Effect of Asphalt Mortar on High and Low Temperature Performance of Asphalt Mixture

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Abstract: In the design of asphalt mixture, the effect of asphalt mortar in asphalt mixture is fuzzy, and the effect of asphalt mortar is not enough. According to the theory of mortar, asphalt binder should be regarded as an important part of asphalt mixture, and the influence of the ratio of powder to rubber and the high and low temperature performance of asphalt mixture were studied. The results show that the performance of asphalt mixture is affected not only by the amount of asphalt and the amount of filler, but also by the relative ratio of filler and asphalt. In the design of asphalt mixture should pay attention to the actual engineering design and control. In the asphalt mixture design but less than rubber powder, adding fiber, it can significantly improve the asphalt mixture at low temperature flexible low temperature relaxation ability, but also make the high temperature performance of asphalt mixture can be greatly improved.

Keywords: Road engineering; Asphalt mortar; Powder to binder ratio; Fiber; Asphalt mixture; Road performance

1. Introduction

The asphalt mixture has obvious rheological properties, and its properties change with temperature and loading time. The results show that asphalt exhibits elastic, viscoelastic and viscous properties under different conditions. The viscoelastic property of asphalt mixture is caused by the addition of asphalt, and is affected by the fine composition of the mineral. According to the modern theory of mortar, the asphalt mixture with viscoelastic property is a kind of dispersed system with 3 levels of spatial network structure. In the 3 stage of the asphalt mixture, the composition and properties of asphalt mortar play a decisive role in the performance of asphalt mixture [1-2]. In engineering practice, although attention to asphalt and mineral powder mixed influence on viscoelastic performance of asphalt mixture, and in this field at home and abroad have done a lot of research, but less on the performance of asphalt mixture from the angle of mortar. In the process of mixing with, and the asphalt is mixed with the mixture of asphalt and less than the thickness of asphalt film. [3-7]The change of the ratio of asphalt and filler has a direct influence on the properties of asphalt mortar, and affects the viscoelasticity and rheological properties of asphalt mixture. It has a great influence on the high and low temperature performance, fatigue durability and water stability of asphalt mixture.

This paper will paste fine components of asphalt and aggregate in the form as the impact performance of asphalt mixture is one of the important influence, and study the effect of composition changes, on the performance of asphalt mixture powder binder ratio on asphalt mixture of high and low temperature performance. At the same time, this study attempts to use the appropriate amount of fiber to replace some of the powder on the asphalt mixture of high and low temperature performance, and provide guidance for the design of asphalt mixture.

2. Test Plan and Test Results of Mixture

The mineral material is made of basalt stone, and the asphalt is made of Panjin 90. The gradation of mineral material is based on the idea of SH RP gradation, and referring to the gradation of AC 16, which is expressed as the S-16 in the current code of china. At the same time, in order to study the influence of the ratio of powder to rubber on the high and low temperature performance of asphalt mixture, this study made a slight adjustment to the gradation, and expressed as gradation S-16A, see table 1. The effect of fiber on the properties of mortar was investigated by adding 0.300 of the lignin fibers in the mixture of the two grades.

Table 1. Aggregate Gradation Table

Number	Through the Different Mesh (mm) /%					
	19	16	13.2	9.5	4.75	2.36
S-16	100	97	85	71	50	34
S-16A	100	97	85	71	50	34

In this paper, according to the Marshall method to obtain the best asphalt content of asphalt mixture, and measured the asphalt content of the Marshall index, as table 20

Table 2. Summary of Marshall Test Results of Fiber

Number	Asphalt content	Density	Theoretical Density	Void Fraction	Mine Clearance	Mineral Saturation
S-16	4.9	2.46	2.58	4.6	16	71
+10%	5.1	2.443	2.58	5.31	16.7	68.2
S-16A	4.75	2.467	2.578	4.305	15.8	72.8
+10%	5.2	2.452	2.578	4.887	16.3	70

Because the 0.075 mm of the graded S-16A is slightly less than that of the graded S, the optimum amount of asphalt is decreased slightly.

The asphalt mixture of fiber asphalt mixture optimum asphalt content without fiber increased. Because of the large surface area of the lignin fiber, and the fiber is a hollow structure of the wood tracheid, the hollow inner diameter is generally 40 ~ 60 gym. The tracheid length is about 1 mm, and there are many small and large pores in the cell wall of the cell, so the optimum asphalt content of the cell is increased by 3.

The density of fiber asphalt mixture is lower than that of common asphalt mixture. This is because the optimum asphalt content after adding the fiber mixture were increased, and the relative density of fiber and asphalt aggregate ratio are low, and to occupy a certain space, which makes the same volume of mixture density decreased. In addition, because of the elastic energy transfer function of the fiber, the elastic energy of the transformation of the compaction work can be transmitted in time, which makes the densification process more difficult. Of course, this is also the reason why the density of fiber asphalt mixture is decreased and the porosity increases slightly. In addition, the test results show that the Marshall stability of fiber asphalt mixture increases with the best asphalt content, which to some extent indicates that the high temperature performance of asphalt mixture can be improved by fiber addition.

