

交通运输

降黏沥青混合料的路用性能研究

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摘要 降黏改性剂是一种节能、环保的新能沥青改性材料。近年逐步地在道路工程中得到了广泛的应用。就基质沥青配伍降黏改性剂后得到的改性沥青, 基于有机降黏剂开展降黏改性沥青的降黏理论讨论, 并对改性后沥青的黏度进行分析。在此基础上, 针对降黏改性沥青的沥青混合料路用性能也开展了相应的研究。

关键词 降黏改性剂 改性沥青 黏温曲线 路用性能

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Viscosity reducing asphalt mixture is an energy saving and environment friendly new material. Viscosity reducing asphalt mixture is decreasing the viscosity of the asphalt by certain technology, so that it has enough liquidity and sufficient mixing at lower temperature, and thus to achieve mixing and paving in lower temperature, while maintaining its performance no less than hot mixture asphalt. The viscosity reducing asphalt mixture has a good environmental performance, and it received widely attention in worldwide.

1 Literature Review of Warm-mixed Technology

Viscosity reducing asphalt mixture is a new type of asphalt mixture, its mixing temperature is between Hot Mix Asphalt (150℃—180℃) and Cold Mix asphalt (room temperature) Asphalt, and its performance can reach to the standard of Hot Mix Asphalt.

Related researches show that, without cutting down the using performance of asphalt mixture, the

mixing temperature of viscosity reducing asphalt mixture^[1] can be reduced to 80℃ to 120℃, its rolling temperature can be reduced to 60℃ to 100℃, energy consumption can reduce 30% compared to HMA. In the production process of Warm Mix Asphalt, its emission of CO reduced by 63 percent, its emission of SO₂ reduced by 40%, and its emission of nitrogen oxide reduced by nearly 60 percent. Due to the reducing influence to the environment, compared to the Hot Mix Asphalt mixing plant, the Warm Mix Asphalt mixing plant can reach relatively high environmental protection requirements, which can save much money.

2 Mechanism of Reducing Viscosity

The contents of the four components of asphalt will have different effect on its viscosity, increasing the heavy elements such as asphaltene and resin would increase the viscosity of asphalt at high temperature, increasing the light elements such as saturation components or aromatic fractions would reduce the viscosity of asphalt at high temperature^[2]. The incorporation of viscosity reducer will reduce the viscosity of asphalt when it mixed at high temperature.

The organic viscosity reducer—reducing viscosity modifier is using easily, its effect of reducing vis-

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cosity is obvious, the viscosity reduction mechanism need to be explored. In this paper, we analysis its chemical structure with some literature^[3,4].

SHRP study^[5] described the effect of wax on asphalt's property, the wax present in asphalt is divided into crystallization wax and non-crystalline wax. They have different influence on its performance. The total content of wax has a major impact on the slope of viscosity-temperature curve, so that the temperature sensitivity of asphalt become seriously, and its directly affect the permanent deformation at high temperature and cracking performance at low temperature. It is proved that Reducing viscosity modifier can be easily and stably dispersed in asphalt, the asphalt's softening point can be effectively improved with a small amount of Reducing viscosity modifier. This is due to the melting point of viscosity reducer——Reducing viscosity modifier is about 100 ℃, it can be completely melted in asphalt with a temperature higher than 115℃.

During the preparation of WMA, after Reducing viscosity modifier is added into hot asphalt, it adsorbed saturated components which is similar to its structure at a high temperature, it adsorbed the asphalt components and swelling, then dissolved in them and formed a stable solution without isolation. Adsorption and dissolution can accelerate asphalt melting, and then reduce

the kinematic viscosity. With the temperature growing, the adsorption and dissolution is more significant, and then causing a sharp decline in kinematic viscosity. The saturation component which is adsorbed by Reducing viscosity modifier at high temperature are mostly wax-based or oil-based molecules or part of the molecule, these molecules generally contain 22 to 44 carbon atoms, it is coarse-grained wax. The molecules of Reducing viscosity modifier is long chain aliphatic hydrocarbons containing 40 to 120 carbon atoms, its structure is different from wax in asphalt. When the temperature of asphalt drops, due to the melting point of Reducing viscosity modifier is about 100 ℃, it is crystallized along with some adsorbed and dissolved saturation components, and then locked the saturated oil and wax components, thus improved the softening point and strength of asphalt, so that in the summer high temperature, asphalt is not easy to become soft weeping, and can prevent the emergence of rutting.

