear and elongational flow is necessary. He introduced a press-rheometer for the determination of the viscosity of fibre reinforced compounds, which was developed at the University of Aachen.

Recapitulating the workshop it can be said that the audience was very satisfied with the outcome of the seminar. There was enough time for the speakers to go into detail and to stimulate intense discussions resulting in a fruitful exchange of ideas. The combination of the presentation of basic knowledge about rheology and processing for newcomers in the field of rheology as well as the transfer of information about new aspects in this field to those of the audience who were already very familiar with the topic was very successful.

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Figure 1 (left): Prof. Münstedt begrüsst die Teilnehmer.

Figure 2: Lebhaftige Diskussion in der Pause.