"Austrian Rheologists meet in Leoben"

September 19, 2005
Leoben, Austria

The Austrian Chemist's Society (GÖCH, Gesellschaft Österreichischer Chemiker) annually organises the "Austrian Chemistry Days". Within this framework, minisymposia of different working groups are organised: one of these was dedicated to polymer rheology (Leoben, 19.09.2005). Around 40 scientists participated in this half-day event with two invited lectures and seven short presentations.

Prof. H. Münstedt (University of Erlangen-Nürnberg, Germany) presented work on "Rheology and molecular structure of long-chain branched polypropylenes" based on several series of LCB-PP produced by irradiation of PP at IPF Dresden. From his combined solution and melt data it became clear that it is not sufficient to talk about average degrees of branching; one has to consider the developed structures. The values of λ (LCB per 1000 monomer units) ranged from 0 to 0.92, producing quite a range of interesting effects. Again it turned out to be important knowing how to measure the zero shear viscosity precisely – in this case a creep test was used. Melt rheology is definitely more sensitive to small degrees of long chain branching, as strain hardening can be observed already for samples considered "linear" from solution analysis alone. The value for η_0 as a function of irradiation dose goes through a clear maximum as seen in Figure 1. An interpretation of this dependence is given by considering the rising branch as resulting from a series of mixtures of linear and branched molecules, and the falling branch as resulting from decreasing arm lengths in star molecules. The maximum of this dependence will depend drastically on the reference molecular weight via the branch lengths at identical branching degree.

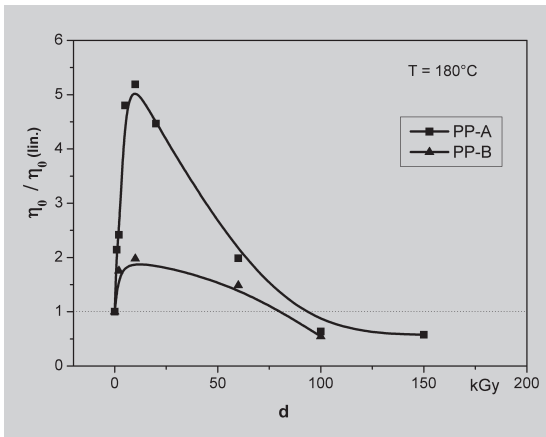

Figure 1:
Values for $\eta_0/\eta_{0(lin)}$ as a function of the irradiation dose for PP-A (Mw = 669 kg/mol) and aPP-B (Mw = 450 kg/mol).

Further information on LCB-PP came from the talk of Prof. A. Schausberger (J. Kepler University Linz, Austria) on "Determination of the degree of long chain branching using melt rheology and solution viscosimetry". Based on experimental data from blends of linear and HMS-PP, he developed a set of coupled equations combining the dependences of zero shear viscisity and intrinsic viscosity on molecular weight and chain structure. The system still needs refining but may prove very useful in the end.

Experimental aspects were covered in the presentation of Dr. J. Läuger (Anton Paar KG, Graz, Austria) entitled "New developments in polymer rheometry". He dealt with two areas related to measuring precisely - temperature control and gap adjustment - and two related to getting additional information out of a rotational rheometer - an extensional setup and rheo-optical methods. The new "TrueGapTM" setup developed by Paar is really revolutionary, allowing measuring the gap width in process with an inductive system. This may well prove the "extra edge" necessary in discerning between sensitive systems with small differences. The extensional setup (developed by Xpansion in the US) is a nice tool for doing uniaxial tests (including relaxation & creep) with a normal rotational instrument with convective oven. Focussing on experimental work the presentation of Dr. W. Friesenbichler (University Leoben, Austria) on "Rheology of polymer melts at high shear rates with a new micro-rheology technique", which was one of the outputs of an EU project on micro injection moulding. The dissipative heating in the flow channel is a decisive factor for flow properties of polymer melts in this case. A special setup with slit channel (0.1/0.15 mm thickness at various lengths) was built for this purpose, combined with a conventional capillary rheometer for "medium" shear rates or with an injection molding machine for the highest ones. Only a complex evaluation procedure allows the determination of relevant parameters for flow simulation in these cases. The sole industry presentation in this meeting was given by Manfred Stadlbauer (Borealis GmbH, Linz, AT) in his talk about "Rheology in structural analysis and application development".

Markus Gahleitner