ON THE CREEP RINGING BEHAVIOR OF SEMI-DILUTE POLYACRYLAMIDE AND POLYETHYLENE OXIDE SOLUTIONS

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Aqueous polyacrylamide solutions (PAAm) and polyethylene oxide solutions (PE) of 5, 10, and 15 wt% were characterized under creep measurements. To the best of our knowledge it is the first time that the creep ringing method is used to study these types of polymeric materials. The rheometric measurements were carried out using an Anton Paar MCR 502 rheometer, equipped with a parallel plate measuring geometry with sandblasted surfaces. By performing a stepwise adjustment of the gap, it was possible to keep the maximum normal force during the loading procedure below 5 N. In addition, after each step the time evolution of the relaxation was recorded. In this way, the measurements could be carried out on fully relaxed samples. Systematic creep measurements showed that the initial response correlates to the moment of inertia of the instrument and the geometry. All samples exhibited dumping oscillations. For both PAAm and PE, a profound effect of the polymer concentration on the characteristic ringing frequency and amplitude of oscillations was found. Although, the results are qualitatively comparable, PE exhibits much higher storage and loss moduli. Independent of the magnitude of the applied stress, the initial ringing data coincide until the end of the ringing behavior. However, the long-term creep behavior is significantly affected by the magnitude of the applied stress. In addition, we studied the impact of NaCl and the molecular weight of the polymer on the viscoelasticity of the PAAm solutions. We found that the ionic strength affects both the frequency and duration of ringing. In addition, we found that decreasing the molecular weight of PAAm decreases the amplitude of oscillation and ringing frequency. If the instrument inertia is taken into account, the Jeffreys model provides a satisfying fit to the creep data. All values of the viscoelastic parameters presented here were obtained by fitting this model to the creep compliance curve. The present study shows that the creep ringing method is an extremely helpful since the short- and long-term creep compliance can be simultaneously obtained.

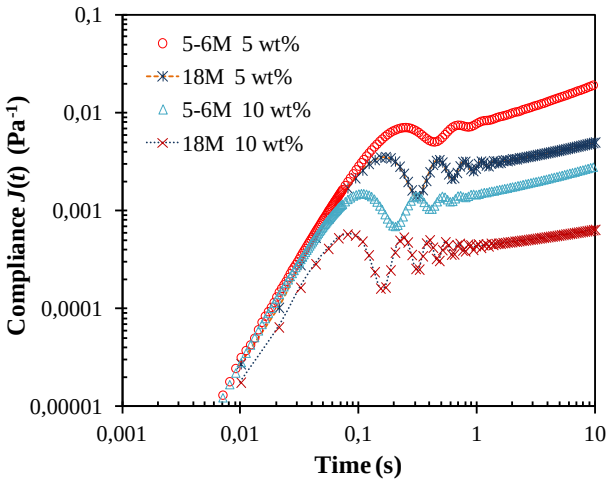

FIGURE 1 – EFFECT OF PAAM MOLECULAR WEIGHT ON THE CREEP RINGING BEHAVIOR

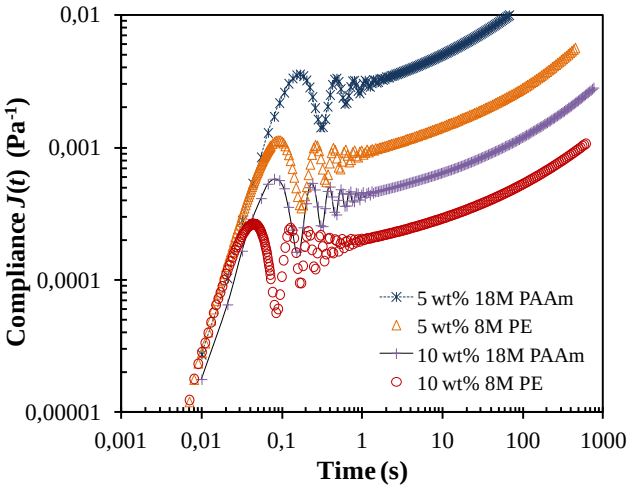

FIGURE 2 – EFFECT OF THE POLYMER TYPE ON THE CREEP RINGING BEHAVIOR