Applied Mechanics and Materials Vols. 638-640 (2014) pp 1185-1189
Online available since 2014/Sep/19 at www.scientific.net

doi:10.4028/www.scientific.net/AMM.638-640.1185

Submitted: 13.07.2014
Accepted: 19.07.2014

Study of Rheological Properties of Cariphalte Modified Asphalt

Tan Hua

Guangxi Key Lab of Road Structure and Materials

Guangxi Transportation Research Institute

601503077@qq.com

Keywords: Road projects; Cariphalte modified asphalt ; Rheological properties; Dynamic shear rheological tests; Rutting resistance

Abstract: To explore the effects of different factors on the rheological properties of cariphalte modified asphalt, based superpave asphalt binder relevant norms, through the use of dynamic shear rheometer Shell 70# asphalt under different temperature, frequency and strain conditions and rheological properties of cariphalte modified asphalt carrying on a systematic study, and comparative analysis of the two anti-fatigue properties of asphalt in the middle and low temperature.The results show that: compared with 70# asphalt, cariphalte modified asphalt has better rutting resistance over a wide temperature range; at lower frequencies and high intensity pavement, cariphalte modified asphalt to better resistance to permanent deformation; better fatigue resistance at low temperatures, and more fatigue damage is not easy to achieve.

Introduction

Cariphalte modified asphalt(CMA) is through a new high-performance polymer modified asphalt mixed with high-quality polymer matrix made of asphalt by shell. From a practical point of view the use of effects, cariphalte modified asphalt t can effectively prolong pavement life, also achieved good results in extreme hot environmental conditions, it is worth promoting. But research on cariphalte modified asphalt is very rare, can not form the same as the systematic study of SBS modified bitumen, many research results only from the observed data in the course of the road come, the cariphalte modified asphalt changed the performance of all aspects of how the performance of asphalt concrete, we still do not know in the end. So conduct research on its nature becomes necessary. Cariphalte modified asphalt is as a viscoelastic material, its performance should study the viscoelastic nature of departure. In this paper, the rheological point of view to analyze its performance, the cariphalte modified asphalt and Shell 70# asphalt asphalt were tested by using dynamic shear rheometer, comparative analysis of their performance changes, in order for the majority of relevant practitioners provide guidance for the use of cariphalte modified asphalt.

Test materials and test methods

Test material

Asphalt tests were used Shell's production of the Shell 70# asphalt and "Shell cariphalte modified bitumen, two asphalt-related technical performance indicators are shown in Table 1.

Table 1, Two kinds of technical indicators asphalt test results

Style / term	Penetration (25˚C,100g,5s)/ 0.1mm	Ductility (5cm/min,10˚C)/cm	Softening Point ring and ball method/˚C	Rotational viscosity 135˚C/pa·s
Shell 70 # asphalt	54.9	111.9	46.5	0.415
Cariphalte modified asphalt	64	68	71	1.500

Test methods

Test equipment used TA brand AR-1500ex model dynamic shear rheometer, by controlling test parameters and analyzing of strain(γ), the frequency (ω) and temperature (T) to impact the rheological properties of cariphalte modified asphalt.

Performance Measurement and Analysis

Effect of temperature

To explore the effect of temperature on the rheological properties asphalt, using dynamic shear rheometer at different temperatures of asphalt complex shear modulus G* and phase angle δ and rutting factor G* / sinδ, comparative analysis of its resistance to high temperature asphalt affect the ability of the rut. Temperature scan range 46.5 ˚C ~ 82.9 ˚C.

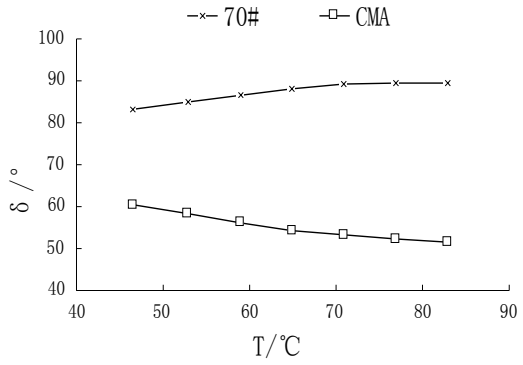

Fig. 1 The variation results of δ with temperature

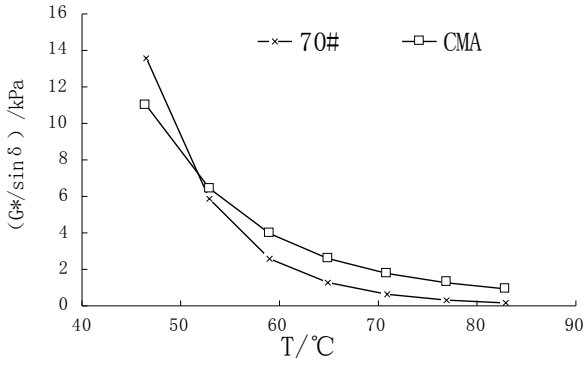

Fig. 2 The variation results of G*/sinδ with temperature

Cariphalte modified asphalt can withstand more recoverable deformation, it will be better resistance to high temperature deformation.

