

Investigation of Related Characteristics of Recycled Asphalt Materials

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Abstract Series of tests were implemented to analysis the related characteristics of recycled asphalt materials using Fourier Transform Infrared (FT-IR) and Dynamic Shear Rheometer (DSR) and statistical analysis. Experimental results indicate that the chemical compositions analysis of asphalt in recycled asphalt materials shows increasing of carbonyl and sulfoxides, decreasing of aromatic functional groups. The rheological behaviors of recycled asphalt investigated using DSR show significant high complex modulus and low phase angle compared to virgin asphalt. Statistical analysis indicates that Percent passing 0.075 mm shows significant coefficient of variation.

Key words recycled asphalt materials; FT-IR; rheological properties; DSR; variability

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Recycled asphalt material is a multiphase system composed of sized aggregates coated with aged asphalt which would vary much due to different positions of pavements which was milled. Fourier Transform Infrared (FT-IR) and Dynamic Shear Rheometer (DSR) were employed to investigate the chemical composition and rheological properties of recycled asphalt binder. In addition, Statistical analysis was also introduced to investigate the variability of aggregates in recycled asphalt materials after ignition.

1 Experiment

Recycled asphalt materials were obtained from Jingzhu Expressway in Hubei province, China. AH-70 paving asphalt was obtained from Ezhou Koch Asphalt Products Co., Ltd in Hubei province, China, which was a comparison to recycled asphalt with Penetration of 78.2 dmm at 25°C, viscosity of 0.43 Pa·s at 135°C, and softening point of 51°C. A Nicolet Nexus Fourier Transform Infrared Spectroscopy (Thermo Nicolet USA) was used to determine the functional characteristics in wavenumbers ranging from 3500 cm⁻¹ to 200 cm⁻¹. Dynamic shear properties were measured with AR2000 dynamic shear rheometer (TA Inc., USA). In addition, statistical analysis of gradation and its variability of recycled aggregates were conducted after ignition.

2 Results and discussion

2.1 Chemical compositions analysis of recycled asphalt

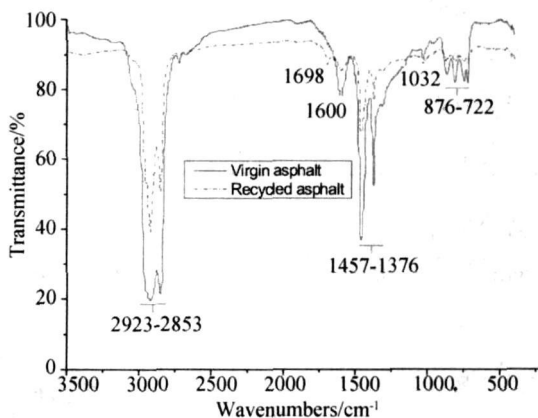


Fig 1 Chemical characterization analysis

An infrared spectrogram is shown in Fig 1, the peak of 1698 cm⁻¹ is newly emerged of recycled asphalt compared to the virgin asphalt, which can be explained that oxidation of methylene and degradation of unsaturated chains lead to ketones and carboxylic acids^[1-2]. The peak of 1032 cm⁻¹ also shows increase, which results from oxidation of thioethers to sulfoxides. In addition, the decrease of 1600 cm⁻¹ and 876 ~ 722 cm⁻¹ presents the degradation of aromatization compounds.

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2.2 Rheological properties of recycled asphalt

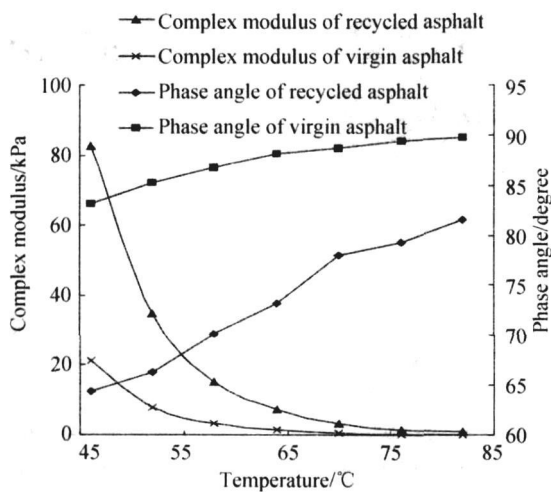


Fig 2 Rheological properties analysis

It is observed from Fig 2 that the slope of G^* curve of recycled binder is remarkably larger than the one of the neat asphalt. The phase angle of recycled asphalt binder decreases significantly over temperature region^[3-4].

2.3 Variability of gradation of recycled aggregates

Fig 3 Presents the distribution analysis of percent age retained on each sieve and its coefficient of variation. The aggregates passing 0.075mm shows high percentage in total aggregates, which also shows relatively high coefficient of variation at 23%^[5].

3 Conclusions

A full scale investigation was implemented to analyze the related characteristics of recycled asphalt materials in this study. The chemical compositions analysis of the aged asphalt in recycled asphalt materials shows increasing carbonyl and sulfoxides, and decreasing aromatic. The rheological behaviors of recycled asphalt

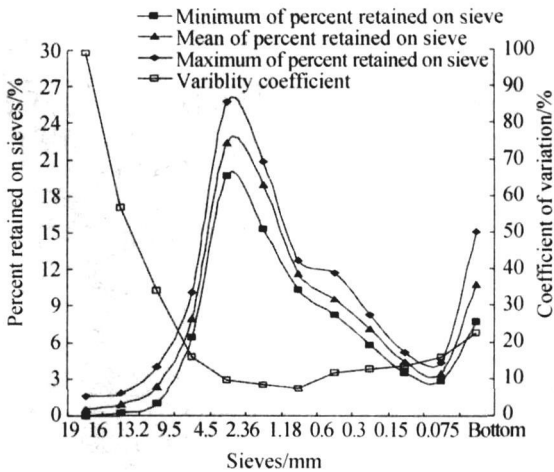


Fig 3 Distributions and variability analysis

show significant high complex modulus and low phase angle. Statistical analysis indicates that percent passing 0.075mm shows significant coefficient of variation.

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回收沥青材料相关特性研究

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摘要：利用红外光谱仪（FT-IR）和动态剪切流变仪（DSR）研究沥青的化学组成和流变性能。同时引入统计分析的方法研究矿料级配的变异性。试验结果表明：与新鲜沥青相比，回收沥青材料中的沥青化学表现为红外光谱中羰基及亚砷基团吸收峰的提高，芳香基团的降低。流变试验表明回收沥青材料中的沥青有较高的复合模量和较低的相位角。统计分析表明，0.075mm筛孔的通过率具有很高的变异系数。

关键词：回收沥青材料；FT-IR；流变性能；DSR；变异性

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