3 Experimental Study on Viscosity Reducing Modifier

Table 1 shows the base asphalt's primary performance, and this asphalt is used to add viscosity reducing modifier and make up reducing viscosity asphalt.

Table 1 Technical properties of base asphalt

Experimental parameters	unit	Standard	Test data
Penetration/(100 g,5 s,25 ℃)	0.1 mm	60 ~ 80	64
Penetration Index		-1.5 ~ +1.0	-0.716
Ductility/(5 cm · min ⁻¹ ,15 ℃)	cm	>100	>100
Softening point	℃	>47	53.2
Density/(15 ℃)	g/cm ³		1.028
RTFOT			
Loss on mass	%	<0.8	0.07
Penetration ratio(25 ℃)	%	>60	83.6
Ductility/(5 cm · min ⁻¹ ,25 ℃)	cm	>50	>100
Ductility/(5 cm · min ⁻¹ ,15 ℃)	cm	>50	89

Table 2 the test result of asphalt viscosity in different content

samples	Viscosity/(mPa · s)				
	90 ℃	105 ℃	115 ℃	125 ℃	135 ℃
Base asphalt	9 136	3 244	1 649	825	468
Reducing viscosity asphalt	31 003	2 239	1 177	602	303

For the mixing and compaction temperature of asphalt mixture, we currently used the viscosity-temperature curve to determine the temperature, using the viscosity-temperature curve to determine the construction temperature is based on the experience data which is given by the rheological properties of common asphalt. In the study of the construction temperature, we mainly use the ASTM methods from abroad for reference, using the corresponding temperature with the viscosity of $(0.17 \pm 0.02) \text{ P} \cdot \text{s}$ and $(0.28 \pm 0.03) \text{ P} \cdot \text{s}$ as the mixing temperature and compaction temperature respectively.

In this paper, we selected two content, 0% and 3.0% respectively, measured the viscosity of bitumen in 90 ℃, 105 ℃, 115 ℃, 125 ℃, 135 ℃ of each group, the data is shown in Table. 2.

We can be see that, as the temperature increasing, the overall trend of viscosity of asphalt is decreasing from table 2. At the temperature higher than 100 ~ 105 ℃, the viscosity of reducing viscosity asphalt is greatly reduced compared to the common asphalt. And at the temperatures lower than 100 ℃ ~ 105 ℃, its viscosity is greatly improved compared to the common asphalt. This is the same as the physical and chemical properties of viscosity reducer^[7], due to the melting point of reducing viscosity modifier is 100 ℃, when the temperature is higher than the melting point, reducing viscosity modifier is liquid form existing in asphalt, then reducing the viscosity, and when the temperature is lower than the melting point. Reducing viscosity modifier crystallized crystal structure of network in asphalt, then increasing the viscosi-

ty. However, for using asphalt, This feature of base asphalt added reducing viscosity modifier is very favorable, high temperature reduced the viscosity of asphalt is helpful for reducing the mixing and rolling temperature of asphalt mixture, and at the lower temperature, it can greatly increasing the viscosity of asphalt, this is helpful for improving the high temperature stability and rutting performance of asphalt mixture.

4 Pavement Performance

Figure 1 is the grading curve of AC—13 and it is used to make up viscosity reducing asphalt mixture, therefore, we can learn the pavement performance from it.

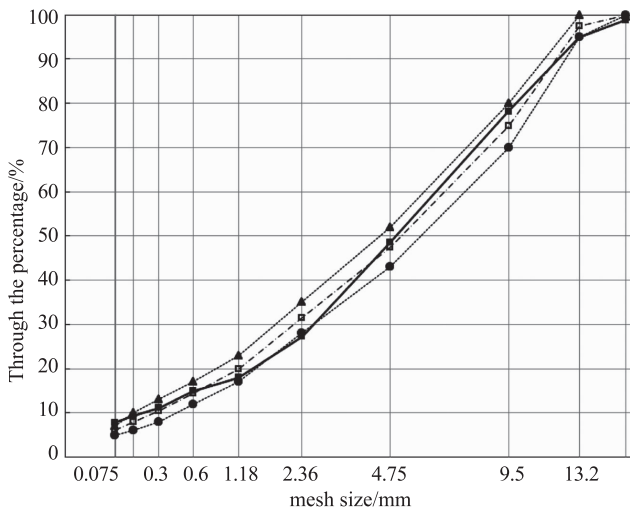


Figure1 the grading curve of AC-13

4.1 Rutting Test

Table 3 shows that the dynamic stability's value of viscosity reducing of asphalt mixture.