3. Effect of Asphalt Mortar on Rutting Resistance of Asphalt Mixture at High Temperature

The grading curve of s-16 and s-16A is basically the same, the difference is only 0.075 mm pass. It can be seen that although the asphalt content of S-16 is higher than that of S-16A, the dynamic stability of S 16 asphalt mixture is higher than that of S 16A. The other two kinds of asphalt mixture of asphalt content similarity is basically the same, but the rutting dynamic stability but also has a big difference, which shows that the high temperature stability of asphalt mixture and asphalt mixture asphalt content is directly related to. It can be seen from the test results that the dynamic stability of asphalt mixture has a good correlation with the asphalt binder ratio. The comparison of the two groups of similar grading of the powder to rubber ratio and dynamic stability can be seen: the greater the ratio of powder to powder, the greater the dynamic stability of the rut. The results show that, in the case of the same gradation, the key to asphalt mixture is not the asphalt content but the property of asphalt mortar. The quality and performance of asphalt mortar have a very important influence on the performance of asphalt mixture. The ratio of powder to binder determines the relative composition of asphalt mortar.

Two kinds of graded s-16 and graded s-16a after adding fiber, asphalt mixture rutting dynamic stability has been greatly improved. The effect of fiber on the high temperature performance of asphalt mixture can be improved in 3 aspects. The surface of lignin fiber is loose and the surface area is large. The asphalt on the surface of the fiber has been stabilized, so that at high temperatures the fiber prevents the softening of the asphalt. Reinforcement and bridging of fibers. Due to the formation of the fiber asphalt mortar network, this effectively enhances the constraints on the mineral skeleton, thereby increasing the stability of the skeleton, and delaying the slippage of the asphalt and the mortar. The stress dispersion and balance of the fiber, which prevents or reduces the relative slip between the minerals. The uniform distribution of the fiber can be used to distribute the load transmitted on the road surface to the mineral skeleton and asphalt sand in a timely manner, which can not cause the material to slide along the contact surface.

Compared with, the grading of S-16A+0. 3% fiber was lower than that of S-16, but the addition of the fiber was about 0.3%. Through the rutting test of asphalt mixture, it was found that the addition of fibers could counteract the adverse effects on the high temperature performance due to the decrease of the powder to binder ratio, and improve the performance of asphalt mixture. The results show that the stability of the fiber, the reinforcement and the bridging effect, the stress dispersion and the equilibrium effect on the high temperature performance of the asphalt mixture are obviously improved. The use of fiber to replace some of the powder will not only adversely affect the high temperature performance of asphalt mixture, but has a certain improvement.

4. Effect of Asphalt Mortar on Low Temperature Crack Resistance of Asphalt Mixture

The low temperature cracking of asphalt pavement is caused by the temperature stress exceeding the tensile strength of the mixture. Therefore, if the asphalt mixture has higher strength, better anti deformation ability and stronger stress relaxation ability at low temperature, it will have better low-temperature cracking resistance.

There are many methods to evaluate the low temperature crack resistance of asphalt mixture, and the method to evaluate the low temperature crack resistance by the low temperature deformation of asphalt mixture is paid attention to. The low temperature failure strain and the low temperature creep rate are the most commonly used indexes to characterize the deformation capacity.

5. Conclusions

The ratio of powder to binder is an important factor affecting the viscoelastic properties of asphalt mixture. With the increase of the powder / binder ratio, the number of asphalt in the asphalt will increase and the high temperature of asphalt mixture can be improved. The ratio of powder to gum is reduced, but the contrary. The results show that the performance of asphalt mixture is affected not only by the amount of asphalt, but also by the relative ratio of filler and asphalt. In the design of asphalt mixture should pay attention to the actual engineering design and control.

If the fiber is added into the asphalt mixture, the optimum asphalt content of asphalt mixture will increase. This will make certain changes in the Marshall index. The density decreases, and the Marshall stability increases. The dynamic stability of the fiber asphalt mixture rutting test increases, while the low temperature failure strain increases, which indicates that the fiber can improve the high and low temperature performance of asphalt mixture.

It can significantly improve the low temperature flexibility and low temperature relaxation ability of asphalt mixture, and also improve the high temperature performance of asphalt mixture. In the low temperature area of asphalt mixture design in order to highlight the low temperature performance, and ensure the performance of anti-rutting sufficient high temperature, can control the appropriate ratio of filler in the mixture, and adding fiber is an effective way to solve the dilemma of the high and low temperature performance.

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