

Effects of SBS Content on the Performance of Modified Asphalt

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Abstract. The effects of different dosage SBS (Styrene-butadiene-styrene) modifiers on the properties of asphalt were compared and analyzed from the temperature sensitivity, high temperature performance and low temperature performance of modified asphalt. The results show that with the increase of the content of SBS modifier, the softening point and kinematic viscosity of SBS modified asphalt are increased and the high temperature performance is improved. The low temperature ductility is improved; the penetration of modified asphalt is reduced, the temperature sensitivity of the asphalt is reduced. However, when the content of modifier is more than 4%, the penetration index of SBS modified asphalt decreases linearly with the increase of the content of modifier, and the temperature sensitivity increases. The engineering application should be determined according to the specific technical requirements.

1. Introduction

SBS modified asphalt is taken matrix asphalt as raw material, adding a certain proportion of SBS modifier, through shearing, stirring and other methods to make SBS evenly dispersed in the asphalt, at the same time, adding a certain proportion of the exclusive stabilizer to blend Materials, the use of SBS good physical properties of the modified asphalt treatment[1]. At present, SBS modified asphalt processing methods generally were used mechanical blending method, in the factory for mixing or site modification in China. The plant premix production through the swelling, shear, development of three stages, the SBS modifier by strong shear, dispersed into the matrix asphalt to achieve the modified effect, and then stored in a storage tank for using.

In this paper, by comparing the performance test and technical characteristics of modified asphalt with different dosage, the difference of modified asphalt and matrix asphalt was compared, and the change rule of SBS modified asphalt was explored, and reasonable SBS modifier Mixed dosage.

2. Raw materials and testing methods

2.1 Raw materials

90-A asphalt and linear SBS was used, the dosage of the agent was 4%, 4.5%, 5%, 5.5% and 6% respectively. FLUKO-FA25 high-speed shear dispersion emulsifier was used [2].

2.2 Sample preparation method

The process of SBS modified asphalt was shown in Figure 1, 90-A asphalt in the 135 °C oven was



heated to a free flow state, adding SBS modifier and high-speed stirring, placed in the oven at 180 °C development expansion, then shearing machine under high-speed for 40 minutes, and then in the oven at 160 °C in the mixer for 2 hours of continuous development, and then remove the sample to test.

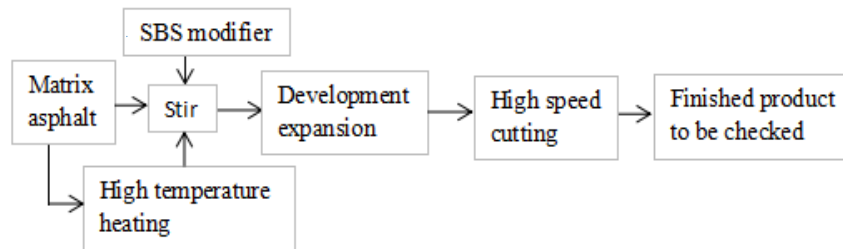


Figure 1. SBS modified asphalt process flow chart

3. Performance Index and Analysis of SBS Modified

Different proportion of SBS modifier to asphalt was produced in accordance with JTG E20-2011[3] for testing. The basic indicators of matrix asphalt are to meet the technical requirements of JTG F40-2004 [4] in the road asphalt 90, the matrix asphalt and SBS modified asphalt index as shown in Table 1.

Table 1. Performance index of SBS modified asphalt with different content.

Content	Penetration/0.1mm			PI	Softening Point /°C	Kinematic viscosity(13 5°C) /Pa s	Ductility(5°C, 5cm/min) /cm	Ductility after Ageing (5°C, 5cm/min) /cm
	15°C	25°C	30°C					
0.0%	22.6	86.6	118.4	-1.36	45.1	0.32	0	0
4.0%	22.7	59.1	86.6	0.14	52.1	0.82	25	15
4.5%	21.7	58.3	85.6	-0.03	57.6	0.86	35	14
5.0%	20.2	57.0	82.2	-0.21	59.6	1.06	41	25
5.5%	19.5	52.7	80.2	-0.21	63.5	1.22	46	26
6.5%	18.4	50.9	79.7	-0.43	78.6	1.52	47	28

3.1 Temperature sensitivity

SBS as a rubber elastomer, itself and the asphalt material has different physical properties, which would cause significant changes in the nature of asphalt. The temperature sensitivity of asphalt is closely related to the paving and performance of asphalt pavements, which is the core indicator of the performance of asphalt, so it is very important to evaluate the temperature sensitivity [5].