From this table we can know that viscosity reducing of asphalt mixture has good anti-rutting ability and it can be used in the high temperature area.

4.2 Residual Stability Ratio

Residual stability ratio shows anti-water damage ability of asphalt mixture and table 4 shows residual stability ratio of the viscosity reducing of asphalt mix-

ture is better than technique demands.

Table.3 Dynamic stability’s value

parameters	Viscosity reducing of asphalt mixture			Average value of DS/(times · mm ⁻¹)
	1	2	3	
Displacement in 45 min/mm	1.974	1.563	1.842	3 892
Displacement in 60 min/mm	2.136	1.736	1.994	
Dynamic Stability /(times · mm ⁻¹)	3 889	3 642	4 145	

Table.4 residual stability ratio

Type	Test condition	Stability/kN	Flow value/(0.1 mm)
Viscosity reducing asphalt mixture	60 ℃ ,1 h	14.66	35.6
		14.67	36.0
		14.46	35.9
		14.42	35.5
	Average value	14.55	35.7
	60 ℃ ,48 h	13.43	29.9
		14.23	32.1
		14.40	32.9
		14.40	32.1
	Average value	14.12	31.7
Residual stability = 14.12/14.55 =97.0%			

4.3 Low Temperature Bending Test

Damage strain of low-temperature bending test shows asphalt mixture’s anti-cracking ability. Table 5 shows that damage strain of viscosity reducing asphalt mixture is meet with technique demands.

Table5 damage strain of low temperature bending test

TEST	Technique demand/με	Test data/με
Low-temperature bending	>2 500	3 480

5 Conclusion

1) Increasing the heavy elements such as asphal-

ting and resin would increase the viscosity of asphalt at high temperature, increasing the light elements such as saturation components or aromatic fractions would reduce the viscosity of asphalt at high temperature.

2) When the asphalt mixture is mixing at low temperature, it can effectively reduce the wear of the mixing equipment, reducing energy consumption, and significantly reducing the aging degree of asphalt in the production of asphalt mixture, and improving its road performance.

3) Viscosity reducing asphalt mixture has good high temperature behavior and its low temperature performance and anti-water damage meet with technique demands. Therefore, Viscosity reducing asphalt mixture has excellent pavement performance.

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Research on Viscosity Reducing of Asphalt Mixture Pavement Performance

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[Abstract] Viscosity reducing modifier is a new kind of materials which is energy saving and environmental protection one, it received widely attention from the road engineering in recent years. In terms of reducing the viscosity of asphalt binder, the mechanism of reducing viscosity based on the organic viscosity reducer, and the viscosity properties of modified asphalt are discussed, and then viscosity reducing of mix asphalt mixture is studied to prove its pavement performance.

[Key words] viscosity reducing modifier modified asphalt temperature curve pavement performance

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VxWorks 的 Spy 工具和异常处理机制等,实现了对嵌入式系统监视信息的采集;对异常信息的捕获和发送通过钩子函数完成,保证了异常信息的实时性;利用 socket 通信,实现了监控端对嵌入式系统的监视和控制。该系统在 Tornado 和 Visual C++ 6.0 环境下编译通过,各项功能运行正常,达到了预期的目标。下一步计划继续完善系统对任务的控制功能,实现对监控任务自身的容错控制,以及实现对任务运行模式的动态配置等。

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Design and Implementation of VxWorks-based Embedded System Remote Monitoring System

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[Abstract] VxWorks is being applied to a wide variety of fields such as industrial control, aeronautics and astronautics, etc. The function and implementation of VxWorks-based embedded system remote monitoring system is introduced, this monitoring system can monitor CPU usage, memory usage and tasks status of VxWorks-based embedded system. The collection of monitoring information is implemented by spy tool and exception handling mechanism of VxWorks, the transmission of monitoring information and commands is realized basing on TCP/IP, which satisfies the requirement of real time and reliability.

[Key words] VxWorks embedded system remote monitoring exception handling