

The Preparation of Coating Material by Modified Asphalt Waterproof Roll Material

Su ZHAO

School of material science and engineering
Shenyang architecture university
Shenyang, Liaoning
e-mail:zhaosu2005@126.com

Da-ren GUAN*

School of material science and engineering Shenyang
architecture university
Shenyang, Liaoning
e-mail:375533139@qq.com

Ruo-nan WANG

School of material science and engineering
Liaoning science and technology college
Benxi, Liaoning
e-mail:2515363294@qq.com

Guang-yi MA

School of material science and engineering
Shenyang architecture university
Shenyang, Liaoning
e-mail:962799702@qq.com

Abstract—In order to enlarge the utilization of the Buton rock asphalt, reduce the cost of polymer modified asphalt waterproofing roll materials, After mixing Buton rock asphalt into matrix asphalt, adding polymer SBS modifier, and prepare composite modified Buton rock asphalt, Then add the suitable amount of naphthenic oil, PP, talcum powder to prepare coating material by modified asphalt waterproof roll material. So, determine the experiment conditions of SBS and BRA composite modified asphalt, and the size of BRA should be selected within 0.075mm. The mixed BRA replacing part of the SBS modifier plays great role, not only reduces the cost of production, also improve the performance of the modified asphalt.

Keywords-modified asphalt; waterproof roll material; Buton rock asphalt; coating material

Waterproof materials of building industry have developed rapidly in our country, the structure of product also have very largely changes, the proportion of modified asphalt waterproofing materials in the waterproofing material market is bigger and bigger. However the high cost of polymer modified asphalt waterproofing materials affects its popularization and application[1-2], so the development of cost-effective of modified asphalt waterproofing materials becomes particularly important.

Natural asphalt has a wide distribution in the world, and belongs to the same nature material with the petroleum asphalt, and have similar chemical structure and properties. With the shortage of oil resources in today's, the use of natural asphalt replacing part of the matrix asphalt, not only reduces the cost of asphalt, also is more of great significance for the development of new energy, at the same time, the addition of natural asphalt can improve the matrix asphalt aging resistance properties[3]. Although the researches on the application of the natural asphalt at home and abroad are not uncommon, it is generally used in asphalt pavement engineering[4-6], and application scope is limited. Therefore, this research use Buton rock asphalt which is belongs to natural asphalt (BRA) to modify the matrix asphalt and then prepare waterproofing roll materials,

planning to expand its range of application.

Elastomer modified asphalt waterproof roll material is consisting of three parts which are coating materials, surface segregation materials and base material. While the coating material is made of asphalt, modifier and auxiliary solvent, filler, etc[7]. After mixing Buton rock asphalt into matrix asphalt, get the Buton rock modified asphalt, then add polymer SBS(styrene-butadiene-styrene block copolymer) modifier, and according certain formula[8] to prepare waterproofing roll materials.

Compared with SBS modified asphalt, the mixed BRA replacing part of the SBS modifier plays a role, not only reduces the cost of production, and improve the heat resistance and segregation resistance of modified asphalt, also improve the performance of the modified asphalt. Due to the 70% composition of Buton rock is carbonate, so more than of carbonate rock, therefore, the mixed cloth, rock can replace some or all of filler like the talcum powder, etc.

I. THE EXPERIMENT PART

A. Main Raw Material

Maoming 90# asphalt, Indonesia Buton rock asphalt; PP(polypropylene); naphthenic oil; talcum powder; SBS(styrene-butadiene-styrene block copolymer) is linear polymers.

B. Experimental Method

1) The pretreatment of the BRA

Crush the Buton rock asphalt, and get the Buton rock powder below 75um.

2) The preparation of coating material by modified asphalt waterproof roll material

Heat adequate amount of maoming 90# matrix asphalt to 120-145°C, add a certain amount of Buton rock asphalt, then mixing 0.5h at a low-speed, making the Buton rock evenly disperse in the matrix asphalt, at last get the Buton rock modified asphalt. Then heating the Buton rock modified asphalt to 185-190°C, add a certain amount of SBS and continue to mix 2h, making the SBS evenly

dispersed in the modified asphalt, and, in turn, respectively add the suitable amount of naphthenic oil, PP, talcum powder in a certain order, mix 5h, finally get the elastomer modified asphalt waterproofing roll material[8].

C. Performance Testing

Do the performance test such as penetration, ductility, softening point, low temperature flexibility, elastic recovery, segregation with the relevant national standards.

