

Abstract Submitted
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An Intriguing Empirical Rule for Estimating the First Normal Stress Difference from Steady Shear Viscosity Data for Concentrated Polymer Solutions and Melts VIVEK SHARMA, University of Illinois at Chicago, GARETH MCKINLEY, Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA — The Cox-Merz rule and Laun's rule are two empirical relations that allow the estimation of steady shear viscosity and first normal stress difference, respectively, using small amplitude oscillatory shear measurements. The validity of the Cox-Merz rule and Laun's rule imply an agreement between the linear viscoelastic response measured in small amplitude oscillatory shear and the nonlinear response measured in steady shear flow measurements. We show that by using a lesser known relationship also proposed by Cox and Merz, in conjunction with Laun's rule, a relationship between the rate-dependent steady shear viscosity and the first normal stress difference can be deduced. The new empirical relation enables *a priori* estimation of the first normal stress difference using only the steady shear viscosity vs shear rate data. Comparison of the estimated first normal stress difference with the measured values for six different polymer solutions and melts show that the empirical rule provides values that are in reasonable agreement with measurements over a wide range of shear rates; thus deepening the intriguing connection between linear and nonlinear viscoelastic response of entangled polymeric materials.

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