Effect of Distribution of Molecular Weight

A - $M_w/M_n = 1.09$
B - $M_w/M_n = 2.0$
C - branched

Figure 6.14, p. 179 Berry and Fox; PVA solns in DEP

Types of polymer architecture

short-chain branching

long-chain branching

star

hyperbranching

dendrimer

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Motion of Branched Polymers

Entangled linear polymer: chains move principally along their contour

Entangled branched polymer: branch points retard motion

Once disentangled (high shear rate), branched polymers flow more freely.

Effect of Branching on $\eta$

Figures 6.17, 6.18, pp. 181,3 Kraus & Gruver; PB
Steady shear rheology of PAMAM dendrimers

Figure 6.20 p. 183; from Uppuluri

Mixtures of Polymers with other materials - Filler Effect

Figure 6.22, p. 184 Chapman and Lee; PP and filled PP

For more on filled systems, see Larson, The Structure and Rheology of Complex Fluids, Oxford, 1999.

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Steady shear viscosity - shear thickening

Figure 6.27, p. 188 Metzner and Whitlock; TiO$_2$/water suspensions

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Steady shear viscosity - temperature dependence

Figure 6.28, p. 189 Gruver and Kraus; PB melt

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Steady shear viscosity - pressure dependence

Figure 6.29, p. 189 Maxwell and Jung: PS and PE

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Steady shear flow - Summary

• Linear Polymers - complex rheology
• Limits on measurability - instabilities
• Material effects - MW, MWD, branching, mixtures, copolymers - strongly affect rheology
• Temperature and pressure - T strongly affects rheology; P less of an effect, but can be important

Next:
Unsteady shear flow (SAOS, step strain)
Steady elongation
Unsteady elongation

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