Experimental Data (continues)

Unsteady shear flow

- Small strain - SAOS, step strain

  linear polymers, material effects,
  temperature effects

- Large strain - start-up, cessation, creep, large-amplitude step strain

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later . ..

Steady elongation
Unsteady elongation

Small-Amplitude Oscillatory Shear -
Storage and Loss Moduli

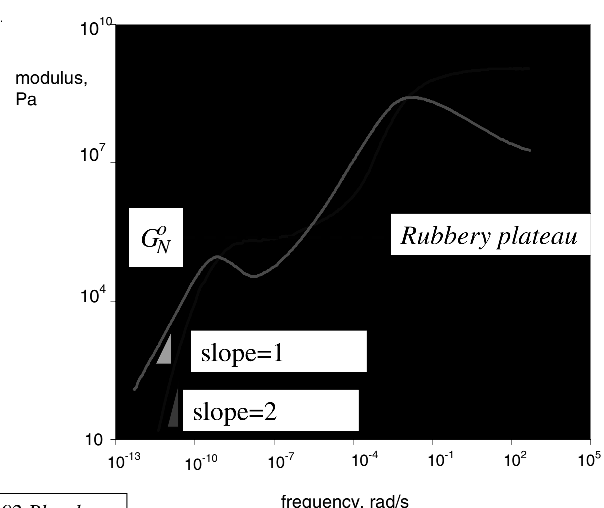


Figure 6.30, p. 192 Plazek and O'Rourke; PS

Small-Amplitude Oscillatory Shear - Storage and Loss Moduli

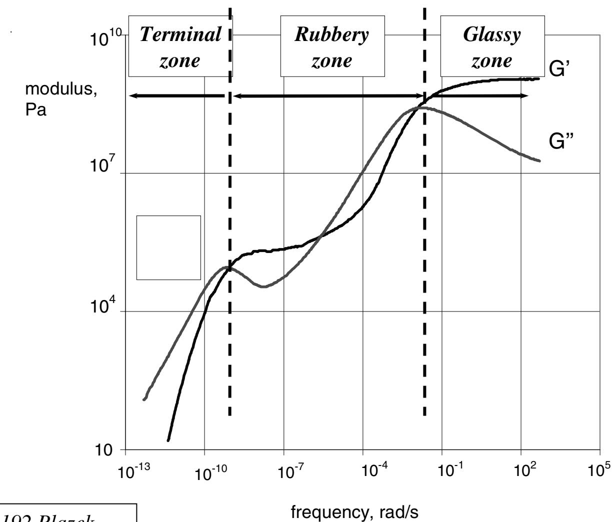


Figure 6.30, p. 192 Plazek and O'Rourke; PS

Step Shear Strain - Relaxation Modulus

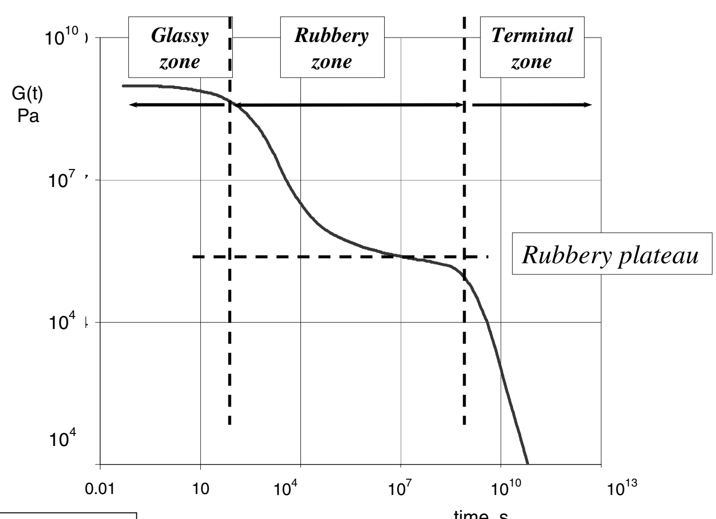


Figure 6.31, p. 192 Plazek and O'Rourke; PS

Ferry’s Summary of Viscoelastic properties of several classes of polymers

Storage modulus

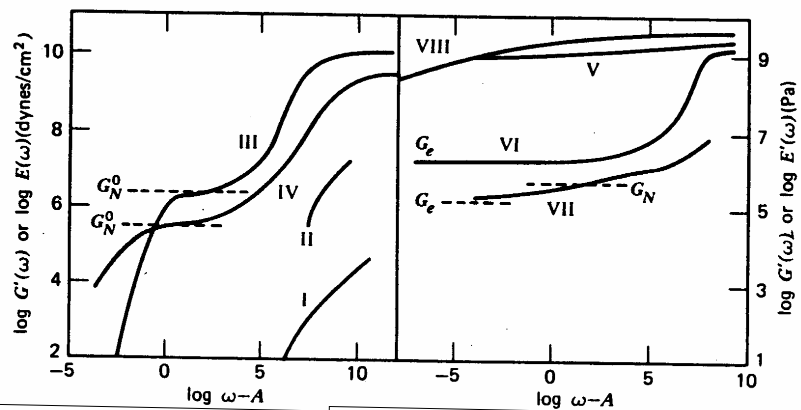


Figure2-3 from Ferry, Viscoelastic Properties of Polymers, Wiley, 1980

Key to Ferry’s plots

I. **Dilute polymer solutions: atactic polystyrene**, 0.015 g/ml in Aroclor 1248, a chlorinated diphenyl with viscosity 2.47 poise at 25°C. M_w=86,000, M_w/M_n near 1.

II. **Amorphous polymer of low molecular weight**: poly(vinyl acetate), M=10,500, fractionated.

III. **Amorphous polymer of high molecular weight**: atactic polystyrene, narrow MW distribution, M_w=600,000.

IV. **Amorphous polymer of high molecular weight with long side groups**: fractionated poly(n-octyl methacrylate), $M_w=3.62 \times 10^6$.

