Start-Up and Cessation of Steady Shear
START-UP

Sample is initially in an equilibrium state.
Shear at constant strain rate $\dot{\gamma}$.
Stress growth coefficient:

$$\eta^+(t) \equiv \frac{\sigma(t)}{\dot{\gamma}} \qquad (2\text{-}84)$$

Boltzmann Superposition:

$$\sigma(t) = \int_{-\infty}^{t} G(t-t')\dot{\gamma}dt' = \int_{0}^{t} G(t-t')\dot{\gamma}dt' \qquad (2\text{-}8)$$

$s = t - t'$ then $ds = -dt'$, $t' = 0 \Rightarrow s = t$, and $t' = t \Rightarrow s = 0$

$$\eta^+(t) = \int_{0}^{t} G(s)ds \qquad (2\text{-}85)$$

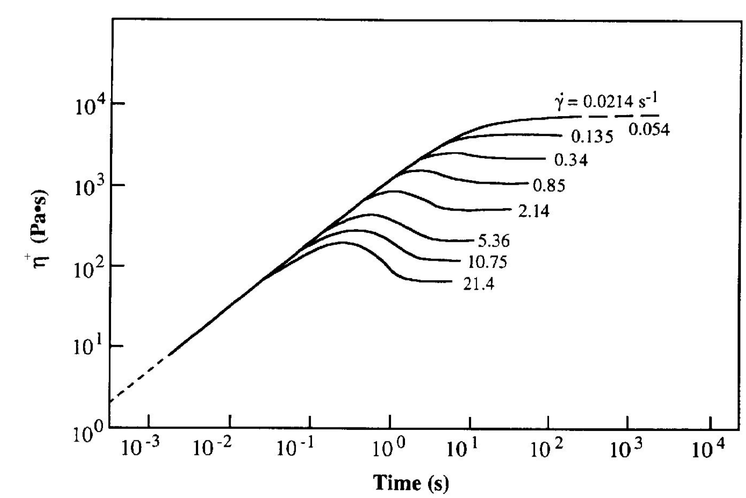

Figure 1: Start-Up of Steady Shear for a 7.55 % polybutadiene solution.

Start-Up and Cessation of Steady Shear STRESS RELAXATION AFTER SHEARING

Stress Decay Coefficient:

$$\eta^{-}(t) \equiv \frac{\sigma(t)}{\dot{\gamma}} \tag{2-88}$$

Boltzmann Superposition:

$$\sigma(t) = \int_{-\infty}^{t} G(t-t')\dot{\gamma}dt' \tag{2-8}$$

For $t' < 0$, $\dot{\gamma}$ is constant, while for $t' > 0$, $\dot{\gamma} = 0$

$$\sigma(t) = \int_{-\infty}^{0} G(t-t')\dot{\gamma}dt'$$

$s = t - t'$ then $ds = -dt'$, $t' = -\infty \Rightarrow s = \infty$, and $t' = 0 \Rightarrow s = t$

$$\eta^{-}(t) = \int_{t}^{\infty} G(s)ds \tag{2-89}$$

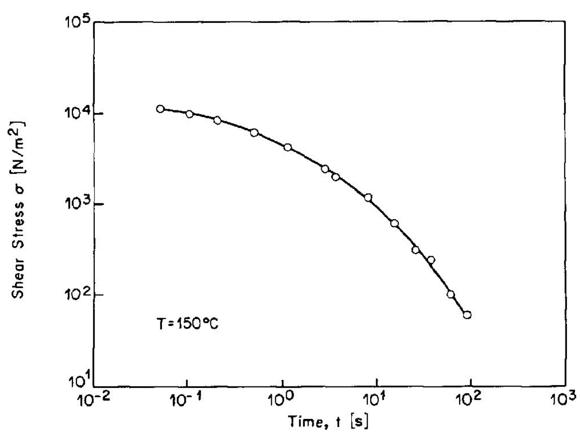

Figure 2: Stress Relaxation after Cessation of Steady Shear for Polyethylene.