It can be seen from Figure 2 that the penetration of SBS modified asphalt decreases with the increase of the modifier content at the same temperature, and the slope of the penetration-temperature relationship curve decreases, indicating that the asphalt temperature sensitivity reduce. It can be seen that the addition of modifier increases the penetration index of asphalt and reduces the temperature sensitivity of asphalt from Figure 3. When the amount of modifier is more than 4%, with the increase of the content of modifier, the penetration index of SBS modified asphalt decreases linearly and the temperature sensitivity increases, indicating that the amount of modifier has the best dosage .In order to meet the requirements of SBS modified asphalt in the technical specification for construction of highway asphalt pavements, lower modifier dosage was recommended so as to reduce costs.

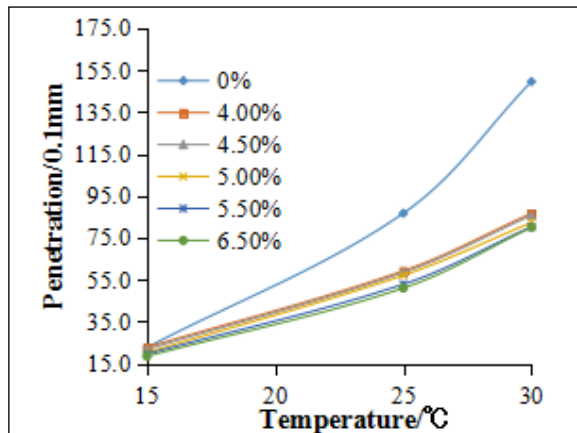


Figure 2. The Relationship between penetration degree and temperature of SBS modified asphalt

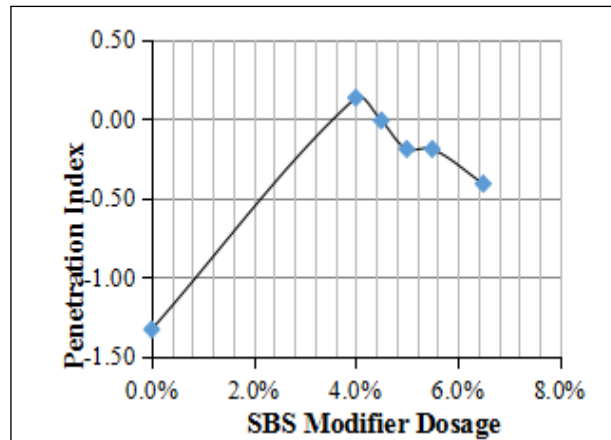


Figure 3. The Relationship between penetration index and modifier content of SBS modified asphalt

3.2 High temperature performance

The high temperature performance of asphalt pavement road performance evaluation is an important indicator [6]. The Modified asphalt is a viscoelastic material, the deformation of the performance of elasticity, delay elasticity and viscous deformation, the former two in the external force will immediately after the recovery or gradually complete recovery, while the latter cannot be restored and become permanent deformation. Asphalt high temperature performance instability of the road, reflected in the summer hot season prone to rut, push and other permanent deformation, not only affect the driving comfort, but also a threat to traffic safety [7]. The addition of the modifier increases the elasticity and delayed elastic deformation of the asphalt, reducing the viscosity deformation. Modified asphalt standard is usually used to soften the point and viscosity of these two indicators to reflect the use of asphalt in high temperature conditions.