With the gradual increase in temperature, the two asphalt G* / sinδ exponential curve showed a decline in the rate of decline to 70# BAK asphalt modified asphalt crack king faster.

Rutting resistance cariphalte modified asphalt is not in the entire temperature range performed better than asphalt, but with specific temperature dependent; On the other hand, the cariphalte modified asphalt is more suitable for use in high temperature environments pavement rutting resistance.

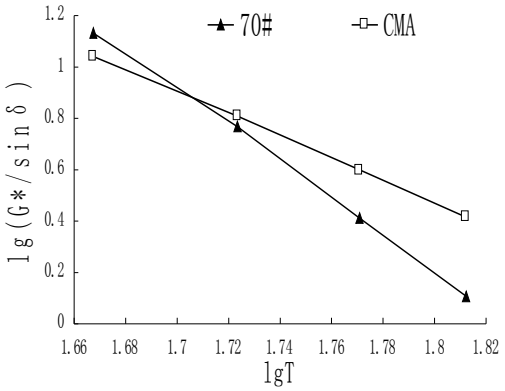

Fig. 3 The variation results of lg （G*/sinδ） with lgT

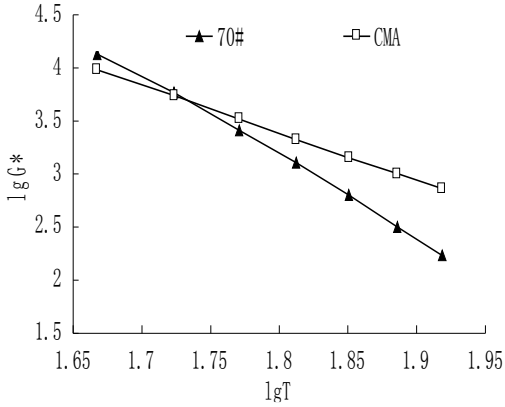

Fig. 4 The variation results of lgG*with lgT

Figures 1 and 2 can be drawn that 70# asphalt temperature is more sensitivity to cariphalte modified asphalt and is more affected by temperature.

Effect of frequency

Selecting 30 ˚C, 50 ˚C and 70 ˚C three test temperature ,to carry on 70# asphalt and cariphalte modified asphalt in 1 rad/s ~ within 100 rad/s range frequency sweeping tests, analysis asphalt at different frequencies, which G*, δ and G*/sinδ changing relationships.

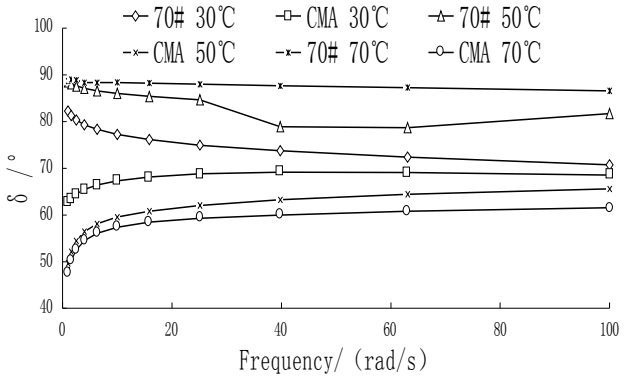

Fig. 5 The δ coefficient with the frequency of at temperature

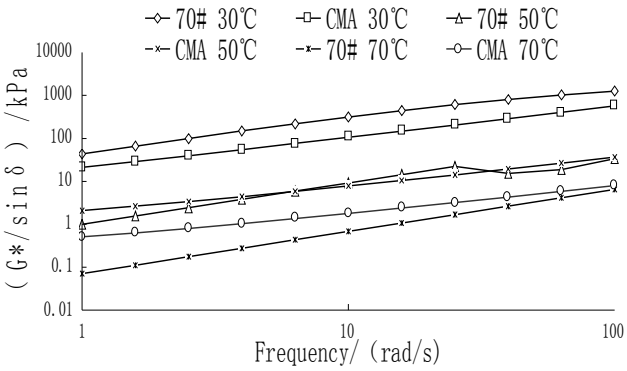

Fig. 6 The G*/sinδ coefficient with the frequency of at temperature

At the same temperature, cariphalte modified asphalt which contained components are more elastic and exhibit better resistance to deformation in the low frequency .

As the temperature increases, the effect on the frequency component is small 70# asphalt, modified bitumen while cariphalte modified asphalt still has some influence, its viscosity increases with frequency components.

Cariphalte modified asphalt has better rutting resistance than 70# asphalt at high temperatures and low frequencies.

