Effect of Vein Graphite Powder on Dynamical Properties of Solid Tire Vulcanizate

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In the construction of solid resilient tires, three layers named tread, cushion, and base are integrated. The cushion, situated in the middle, not only contributes to a comfortable ride but also plays a crucial role in mitigating heat buildup under heavy loads. This study aims to optimize the properties of the cushion compound in solid tires by incorporating Sri Lankan vein graphite powder as a filler. This study investigates the dynamic properties of graphite-filled solid tire compounds under frequency sweep and strain sweep. Frequency sweep was given at 100°C and 10% strain. Complex viscosity of both unfilled and graphite-filled compounds exhibits shear-thinning behavior at lower frequencies, transitioning to Newtonian behavior at higher frequencies. Graphite loading influences these properties, with the 2% graphite-filled compound demonstrating the highest shear-thinning behavior and viscosity. The complex shear modulus (G^*), inversely proportional to viscosity, decreases with graphite loading, with the 2% graphite-filled compound exhibiting the highest modulus. Storage (G') and loss (G") moduli, representing elastic and viscous behavior, are influenced by graphite loading, mirroring the complex shear modulus trends. The damping factor, indicating energy dissipation, decreases with frequency and increases with graphite loading. Strain sweep analysis reveals linear behavior at low strains, transitioning to non-linear behavior beyond a critical strain, influenced by graphite content. The 10% graphite-filled compound shows distinctive behavior, exhibiting the highest damping factor at both low strains and in the entire frequency range. Overall, the study provides comprehensive insights into the viscoelastic characteristics of graphite-filled solid tire compounds, crucial for optimizing tire performance.

Keywords: Dynamic properties, Frequency sweep, Strain sweep, Complex viscosity, Shear modulus, Storage modulus, Loss modulus, Damping factor.