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Impact of Aging on Fatigue Performance of Novel Hybrid HMA

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Abstract : Aging, in general, refers to changes in rheological characteristics of asphalt mixture due to changes in chemical composition over the course of construction and service life of the pavement. The main goal of this study was to investigate the impact of oxidation on fatigue characteristics of a novel HMA composite fabricated with a combination of crumb rubber (CRM) and polyvinyl alcohol (PVA) fiber subject to aging of 7 and 14 days. A flexural beam fatigue test was performed to evaluate several characteristics of control, CRM modified, PVA reinforced, and novel rubber-fiber HMA composite. Experimental results revealed that aging had a significant impact on the fatigue performance of novel HMA composite. It was found that a suitable proportion of CRM and PVA radically affected the performance of novel rubber-fiber HMA in resistance to fracture and fatigue cracking when subjected to long-term aging. The developed novel HMA composite containing 2% CRM and 0.2% PVA presented around 29 times higher resistance to fatigue cracking for a period of 7 days of aging. To develop a cumulative plastic deformation level of 250 micros, such a mixture required over 50 times higher cycles than control HMA. Moreover, the crack propagation rate was reduced by over 90%, with over 12 times higher energy required to propagate a unit crack length in such a mixture compared to conventional HMA. Further, digital imaging correlation analyses revealed a more twisted and convoluted fracture path and higher strain distribution in rubber-fiber HMA composite. The fatigue performance after long-term aging of such novel HMA composite explicitly validates the ability to withstand load repetition that could lead to an extension in the service life of pavement infrastructure and reduce taxpayers' dollars spent.

Keywords : crumb rubber, PVA fibers, dry process, aging, performance testing, fatigue life
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