Effect of strain

Taking into account previous studies have shown that cariphalte modified asphalt more excellent high temperature performance at higher temperatures, in order to analyze the effect of strain on the asphalt rutting factor test to select 70 ˚C under the conditions of the two asphalt strain sweep.

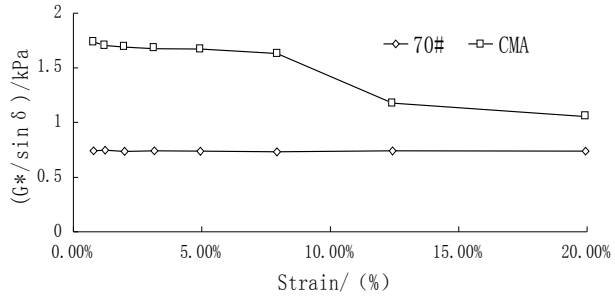

Fig. 7 Strain relations with G*/sinδ of at 70 ℃

Compared with 70# asphalt, cariphalte modified asphalt had a certain strain dependent, which showed better resistance to rutting in strong pavement structure.Pavement structure is stronger, cariphalte modified asphalt has better rutting resistance.

Fatigue cracking resistance

In order to study fatigue cracking resistance of cariphalte modified asphalt, the test which uses the SHRP specified methods carrys RTFO/PAV aging on the two asphatl respectively, and analyzes the changes in fatigue resistance at middle and low temperature conditions.

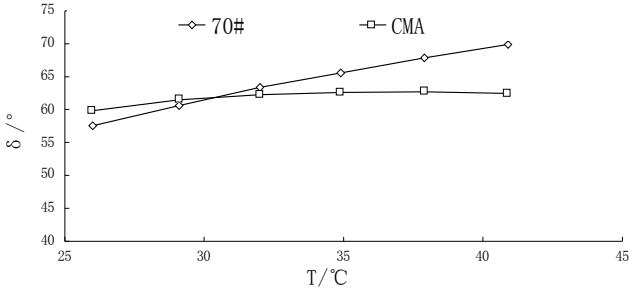

Fig. 8 The relationship between δ and temperature

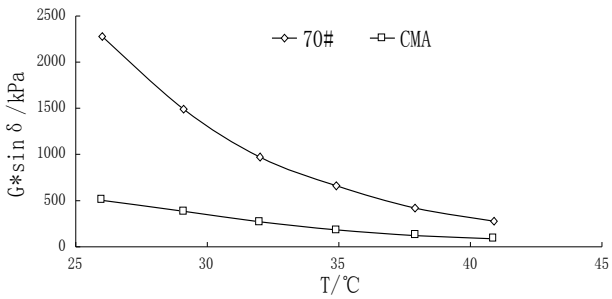

Fig. 9 The relationship between G*/sinδ and temperature

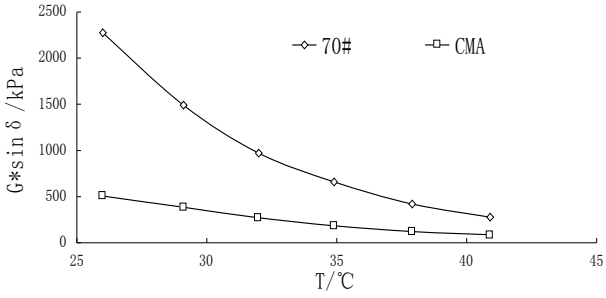

Fig. 10 The regression results G*/sinδ between temperature

As the temperature decreases, ingredient by RTFO / PAV aging asphalt after two viscous component gradually shifted from the elastic component. In the process the temperature is gradually decreased, the bitumen composition after RTFO / PAV aging by viscous components into the elastomeric component.Cariphalte modified asphalt is not more easy to achieve fatigue damage than 70# asphalt.

Summary

The G*/sinδ of two asphalts decrease with increasing temperature, and cariphalte modified asphalt has lower temperature sensitivity, the G* and G*/sinδ decay more slowly, which has better resistance to rutting in the higher temperature range.

Cariphalte modified asphalt is much better rutting resistance than 70# asphalt at high temperatures and low frequencies.

Cariphalte modified asphalt can significantly improve its rutting resistance at high temperatures and overloading.

The G*/sinδ value of cariphalte modified asphalt is always less than 70# asphalt, and is not easy to reach fatigue failure.

References

[1] Yuan Yingjie based Superpave asphalt mortar rheological properties and gradation optimization [D]. Chang'an University, 2004.

[2] Ma Li xing. Asphalt and asphalt during the viscoelastic properties of [D] material aging. Wuhan University of Technology, 2012.

[3] Fu Zhiyong study [D]. Asphalt temperature performance test methods. Changsha University.2005

Progress in Industrial and Civil Engineering III
10.4028/www.scientific.net/AMM.638-640

Study of Rheological Properties of Cariphalte Modified Asphalt
10.4028/www.scientific.net/AMM.638-640.1185