II. RESULT AND DISCUSSION

A. The Influence of BRA Miscible with Asphalt at Different Time and Temperature

Table 1. THE INFLUENCE OF BRA MISCIBLE WITH ASPHALT AT DIFFERENT TIME AND TEMPERATURE

time/h \ Temperature /°C	120	125	130	135	140	145
0.5	Not dissolved	Not obviously dissolved, more particles	mostly dissolved, less particles	Completely dissolved, no particles	Completely dissolved, no particles	heavier smoke
1	Not dissolved	Less dissolved, more particles	Completely dissolved, no particles	Completely dissolved, no particles	heavier smoke	-
1.5	Less dissolved, more particles	Partly dissolved, obviously particles	heavier smoke	heavier smoke	-	-
2	Less dissolved, more particles	mostly dissolved, less particles	heavier smoke	heavier smoke	-	-

B. The Influence of SBS Miscible with Asphalt at Different Time and Temperature

Miscibility temperature of SBS is higher than that of BRA miscible temperature, so when mix the SBS with modified BRA, the need to raise the temperature. At the 300r/min of mixing speed, add 12% of SBS into the matrix asphalt, the dissolving condition as shown in table 2.

According the experiment phenomenon to analyze: when the temperature is below 180°C, although the SBS has partly dissolved, the miscibility effect is not obvious. With the increase of mixing time at 180°C, SBS has been dissolved, but long time mixing also increase the energy consumption, Due to the volatilization of light component, miscibility time can not be too long. When heating to 190°C, the speed of SBS dissolution ability up, mixing for 1h, most of the SBS has been dissolved, and the mixture only have

Respectively heat the matrix asphalt to 120°C,125°C,125°C,135°C,140°C,145°C and maintain the temperature, then add 20% of the BRA, mix 0.5h, 1h, 1.5h and 2h, the dissolving condition as shown in table 1.

Can be seen from table 1, when the temperature is 135°C, the mixing time is 0.5h, BRA and matrix asphalt are completely dissolved, and the miscibility works best. So determine the preparation conditions of BRA modified asphalt: heat matrix asphalt to 135°C, according a certain ratio to add BRA, and mix 0.5h, lead BRA evenly distribute in the matrix asphalt.

less amount of small particles, and a reasonable amount of smoke; When mixing to 2h, mixture has no particles, and the SBS has been completely mixed with asphalt, then continue to mix, the amount of smoke is gradually increasing, mixing also become increasingly difficult. this is because that with the increase of mixing time, light component that can dissolve the SBS begin to evaporate, The SBS begins to gather, cross-linking, plastic modification, resulting in deterioration of mixture system. When the temperature up to 200°C, SBS quickly begins to cross-linking, plastic modification, and at that time it is difficult to control the whole process. The temperature of SBS and asphalt mixture must be strictly within the range of 185-190°C, and maintain the mixing time at 2h.

So the test steps are determined: heat matrix asphalt to 135°C, reference relevant ratio to add the BRA, mix 0.5h,

making BRA uniformly distributed within the matrix asphalt, and then heat to 185°C, mix with a certain ratio of

SBS, mixing 2h, SBS uniformly distributed in modified asphalt[9-11].

Table 2. THE INFLUENCE OF SBS MISCIBLE WITH ASPHALT AT DIFFERENT TIME AND TEMPERATURE

time/h	Temperature /°C	170	180	190	200
		1	Not dissolved	Not obviously dissolved, more particles	Partly dissolved, less particles
2	Not dissolved	Less dissolved, more particles	Partly dissolved, obviously particles	Completely dissolved, no particles	-
3	Less dissolved, more particles	Less dissolved, more particles	Partly dissolved, obviously particles	heavier smoke, bigger viscosity	-
4	Less dissolved, more particles	Less dissolved, more particles	Partly dissolved, less particles	unable to mix	-

C. The Influence of Particle Size on BRA Modified Asphalt

In order to study the effects the particle size of BRA on the properties of the modified asphalt, According to test steps 1.2, take different particle sizes of BRA separately to mix with the matrix asphalt and prepare BRA modified asphalt, the content of BRA is 20%, then respectively determine the penetration and ductility, the results are shown in table 3 and table 4.

Table 3. INFLUENCE OF PARTICLE SIZE ON THE PENETRATION OF BRA ASPHALT

particle size/mm	times				
	1	2	3	4	5
2.36	70	67	70	75	74
1.18	73	72	74	71	69
0.60	75	73	74	72	74
0.30	73	74	75	73	74
0.15	74	74	75	74	75
0.075	75	75	75	74	75

Note: Test condition is 25°C, 100 g, 5 s, unit is 0.1 mm.

Shown in table 3, if joining the equal amount of BRA (20%), The smaller the particle size, the smaller the deviation of the test results.in turn the greater the particle size, the greater the deviation and test results, the greater the deflection, and The lower the reproducibility. The reason may be that the BRA contains a lot of mineral particles. In the penetration tests, when mineral particles of asphalt is bigger than the pinpoint, pinpoint can tip into the mineral grains and make penetration small. On the opposite, it has a trend to become larger. The penetration of mineral without discipline changes is because of the dispersion of

the particle distribution. When the size of particles is in the case of 0.075mm diameter, it is smaller than the diameter of the tip in penetration test, so the mineral materials in BRA can evenly dispersed in the BRA modified asphalt, and play a good modification effect. Filler and asphalt have smaller relatively difference in density, and filler is not easy to occur precipitation in the asphalt BRA. The combination of stand or fall between filler and asphalt is related to the size of the adhesive surface, the larger the surface area, the better the the combination with the asphalt, and the greater the stability of the system.

