

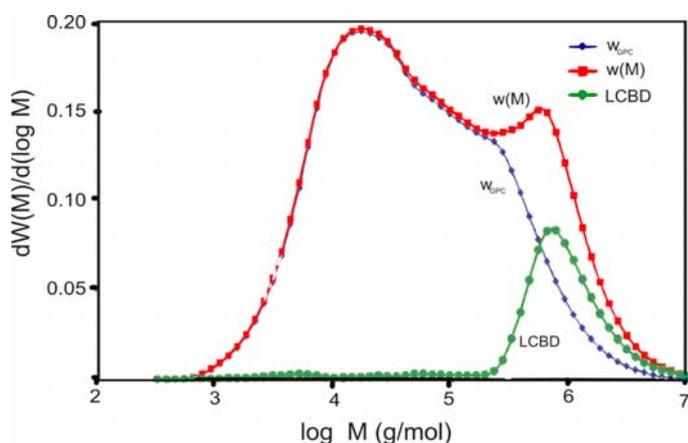
Long Chain Branching and Molecular Weight Distribution Characterization by Rheology

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New findings of polymer structure, relations with viscoelastic flows and measurement routines are presented based on Control Theory used for polyolefin melts. At first the wide subject is discussed briefly. In our published papers are found over 60 new formulas for different types of polymer flows. The model starts from the dimensions of statistical tube of a single molecule chain, which conducts to the formulas according to Control Theory. The final mathematical formula is the homogeneous differential equation, where RED (Rheological Effective Distribution) is the fingerprint of the behaviours of polymer. This function has similarities with the elugram or elution curve used in chromatography analyses. The RED is related and can be converted to many viscoelastic flow functions as relaxation modulus and spectra,¹ dynamic moduli² and shear viscosity³, transition viscosity, start-up⁴ and elongation viscosity⁵. Furthermore, by melt calibration, which has again similarities with the procedures used in chromatography analyses, RED is converted to the MWD. Finally, new case studies are presented and is discussed the effect of LCBs and MWDs to the viscoelastic properties. Free and commercial RheoPower software package versions is developed using the above principle.



MWDs and LCBD obtained from REDs by melt calibration for HDPE. Simulations of GPC/SEC measurements are indicated by w_{GPC} (blue line). The complete RED was converted into MWD $w(M)$ (red line), which shows the second peak relating to LCB. The LCBD or $w_{LCB}(M)$ was obtained from the difference $w(M) - w_{GPC}(M)$.

1. Borg T, Pääkkönen EJ (2009) Linear viscoelastic models: Part I. Relaxation modulus and melt calibration J Non-Newtonian Fluid Mech 156: 121–128
2. Borg T, Pääkkönen EJ (2009) Linear viscoelastic models: Part II. Recovery of the molecular weight distribution using viscosity data J Non-Newtonian Fluid Mech 156: 129–138
3. Borg T, Pääkkönen EJ (2009) Linear viscoelastic models: Part III. Start-up and transient flow effects from the molecular weight distribution J Non-Newtonian Fluid Mech 159: 17–25
4. Borg T, Pääkkönen EJ (2010) Linear viscoelastic models: Part IV. From molecular dynamics to temperature and viscoelastic relations using control theory J Non-Newtonian Fluid Mech 165: 24–31
5. Borg T, Pääkkönen EJ (2011) , Linear viscoelastic model for elongational viscosity by control theory, Rheologica Acta, 51:371-384.