Rheological Behaviour and Relaxation Phenomena of Immiscible Blends: Application of Creep

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Rheological Behaviour and Relaxation Phenomena of Immiscible Blends of Polypropylene and Polystyrene Vahid Shaayegan, Paula Wood-Adams, Nicole Raymonde Demarquette, Adriana M.C. Souza Abstract: A new method, using creep measurements to study the long-time linear relaxation mechanisms in immiscible blends, was developed. Rheological behaviour of immiscible blends of PP/PS was investigated at different concentrations of dispersed phase, for both compatibilized and noncompatibilized systems. Dynamic experiments were performed to analyze the shorter time relaxation processes. An experimental protocol based upon incomplete-creep/recovery was defined such that the morphological changes during flow were minimized. The creep and recovery measurements were used to detect the long-time portions of the weighted relaxation spectra. Data from dynamic and creep measurements were combined using the method proposed by He et al. [J. Rheol, 48(4),711-724 (2004)] to construct an extended retardation spectrum. The extended retardation spectrum was then converted to an extended relaxation spectrum and other LVE material functions covering a broader viscoelastic window than either test on its own. It was observed that the extended relaxation spectrum depicts well the long-time relaxation processes and differs significantly from the spectrum obtained using only dynamic measurements at longer times. This is especially evident for the compatibilized, higher concentration blend which exhibited higher elasticity at low frequencies. The relaxation spectra for the different blends were then compared by means of the weighted and the interfacial relaxation spectra. The effects of composition as well as compatibilizer on the shape of the spectrum and on the form relaxation were elucidated. It was found that the pronounced elasticity at low frequencies qualitatively determines the form relaxation times.