V. **Amorphous polymer of high molecular weight below its glass transition temperature**: poly(methyl methacrylate).

VI. **Lightly cross-linked amorphous polymer**: lightly vulcanized Hevea rubber.

VII. **Very lightly cross-linked amorphous polymer**: styrene butadiene random copolymer, 23.5% styrene by weight.

VII. **Highly crystalline polymer**: linear polyethylene.

Ferry's Summary of Viscoelastic properties of several classes of polymers

Loss modulus

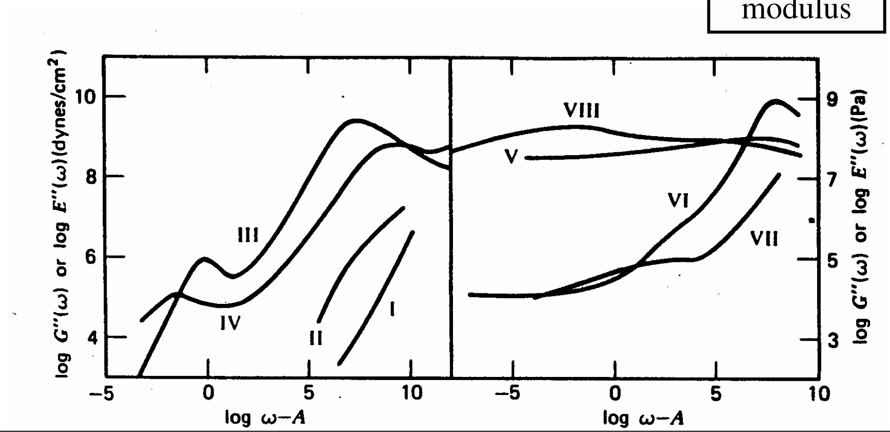


Figure2-4 from Ferry, Viscoelastic Properties of Polymers, Wiley, 1980

