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● Effects of kraft lignin incorporation on rheological behavior of a pressure sensitive adhesive

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Abstract content

Pressure sensitive adhesives (PSA) are among the most important industrial applications of block copolymers, in which one block segment acts as a soft domain, contributing to adhesive flexibility and facilitating its contact with the adherend when submitted to an external loading. The coexisting rigid block segments gather in domains which behave as physical crosslinking sites, avoiding adhesive flow and its early failure[1]. On the one hand, the synergistic effect of both domains usually results into a viscoelastic material, suitable for application as a PSA. Moreover, the required properties are strongly dependent on the rheological behavior resulting from the combination of both polymer blocks or domains. Recent works reported the use of nanoparticles in PSAs in order to improve or generate new adhesive properties, in which the relation between nanoparticle incorporation and adhesive rheological behavior was exploited[2].

In this context, an industrial byproduct and natural polymer emerges as a promising nanostructured material for improvement of block copolymer rheological behavior: kraft lignin. This natural polymer, as a residue of pulp and paper manufacturing, presents one of its dimensions under 100 nm and its predominantly phenolic structure can selectively interact with the rigid domains, allowing the optimization of the adhesive rheological behavior. According to Sivasankarapillai et al[3], the incorporation of 30 wt% of lignin into polycarboxylate polyether (PCE) improved its thermal stability and viscoelastic response, improving its tack. Thus, in this work we obtained PSAs based on a polystyrene-*b*-poly(ethylene-butylene)-*b*-polystyrene block copolymer (SEBS) and different concentrations of kraft lignin, in order to evaluate the effects of lignin on PSA rheological behavior. Results revealed that kraft lignin incorporation increased the mechanical strength, promoted the formation of a storage modulus plateau below 0.1 MPa and provided a high dissipation factor in the debonding region. Subsequently, the effects of lignin concentration on tack adhesion properties were investigated using the probe tack tester in order to correlate with the rheological results obtained.

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References

[1] Baïta, N., Grasslc, B., Benabourab, A. and Derailc, C. *Journal of Adhesion Science and Technology*, 2013, 27, 1032–1047.
[2] Kajtnaa, J. and Sebenik, U. *International Journal of Adhesion & Adhesives*. 2009, 29, 543–550.
[3] Sivasankarapillai, G., Eslami, E. and Laborie M. *ACS Sustainable Chemistry & Engineering*. 2019, 7, 12817−12824.