

Microstructural Characterisation of Rubber Modified Asphalt Mixtures

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Background

It has been found that dry mixing of crumb rubber in asphalt mixture has inconsistent mechanical performance. Therefore it is necessary to study the crumb rubber modified (CRM) asphalt mixture at micro level and quantify the arrangement of aggregates and distribution of voids and crumb rubber which potentially has a significant influence on the performance of CRM mixture. X-ray computed tomography (CT) along with image analysis is applied to characterise the microstructure properties of CRM mixture. These technologies make it possible to optimise the various parameters of microstructure properties and quantitatively relate the properties to the pavement performance. This could provide a good potential for studying the behaviour of the CRM mixture from the microstructure point of view and optimising the capability of digital image processing for composite material characterisation.

Aims

The aim is to investigate the rubberised mixture at the micro level using X-ray CT. The objectives are as follows:

- ◆ To develop imaging and thresholding techniques in order to analyse the microstructure of CRM mixture (aggregates, voids and rubber).
- ◆ To investigate the nucleation and progression of microstructural damage in the CRM mixture subjected to stiffness tests.
- ◆ To study the effect of different combinations of mixture design variables.

Methodology

The research programme is divided into two main studies. Firstly, the study focus on crumb rubber as a modifier in asphalt mixtures. Second study involve an extraction of some information from the X-ray images with application of various mathematical procedures. These are achieved through the following tasks:

- ◆ Material selection and specimen preparation - crumb rubber is used to modified Hot Rolled Asphalt (HRA).
- ◆ Image analysis study - thresholding method is performed to obtain microstructural data from the X-ray CT images.
- ◆ Microstructural damage investigation - different mechanical testing are carried out and specimens are then x-rayed to identify any changes in the microstructure properties.
- ◆ Mixture design variables - examine the effect of these combinations on the microstructure properties.

Current Progress

Extensive work is carried out on imaging and image analysis techniques which are associated with capturing, processing and analysing the digital X-ray CT image. This includes identifying and separating the different phases of microstructure particularly aggregates, rubber, voids and mastic. Also, some analysis to characterise damage evolution such as the growth and inter-linkage of cracks and air voids in the deformed specimen.

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