Ferry's Summary of Viscoelastic properties of several classes of polymers

Relaxation modulus

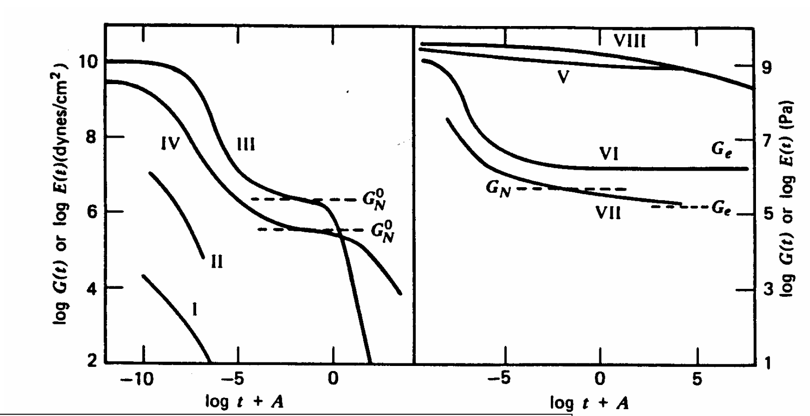


Figure2-2 from Ferry, Viscoelastic Properties of Polymers, Wiley, 1980

Ferry's Summary of Viscoelastic properties of several classes of polymers

Loss tangent

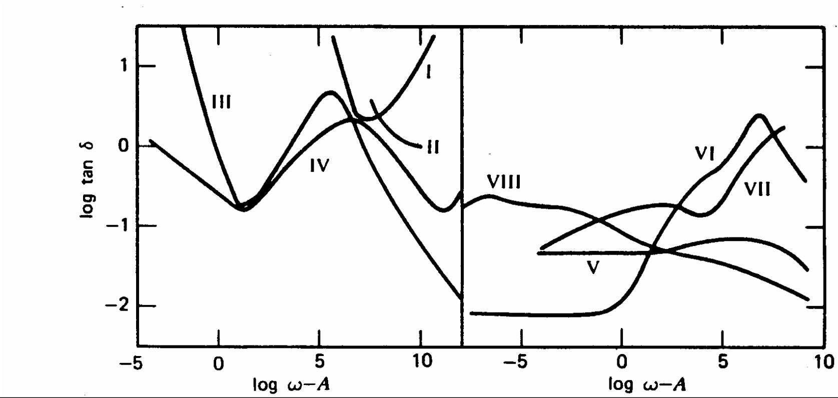


Figure2-8 from Ferry, Viscoelastic Properties of Polymers, Wiley, 1980

Cox-Merz Rule

$$\eta(\dot{\gamma}) = \left|\eta^*(\omega)\right|_{\dot{\gamma}=\omega}$$

An empirical way to infer steady shear data from SAOS data.

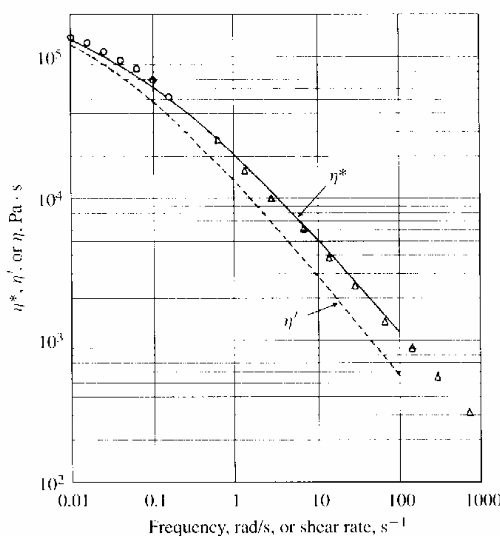
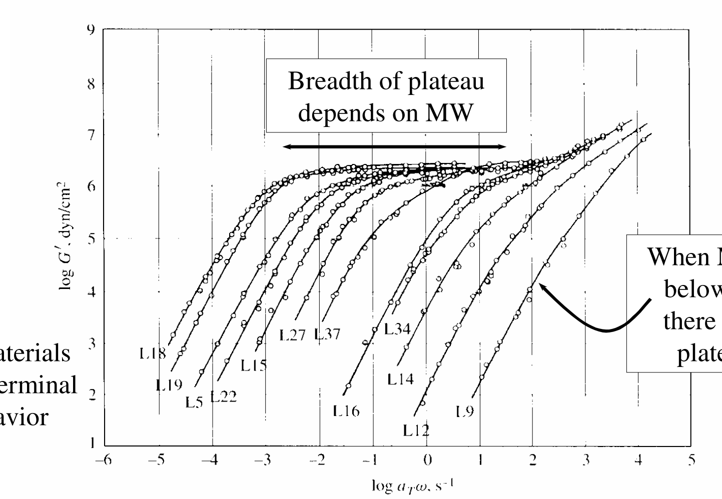


