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Evaluation of Crack Propagation Phenomenon in Bituminous Mix

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ABSTRACT

Crack propagation was experimentally simulated using semicircular specimen with a crack initiated on one side. The work shows that the rate of crack propagation can be described by a power relationship between the stiffness of the mixture and the number of cycles to failure, which is mixture and binder dependent.

Keywords: SCB Test, Lime as Additive, Crack Propagation

INTRODUCTION

Fatigue cracking occurs in the asphalt pavement due to the repetition of loads; It includes two steps one is crack initiation another is crack propagation. Once the crack initiated, it grows in a different direction due to various effect. To take any preventive measure, we need to find out what are effects that influence the growth of the crack. In this paper, I have discussed how to measure the crack propagation by semicircular bending test and how different components are affecting the propagation once it's initiated. I have also added lime as an additive to see the result.

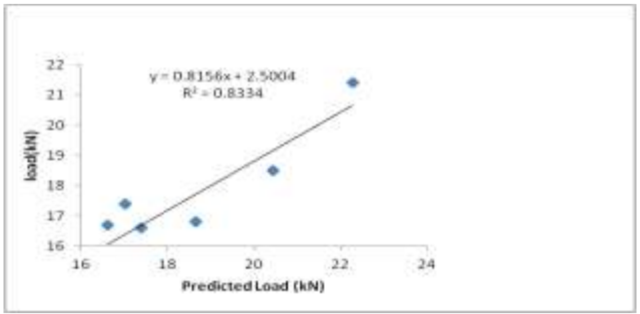
METHOD

Gyratory specimens, 150-mm diameter, were compacted to a height of 63.5mm and an air void content of 4 ± 0.5%. The circular specimens were then cut along the center diameter of the specimen yielding two semi-circular halves. Each half of the specimen was designated with the same notch depth about 2mm that indicates the crack initiation. The virgin binder utilized has a viscosity grade (VG) of 30. Lime was added as additives 1%, 1.5%, 2% and2.5% of the mixture by mass.

Afterward, specimens were placed under the UTM-25kN and allowed subsequently, and specimens were set up on a three-point bending test fixture to perform the test. The fixture has two cylindrical supports of 25 mm in diameter at each end, separated by a 67mm span length. The load-line displacement in the vertical direction recorded by the loading actuator. As they started to show up, we noted down the load at which crack initiated and then the maximum load up to which the failure of sample occurred. With each percentage, there were two samples so we can have two values. After getting the values, we had found the average of two, and the load was determined.

Fracture Load Predictive Model

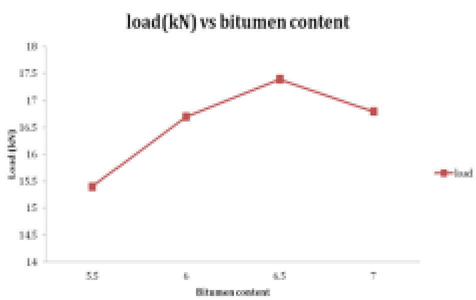
The predictive model for the fracture load (F) combining the different asphalt mixtures totaling 48 sample data points is given by the equation below, and here the parameters are bitumen, lime, air void.
F= 2.820(B) +3.496(L) +2.973(AV) -12.411

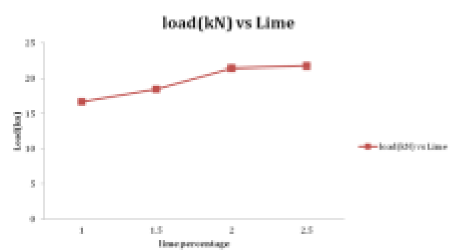


The statistical goodness of fit measures of the model, namely, R^2 and was 0.8334, the statistical measures were in the very good regime exemplifying that the model can be used to understand the total fracture load of the different asphalt mixtures.

Analysis of Model

The sensitivity analyses of the material parameters were performed in this study by varying one factor within its full range while keeping all the other input variables constant. From the figures, we can clearly see that at 6.5 bitumen content and 2.5 lime content the mixture is taking the highest possible load, so they are the optimum values.





Summary

The main objective of this study was to evaluate crack propagation potential of different asphalt mixtures, including the different percentage of lime through a simple but rational technique using the Semi-Circular Bending (SCB) test. The SCB test parameters obtained in this study was used to develop crack propagation predictive models based on the various asphalt materials properties.A total of 48 samples were prepared two sample replicates per mix type.
Using the SCB crack propagation test parameters obtained in this study, predictive models were developed based on material properties in case of using those equations to predict crack propagation potential of asphalt mixtures when testing is not practicable.

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