DRG Annual Meeting 2011
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VISCOELASTICITY AND MELT CHROMATOGRAPHY BY NEW LINEAR PRINCIPLE

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Control theory is applied to model the linear relationship between the relaxation modulus [1], dynamic [2] and shear viscosity, transient flow effects, power law and Cox-Merz rule related to MWD [3] by melt calibration. The principle starts from micro scale as statistical tube dimensions up to macro scale viscoelastic flows [4] as shown in Fig. 1 and is a powerful tool for molecular characterization. The same principle is used to model temperature dependences, elongation viscosity with long chain braches (LCB) and chromatography methods.

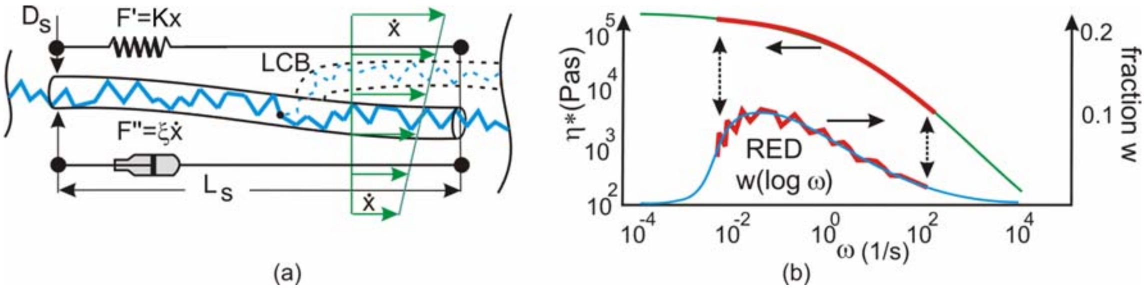

Figure 1. a) Dimensions of an oriented unit and chain segment in a statistical tube at high shear rate. b) Derived rheologically effective distribution (RED) from viscosity measurements. Measured complex viscosity and respective accurate computed RED curve segment are marked by ticker lines. Wider fits are gained by least-square procedures and best fit routine.

Melt chromatography is introduced by terminology of liquid chromatography, closer gel permeation chromatography (GPC), also referred as size-exclusion chromatography (SEC), to detect elution curve and molecular weight distribution (MWD). Another important feature, reached simultaneously from developed chromatogram, in other words rheologically effective distribution (RED), relates very accurately and linearly to the viscoelastic properties. RED gives fast reliable characterization of any kind polymer mixtures during processing polymers. Analysis starts from viscoelastic measurements done by oscillation rheometer. The method is using control theory and linear viscoelastic model [2]. Method has the closest similarities with the widely used linear broad-standard calibration with SEC. Procedure is accurate to detect long chain branching distribution (LCBD) on the contrary to GPC/SEC.

[1] Borg T., Pääkkönen E. J., J. Non-Newtonian Fluid Mech. **156** (2009) 121–128.
[2] Borg T., Pääkkönen E. J., J. Non-Newtonian Fluid Mech. **156** (2009) 129–138.
[3] Borg T., Pääkkönen E. J., J. Non-Newtonian Fluid Mech. **159** (2009) 17–25.
[4] Borg T., Pääkkönen E. J., J. Non-Newtonian Fluid Mech. **165** (2010) 24–31.