Figure 6.32, p. 193 Venkataraman et al.; LDPE

Small-Amplitude Oscillatory Shear - *G′*
molecular weight dependence

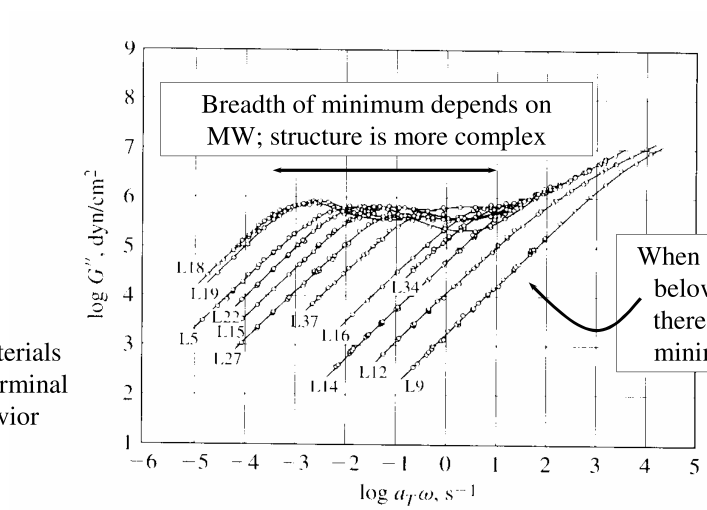


When MW is below M_c, there is no plateau.

All materials show terminal behavior

Figure 6.34, p. 195 Onogi et al; narrow MWD PS

Small-Amplitude Oscillatory Shear - *G″*
molecular weight dependence



When MW is below M_c, there is no minimum.

All materials show terminal behavior

Figure 6.36, p. 196 Onogi et al; narrow MWD PS

Small-Amplitude Oscillatory Shear - *G′ as a function of temperature for copolymers*

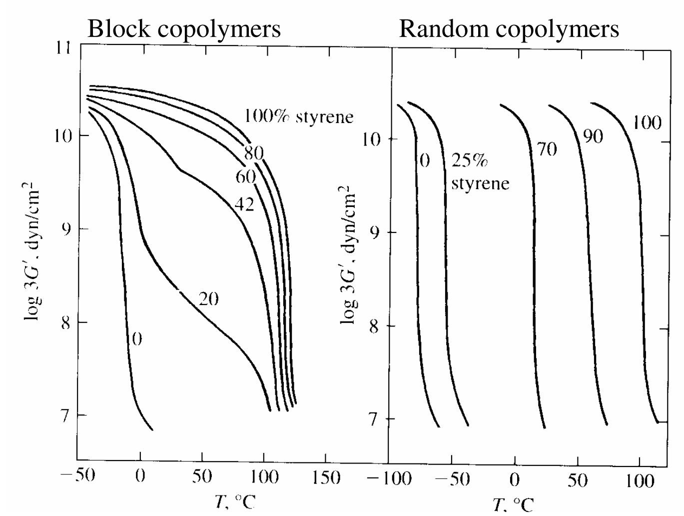


Figure 6.39, p. 198 Cooper and Tobolsky; SIS block and SBS random