

Accepted Manuscript

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

Kefei Liu, Kun Zhang, Junliang Wu, Balasingam Muhunthan, Xianming Shi



PII: S0959-6526(18)31367-2

DOI: [10.1016/j.jclepro.2018.05.040](https://doi.org/10.1016/j.jclepro.2018.05.040)

Reference: JCLP 12897

To appear in: *Journal of Cleaner Production*

Received Date: 5 December 2017

Revised Date: 2 May 2018

Accepted Date: 4 May 2018

Please cite this article as: Liu K, Zhang K, Wu J, Muhunthan B, Shi X, Evaluation of mechanical performance and modification mechanism of asphalt modified with graphene oxide and warm mix additives, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.05.040.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

1 Evaluation of mechanical performance and modification mechanism 2 of asphalt modified with graphene oxide and warm mix additives

3 Kefei Liu^{a, b, 1}, Kun Zhang^{b, 1}, Junliang Wu^b, Balasingam Muhunthan^b, Xianming Shi^{b*}

4 ^a*School of Civil Engineering, Central South University of Forestry & Technology, Changsha*
5 *410004, Hunan, P. R. China*

6 ^b*Department of Civil and Environmental Engineering, Voiland College of Engineering and*
7 *Architecture, Washington State University, P.O. Box 642714, Pullman, WA 99164, USA*

8 ¹ *These two authors made equal contributions to this work.*

9
10 **Abstract:** A hot mix asphalt binder (HMAB), PG 64-22 with 0.05 wt.% graphene oxide (GO),
11 was used to prepare warm mix asphalt binders (WMABs) with three types of warm mix additives,
12 i.e, 3 wt.% Sasobit, 5 wt.% waste cooking oil (WCO), and Sasobit + WCO. The
13 viscosity-temperature performance, rheological performance, low-temperature cracking behavior,
14 Fourier Transform infrared spectroscopy (FTIR) spectra, and low-temperature thermal properties
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
17 deformation resistance of the non-modified PG 64-22 asphalt binder. When used individually or in
18 combination, Sasobit and WCO can significantly decrease the viscosity of GO-modified asphalt,
19 and reduce the construction temperatures of asphalt paving. Modification of asphalt by the
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)
26 results suggest that WCO significantly decreased the T_g of the non-modified asphalt but Sasobit
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
31 **Keywords:** Warm mix asphalt (WMA); additives; graphene oxide (GO); Sasobit; waste cooking oil
32 (WCO)

Download English Version:

<https://daneshyari.com/en/article/8094365>

Download Persian Version:

<https://daneshyari.com/article/8094365>

[Daneshyari.com](https://daneshyari.com)