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## **Investigation of the Effect of Nano Graphene Oxide on Fracture Resistance of Asphalt Mixtures with a Fracture Energy Approach**

*In recent years, extensive studies have been conducted on the effect of different nanomaterials on the performance of asphalt mixtures. Also, in the present study, Nano graphene oxide (GO) in the amounts of 0.2, 0.5, and 0.8% by weight of bitumen was used to improve the fracture resistance of HMA asphalt mixture against cracking at negative temperatures. Nano graphene oxide (GO) has been introduced as the material of the century due to its very unique and excellent properties. For this purpose, to investigate the effect of this nanomaterial on the fracture resistance of the asphalt mixtures, the semi-circular bending (SCB) fracture test at temperatures of -5 and -15°C and four different loading modes have been used. In addition, conventional bitumen tests were performed to investigate the effect of Nano GO on pure bitumen in this study. The conventional bitumen tests showed that the addition of Nano GO to pure bitumen increased the softening point, viscosity, and specific gravity and reduced the penetration and ductility in pure bitumen. Also, the semi-circular bending (SCB) fracture test results indicate that using Nano graphene oxide increases the fracture energy of asphalt mixtures and improves the resistance of asphalt specimens to cracking. So that mixtures containing 0.5% of this additive have the best performance. The results show that the use of this amount of additive in the asphalt mixture at -5°C and pure loading mode I increases by 105% and at -15°C and pure loading mode II increases by 60% in the fracture energy.*

**Keywords:** Nano graphene oxide, fracture energy, low temperature cracking, SCB fracture test, asphalt mixture.

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