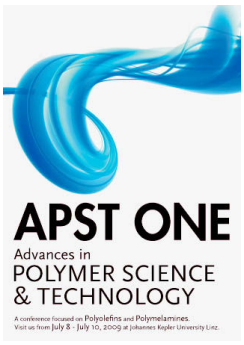
Advances in Polymer Science and Technology (APST 01)

July 8 – 10, 2009
Linz / Austria



The APST01 was the first of a planned series of conferences aimed at bridging the gap between academic and industrial research in polymer science. It was co-organized from July 8th to 10th in the European Cultural Capital Linz for 2009 by the Johannes Kepler University Linz and Borealis, serving also as a "kickoff" event for the new polymer science focus at JKU. The participation was good with about 200 people, including a rather high number of industrial representatives. A highlight was the conference dinner including a best poster award ceremony (see Figure 1).

While none of the seven symposia ranging from catalysis to new markets and environmental challenges was directly dedicated to rheology, a number of the presentations involved interesting rheological developments. Especially in the symposium on "Advanced Polymer Characterization" several presenters outlined the importance of rheological characterization techniques for modern polymer development.

Prof. Han Meijer from Eindhoven University of Technology (NL) presented an overview on recent developments in understanding mechanical changes in glassy polymers under the title "Outstanding Problems in the Physics of Deformation of Polymers". He started with the general comment that for polymers deformation and failure is mostly determined by localization of strain, the type of which will make the difference between brittle and ductile (tough) response. Polymer mechanics is about solid state rheology, meaning that it involves time-dependent reversible processes; extensive work for both polycarbonate (PC) and polystyrene (PS) has been done in the last years at TuE, resulting in models capable of predicting quite different processes like tension, indentation and even scratching of the material. The latter allows fundamental views on tribological processes, resulting in an improved understanding of force and velocity consequences on the resulting deformation.

Another plenary was presented by Borealis' VP for Innovation and Technology, Alfred Stern, under the title "Turning Market Needs into Innovative Polyolefin Products". Following an outline of Borealis' way of "market driven innovation" and some general comments about how to combine catalyst and process advances with market requirements (and the anticipation of those!) for the development of advanced solution for ones customers, three examples of advanced product developments were presented in detail: Sterilizable stand-up pouches, bodypanels for passenger cars and high-purity PP baby bottles produced in injection-stretch blow molding (ISBM; see picture 1). For ISBM the rheological and processing behavior had to be both understood and modified significantly.

Figure 1 (left): Cornelia Kock of Borealis Linz received one of the poster awards, handed over by Clemens Schwarzinger and Christian Paulik from the organizing committee.

Figure 2: ISBM-bottle from polypropylene with bimodal molecular weight distribution to optimize processability.

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Multi-phase material design was the subject of many presentations. The possibilities of reducing the thermal expansion of polypropylene compounds by controlling the micro-morphology of the blends were explained by Cornelia Kock in her talk "Controlling the thermal expansion on polypropylene-compounds". If a co-continous structure is obtained between the PP-matrix and the plastomer phase the CLTE of PP- and PP/talcum compounds can be further reduced, although the plastomer is having higher thermal expansion then the PP-matrix. If talcum is added the achieved reduction of CLTE becomes remarkable due to mechanical restrain induced by the filler and morphological effects through the co-continuous structure.

More "basic" was a presentation of Julia Resch from Erlangen University (Institute of Polymer Materials) about "Rheological measurements as an analytical tool for the molecular characterization of polyolefins". Dynamic-mechanical experiments and creep-recovery tests in shear were applied to various polyolefins of different molecular structure carefully characterized by SEC-MALLS. The combination of the different methods allows interesting conclusions. As figure 3 shows, the linear molecules follow the well-known scaling law Ëo~Mw3.6, while the LDPE resins (tree-like LCB structure) have significantly lower values compared to their linear counterparts of the same molar mass. In contrast, higher viscosities are found for LCB-mLLDPE (star-like branching topography).

Again more related to processing effects was the talk of Bernardette Duscher from the Institute of Polymer Science at Johannes Kepler University Linz entitled "Shear modification by processing mixtures of long chain branched and linear polypropylenes". High melt strength PP exhibits noticeable processability in conventional operations like thermoforming, foaming and extrusion blow molding. These processing characteristics arise from its long chain branched structure. However, due to their special structure long chain branched polymers are sensitive to the applied processing history. The rheological properties in elongation and shear of LCB-PP and blends with linear PP are strongly affected by processing time, temperature, processing method and even screw configuration. The resulting modification is partly reversible, as found before for LDPE.

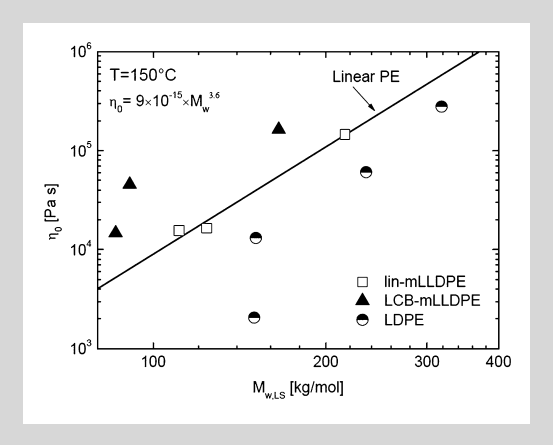

Figure 3: Zero-shear rate viscosity η_o as a function of absolute weight average molar mass $M_{w,LS}$ for polyethylenes with different molecular structure.

From other presentations in the symposium "Innovative Processing Technologies" it became clear that new conversion processes will require more detailed information both about the rheological behavior at high strains and strain rates, and about the interaction between flow and solidification. Some of the poster contributions related to this interesting question will be part of an upcoming special edition of "Journal of Thermal Analysis and Calorimetry" edited by the rheology group of the Austrian chemist's association (GÖCH).

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