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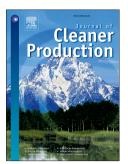
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Evaluation of mechanical performance and modification mechanism

2 of asphalt modified with graphene oxide and warm mix additives

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Abstract: A hot mix asphalt binder (HMAB), PG 64-22 with 0.05 wt.% graphene oxide (GO), 10 11 was used to prepare warm mix asphalt binders (WMABs) with three types of warm mix additives, i.e., 3 wt.% Sasobit, 5 wt.% waste cooking oil (WCO), and Sasobit + WCO. The 12 viscosity-temperature performance, rheological performance, low-temperature cracking behavior, 13 Fourier Transform infrared spectroscopy (FTIR) spectra, and low-temperature thermal properties 14 15 of various HMABs and WMABs were investigated in the laboratory. The experimental results 16 revealed that GO remarkably increased the viscosity, high-temperature elasticity and permanent deformation resistance of the non-modified PG 64-22 asphalt binder. When used individually or in 17 18 combination, Sasobit and WCO can significantly decrease the viscosity of GO-modified asphalt, and reduce the construction temperatures of asphalt paving. Modification of asphalt by the 19 20 admixtures of GO and Sasobit results in excellent high-temperature properties but compromised 21 the low-temperature performance of the asphalt, thus making it more suitable for hot-climate 22 regions. On the other hand, modification of asphalt by the admixtures of GO and WCO exhibited 23 the exact opposite trend, making it more suitable for cold-climate regions. The GO+Sasobit+WCO 24 composite modified asphalt exhibited excellent properties both in high and low temperatures, 25 implying its suitability for all climatic regions. The Differential Scanning Calorimetry (DSC) results suggest that WCO significantly decreased the T_g of the non-modified asphalt but Sasobit 26 27 did not and both of them can enhance the crosslinking degree of asphalt. The FTIR results suggest 28 that the modification of asphalt by the admixtures of GO and warm mix additive (Sasobit or WCO) 29 entailed both chemical reaction and physical blending.

30

- 32 (WCO)
- 33
- 34

³¹ *Keywords:* Warm mix asphalt (WMA); additives; graphene oxide (GO); Sasobit; waste cooking oil

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