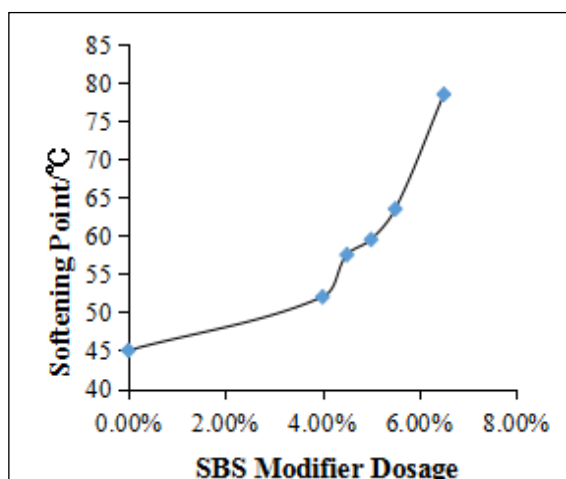


Figure 4. The relationship between the softening point of SBS modified asphalt and the content of modifier.

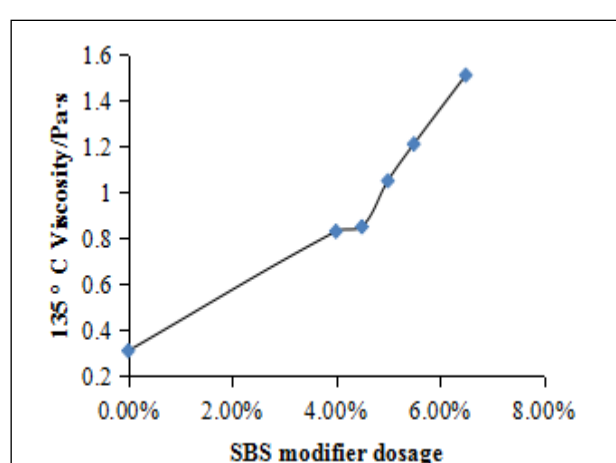


Figure 5. The Relationship between the Viscosity of SBS modified asphalt and the content of modifier.

From Figure 4 and 5 can be seen the viscosity increases gradually and does not exceed the viscosity of

SBS modified asphalt in the technical specification of asphalt pavement construction not more than 3.0 Pa s limit. The addition of modifier can improve the high temperature performance of asphalt and meet the requirements of on-site pumping and mixing[8].The study shows that the incorporation of SBS modifier will greatly improve the high temperature performance of asphalt, thus improving the high temperature stability of asphalt mixture and the anti-rutting ability of asphalt pavement.

3.3 Low temperature performance and ductility

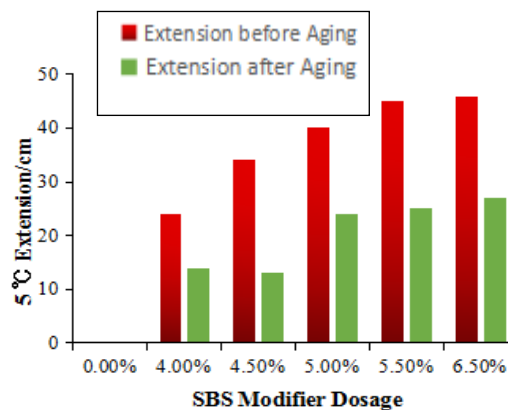


Figure 6. The Relationship between the ductility of 5 °C and the modifier content before and after aging of SBS modified asphalt

Asphalt pavement low temperature cracking resistance depends mainly on the low temperature tensile deformation of asphalt; China developed the polymer modified asphalt technical requirements [9]. The influence of the addition of modifier on the low temperature and anti-aging properties of asphalt was studied by measuring the ductility of SBS modified asphalt before and after aging [10].

With the increase of the content of the modifier, the value of 5 °C ductility of the asphalt before and after aging was gradually increased from Figure 6. The addition of the agent improves the low temperature ductility of the asphalt, the low temperature tensile properties of the asphalt was enhanced, improves the low temperature performance and anti aging function of the asphalt. The results show that the DSR test can accurately describe the effect of aging on the performance of modified asphalt.

4. Conclusions

- (1)The addition of SBS modifier can improve the temperature sensitivity of asphalt, but the optimum dosage should be selected according to technical requirements and engineering conditions.
- (2)SBS modifier can not only improve the high temperature performance of asphalt, but also meet the requirements of field pumping and mixing.
- (3)The addition of SBS modifier has improved the low temperature ductility of the asphalt, enhanced the low temperature tensile properties of the asphalt, and improved the low temperature performance and anti-aging properties of the asphalt.

5. Acknowledgements

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