3RD IRF AFRICA REGIONAL CONGRESS & EXHIBITION
Accra International Conference Centre, April 25–28, 2023

Modification of Bitumen with Waste Materials for Enhanced Aggregate Retention in Surface-Dressed Roads

Nathan David Obeng-Amoako
Arthur L. E. Senaya
Bundu N. Kassim
Francisca Owusu-Ansah
Eugene K. Damoah,
Santus Y. Worclachie
Kenneth A. Tutu

Department of Civil Engineering
Kwame Nkrumah University of Science and Technology, Kumasi
*Corresponding Author (kensfold@yahoo.com)

ABSTRACT

Surface-dressed roads represent about 22% of Ghana's 78,000-km long road network; the vast majority (74%) are unpaved. Stripping – loss of bitumen-aggregate bonding – is significant distress in surface-dressed roads, which results in raveling (loss of aggregate). Stripping may occur early or over many years during service. Raveling promotes other problems, such as water ingress and pothole formation. This study investigated various waste materials as potential bitumen modifiers to minimize stripping. They were high-density polyethylene, polyethylene terephthalate, low-density polyethylene, expanded polystyrene foam, and ground-tire rubber (GTR). Through penetration and softening point testing of AC-10 graded bitumen, a 2% optimum dosage rate was selected for all the modifiers. Fourier Transform Infrared Spectroscopy analysis of the modified and unmodified bitumen showed similarity in the functional groups. The modified bitumen was used to produce pseudo-bituminous mixtures comprising 10mm and 14mm sized granite aggregate (mimicking surface-dressed roads) and subjected to short-term oven aging (three hours) and long-term oven aging (five days at 95°C). Marshall compaction was performed on the mixtures at 130°C by administering 50 blows on each face. A set of the fabricated specimens was conditioned in water at room temperature for 12 hours. Finally, the dry and wet specimens were subjected to Cantabro abrasion loss testing to measure aggregate loss. Under the combined effects of moisture and long-term aging, the specimens containing the GTR-modified bitumen recorded the least Cantabro loss, suggesting enhanced aggregate retention. Field studies should be conducted to validate the laboratory findings.

Keywords: surface-dressed roads, raveling, Cantabro, modifiers, Marshall, stripping