

Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Entanglement Percolation Effects on the Dynamics of Polymer Rheology RICHARD WOOL, Department of Chemical Engineering, University of Delaware — The percolation model of entanglements (Wool 1983) makes unique predictions regarding the dynamics of polymer chains in the terminal relaxation zone of reptating linear polymer melts of molecular weight M . When percolation occurs during relaxation of entangled chains in the terminal zone, we observe some unusual results. These include: (a) for homopolymers of molecular weight $M \gg M_c$, reptating chains appear to be non-reptating as their ends and centers relax at the same rate during percolation. (b) During stress relaxation, the random coil dimensions $R_g(\parallel)$ and $R_g(\perp)$ are predictably not fully relaxed when the stress and birefringence relax to zero. (c) The matrix molecular weight P effects on relaxation time τ of the probe chain $M \gg M_c$ are as follows: Rouse-like dynamics is observed for reptating chains with $\tau \sim PM^2$ when $M \gg P$ and (d) the relaxation time $\tau \sim P^0 M^3$ when $P \gg M$, in accord with reptation. These unusual results predicted by entanglement percolation are supported by significant experimental data from selectively deuterated polystyrene chains HDH, DHD and DPS. Entanglement Percolation replaces Constraint release and Chain End Fluctuation mechanisms in the understanding of the dynamics of polymers in the melt and concentrated solutions.

Richard Wool
Department of Chemical Engineering, University of Delaware

Date submitted: 27 Nov 2007

Electronic form version 1.4