

Evaluating and quantifying the variations and sensitivity in asphalt-filler interaction indices

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ABSTRACT

The interaction within an asphalt-filler blend is usually defined by its volume filling and interfacial reciprocation tendencies. This interplay between a reinforcing solid filler within liquid asphalt thus ends up dictating the blend's transition point from a “diluted region” to a “concentrated region”, and the glass transitioning state of the asphalt itself. While prior studies focused on distinguishing asphalt-filler interactions based on composite reinforcement models, describing the definitive behaviour of its suffusing phase reciprocation has proved elusive. Hence, this study aims at redefining asphalt-filler interaction by evaluating and quantifying the varying distinctions in each established mastic composite model. Asphalt mastics composed of three distinct fillers of dolomite powder (DP), lime kiln dust (LKD), and ordinary Portland cement (OPC), along with a conventional PEN 60/70 binder, were blended together at 0.4, 0.8, and 1.2 filler to binder ratios (F/B) based on the Superpave mix dust to binder specification. The OPC mastic was regarded as the control mastic sample for all tests performed. A temperature sweep test was conducted on all prepared mastic test samples using dynamic shear rheometer equipment at varying temperatures of 46 °C, 52 °C, 58 °C, 64 °C, 70 °C, 76 °C, and 82 °C, for a controlled strain value of 5%, and an angular velocity of 10 rad/s. Asphalt-filler interaction was further analysed using evaluation index coefficients based on rheological performances, i.e., ΔG^* , L-A- δ , K-B- δ , K-B-G*, and K_E respectively. Variations in the evaluation coefficients obtained were also determined via statistical normality tests of skewness and kurtosis. Results obtained indicated a strong asphalt-filler interaction response for coefficients ΔG^* , L-A- δ , K-B-G*, and K_E , while K-B- δ exhibited inconsistent interaction responses. Similarly, the normality test results also inferred that ΔG^* , L-A- δ , K-B-G*, and K_E portrayed better skewness values compared to K-B- δ .

KEYWORDS

Interaction indices; Lime kiln dust; Dolomite powder; Mastic composite; Filler concentration

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