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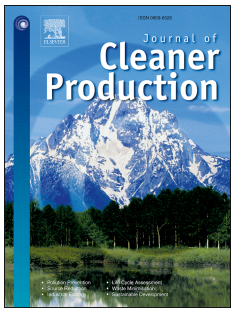

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Evaluation of mechanical performance and modification mechanism of asphalt modified with graphene oxide and warm mix additives

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Abstract: A hot mix asphalt binder (HMAB), PG 64-22 with 0.05 wt.% graphene oxide (GO), 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 viscosity-temperature performance, rheological performance, low-temperature cracking behavior, Fourier Transform infrared spectroscopy (FTIR) spectra, and low-temperature thermal properties of various HMABs and WMABs were investigated in the laboratory. The experimental results 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 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 admixtures of GO and Sasobit results in excellent high-temperature properties but compromised the low-temperature performance of the asphalt, thus making it more suitable for hot-climate regions. On the other hand, modification of asphalt by the admixtures of GO and WCO exhibited the exact opposite trend, making it more suitable for cold-climate regions. The GO+Sasobit+WCO composite modified asphalt exhibited excellent properties both in high and low temperatures, 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 did not and both of them can enhance the crosslinking degree of asphalt. The FTIR results suggest that the modification of asphalt by the admixtures of GO and warm mix additive (Sasobit or WCO) entailed both chemical reaction and physical blending.

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