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Relaxation Behavior of Biorenewable Waterborne Castor Oil-Based Polyurethane-Lignin Thin Films

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Abstract : The relaxation behavior of biorenewable castor oil-based polyurethane-lignin thin films synthesized in homogenous waterborne dispersions was investigated as a function of concentration at different temperatures and frequencies using broadband dielectric relaxation spectroscopy (BDRS). The molecular dynamics of the glass relaxation process and the local relaxation process of the PU-LS thin films were studied over a wide range of temperatures (-70 to 30 ℃) and frequencies (5 × 10−2 to 0.5 × 107 Hz) for different lignin concentration. Four relaxation processes have been observed namely; ?-, β-, γ-relaxations and ionic conductivity for pure castor oil-based PU and castor oil-lignin-based PU thin films at different temperatures and frequencies ranges. The Vogel-Fulcher-Tammann equation was found to be well described the temperature dependence of the characteristic relaxation times of the ?-relaxation process. However, on the other hand, the molecular dynamics of both β- and γ-relaxation processes were given by the Arrhenius equation. The incorporation of lignin into the castor oil-based PU significantly increased the glass transition temperature and primitivity of the thin films. In addition, the broadness, intensity, and molecular dynamics of the only observed ?-relaxation process were found to be strongly dependent on lignin concentration.

Keywords : castor oil, lignin, polyurethane, dielectric, dispersions
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