Evaluation of Asphalt Produced from Waste Tyre and Polyethylene Terephthalate-Based Bitumen with Paraffin Wax as Rejuvenator

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During pavement construction and rehabilitation, large amounts of bitumen are often required. As such, the need for material diversification in pavement construction is essential to conserve the non-renewable natural resource deposits. This study assessed the use of Polyethylene Terephthalate (PET) waste and grounded tyre combined in varying proportions with aged bitumen modifier, and wax as a rejuvenator in the production of asphaltic concrete. A 10% polymer replacement level was maintained for all modified mix batches with three distinct proportions: 6%-PET:4%-GWT, 5%-PET:5%-GWT, and 4%PET:6%-GWT. The rejuvenator was added in percentages 1, 2, and 3 by the total mass of modified bitumen mix. Results showed that the penetration values of the modified bitumen mixes with wax fall between bitumen grades 20–60, indicating suitability in warmer climates. Ductility results indicate an increase in ductility upon modification compared to the control mix. The 6%PET/4%GWT samples obtained the highest ductility values (M2 = 23.5 cm, M5 = 12.5 cm, M8 = 22 cm, M11 = 24.25 cm). The highest softening point value (84.5°C) was obtained with M3 (5%PET/5%GWT/0%wax). The inclusion of wax as a rejuvenator led to massive increases in viscosity values compared to both the control mix and the mixes without wax. Flash and fire point results fell within the same range, implying that the modification and rejuvenation did not yield significant impact on the flash and fire point properties. Marshall stability results showed that no modified bitumen batch obtained stability up to the control mix. The highest flow value (5.9 mm) was obtained with the M12 (5%PET/5%GWT/3%wax) mix. This was about 47.45% higher than that of the control mix and 23.7% higher than that of the corresponding mix without wax. The study recommends material diversification as well as dosage variation as essential in the drive towards achieving optimum stability in asphaltic composites.

Keywords: AGED BITUMEN; ASPHALTIC CONCRETE; BITUMEN REJUVENATOR; ENVIRONMENTAL SUSTAINABILITY; POLYETHYLENE TEREPHTHALATE; WASTE MANAGEMENT; WASTE TYRE

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