INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Evaluating the Effect of Aging and Moisture Conditions on the Performance of Bituminous Mixtures

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SHORT ABSTRACT

Environmental factors such as aging and moisture intrusion significantly influence the performance of the bituminous mixture. Hence, the study's objective was to evaluate the effect of aging and moisture conditions on the performance of bituminous mixtures. In this study, the effect of aging and moisture conditioning on Hot and Warm bituminous mixtures were evaluated using an indirect tensile strength (ITS) test, indirect tensile stiffness modulus (ITSM) test, fatigue test, and creep tests. In addition, adhesive failure (AF) in moisture conditioned (MC) fractured specimens and the loose bituminous mixture was determined using image analysis and photodetection technique.

This study noticed that an increase in moisture conditioning cycles or reduction in test temperature increased the coefficient of variation (CoV) of different cracking parameters. A one-way analysis of variance showed that ITS, fracture work density, and fracture energy parameters were sensitive to different aging and moisture conditioning levels. Furthermore, the cracking resistance parameters indicate that the WMA mixture was relatively moisture-resistant than HMA, attributed to additive characteristics. The AF was higher at 15 °C when compared to 25 °C. However, both HMA and WMA mixtures exhibited comparable adhesive failure. In conjunction with the tensile strength ratio, AF was used to classify moisture susceptibility into three zones. The study also highlights that fracture energy can serve as a measure of cracking resistance in the presence of moisture.

The ITSM and fatigue life of the long-term aged (LTA) mixture was relatively higher than the short-term aged (STA) mixture. However, irrespective of the aging level, moisture conditioning reduced the ITSM and fatigue life of the mixture. The effect of moisture on the bituminous mixture's fatigue life increased with the reduction in test temperature, as noticed in terms of AF of the mixture. The damage-based fatigue life prediction model showed a good coefficient of determination for the conditions evaluated in this study. Stochastic analysis showed that moisture conditioned mixture had a higher likelihood of fatigue damage than the unconditioned mixture. Also, in the case of moisture susceptible mixture, moisture damage might dominate the fatigue behavior compared to the stiffening effect of aging. The effect of aging and moisture on both HMA and WMA mixtures was comparable.

A flow number analysis of the bituminous mixture using the Francken model showed that the LTA mixture had a higher creep resistance than the STA mixture. The creep resistance of the MC bituminous mixture was noticed to be inconsistent due to entrapped moisture in the MC specimen for both HMA and WMA. In contrast to fatigue behaviour, moisture had a lower effect than aging on the creep behaviour of the bituminous mixture.

The study highlights that moisture and aging had a profound effect on the performance of bituminous mixture and further studies are required to understand different aging and moisture damage mechanism to control their effects on the performance of bituminous mixture.