

Performance of glass powder as bitumen modifier in hot mix asphalt

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ABSTRACT

The disposal of glass bottles in landfills has been an ongoing global environmental issue that is yet to be resolved. Using discarded glass in the asphalt mixture may assist in easing the strain on environmental authorities. In this experiment, the discarded glass bottle was repurposed to create glass powder, which was subsequently used as a potential modifier material in an asphalt binder. This study aims to evaluate the characteristics of modified asphalt binders that incorporate glass powder from waste glass bottles. The asphalt binder with a 60/70 penetration grade was used. Bitumen was mixed with varying percentages of glass powder (0, 2, 4, 6, 8 and 10%). The characteristics evaluation using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), X-ray fluorescence (XRF), Field emission scanning electron microscopy (FESEM), Scanning electron microscopy (SEM), softening point, penetration test, penetration index, and Marshall tests were performed. The main oxide group found in glass powder was contributed by silicon oxide (SiO₂). The FESEM morphology analysis showed that the glass powder texture was dense, compact, and contained high contents of Silica (Si) and Oxygen (O) forming silicon dioxide (SiO₂). Results showed that adding 2% and 4% of glass powder to bitumen lowered the bitumen's softening point and increased its heating loss compared to the unmodified sample. The Marshall stability of the asphalt mixture was significantly improved with the addition of glass powder.

KEYWORDS

Waste glass bottle; Bitumen; Physical; Chemical; Stability

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