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RHEOLOGICAL CHARACTERIZATION OF MODEL PRESSURE SENSITIVE ADHESIVES

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Pressure sensitive adhesives (PSAs) are viscoelastic materials that adhere to any solid surface with light pressure. As a result, they find widespread applications in packaging and labelling industries. The performance of PSAs in these fields is primarily determined by substrate-adhesive interactions, which are strongly influenced by the bulk viscoelasticity of the material. Thus, rheological characterization is an important method to understand the mechanical behavior of PSAs. Moreover, rheological measurements can also provide relevant material parameters for mathematical or numerical models of the viscoelastic behavior.

In the present study, the rheological measurements of the model PSAs samples were performed in the linear and non-linear viscoelastic regime. Films of the samples were prepared by drying at room temperature in non-sticky molds. Small amplitude oscillatory shear (SAOS) was used to study the linear rheological properties in shear. SAOS test was performed using strain-controlled rheometer (ARES, TA Instruments) with parallel plate tools at frequencies between 10^2 rad/s to 10^{-2} rad/s and at temperatures between -50℃ to 90℃. T he master curves for model PSAs samples were obtained by applying time-temperature superposition (TTS) method using a single shift parameter. The master curves were reduced at a reference temperature of 30℃ as shown in Figure 1. At lower frequencies, absence of crossover in storage modulus (G') and loss modulus (G") indicate no terminal flow regime. From lower to higher frequency range, values of G' are greater than G", which means the elastic behavior becomes dominant. At higher frequencies, we observe a rubbery behavior of PSA. Both model PSA samples satisfy Dahlquist criteria (G'<0.1MPa)[1], which indicate good adhesive properties. However, low molecular weight (M_w) PSA shows lower values of G' at low frequency compared to high M_w. Therefore, low M_w PSA is expected to be a better PSA material than high M_w PSA.

The nonlinear viscoelastic behavior of the PSAs was measured in uniaxial elongational flow using the extensional viscosity fixture (EVF, TA instruments) at a temperature of 30℃ and at strain rates in between 10 $s^{-1}$and 0.001 s^{-1}. The uniaxial elongational stress growth curves versus time at temperature of 30℃ for high M_w PSA are shown in Figure 2. The adhesives obey a strong strain-hardening behavior in extensional viscosity for all strain rates.