Table 4. THE INFLUENCE OF BRA PARTICLE SIZE ON THE EXTENSION DEGREE OF MODIFIED ASPHALT

particle size/mm	times				
	1	2	3	4	5
2.36	57.2	54.3	56.7	53.4	56.0
1.18	58.0	56.4	58.6	58.9	56.3
0.6	57.6	58.0	58.6	57.6	58.1
0.3	57.8	58.8	58.6	62.8	57.1
0.15	65.3	63.3	65.1	65.4	63.7
0.075	67.7	68.2	68.4	68.2	67.0

Note: Test condition is 15°C, unit is 1cm.

As shown in table 4, When the size of particles is in the case of less than 0.6mm diameter, with the reduction of grain size, the ductility of BRA modified asphalt has the tendency to become larger. This is due to that the size of BRA become smaller, making the BRA mixed with the matrix asphalt more evenly, the possibility of stress concentration appears become smaller, so it can avoid the premature fracture, make ductility values gradually tend to be more accurate. When the BRA size under the condition

of only 0.075 mm, ductility value fixed in 68cm, and generally there is no change. this is also why use 0.075 mm size of particle to prepare BRA modified asphalt, and discuss the modification effect.

D. The Influence of SBS Content on Modified Asphalt Softening Point

The influence of SBS and BRA content on modified asphalt softening point is shown in figure 1.

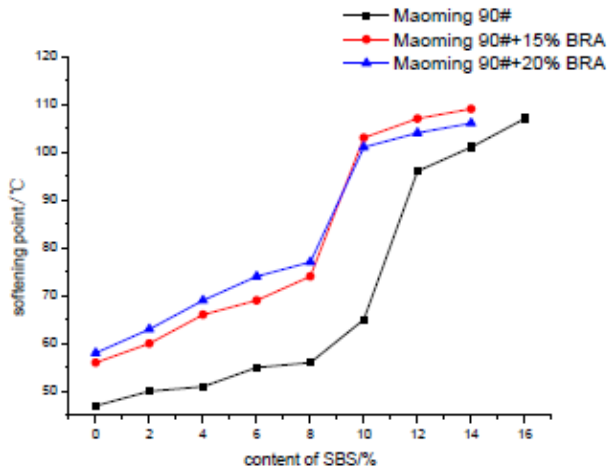


Figure 1. The influence of SBS content on modified asphalt softening point

The results showed: Under the condition of the SBS modified, softening point improved with SBS content increased. The dose is less than 8%, the increasing speed is relatively moderate; while the dose is more than 12%, rising speed of softening point is relatively fast, and has a mutation point between 10-12%. Under the modification with SBS and BRA, the whole changing rule is the same. The abrupt changing point of the softening point jump in advance by 8-10%. When the dose of SBS is more than 10%, the rising speed of softening point modified by 20% BRA asphalt is lower than its content is 15%, the reason is that the large number of minerals of BRA effect the blending of SBS and modified asphalt.

E. Talcum Powder and BRA Modified Asphalt

After heating matrix asphalt to 135°C, respectively adding 5%, 10%, 15%, 20%, 25% and 30% content of BRA and 11%, 20%, 28%, 34%, 39% and 44% content of talcum powder into matrix asphalt, mixing 0.5h, At last, the modified asphalt can be obtained, then test the penetration degree. As shown in the figure 2.

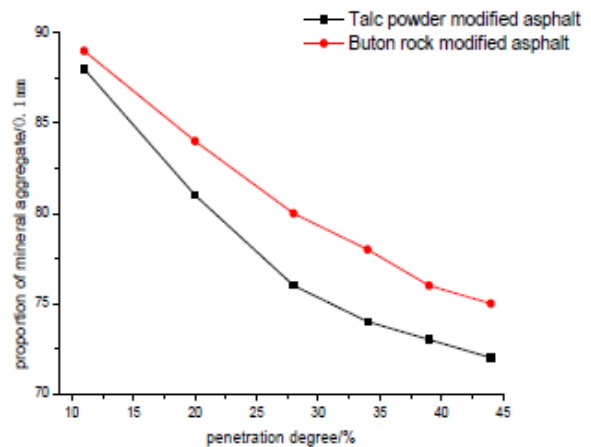


Figure 2. Talcum powder and BRA modified asphalt penetration

The results of modified asphalt penetration showed: Increasing content of talcum powder and BRA, modified asphalt penetration have a tendency to decline. In other words, Whether mix with the BRA or talcum powder, asphalt will become harder and its resistance to deformation is also enhanced; The decline of modified asphalt penetration is roughly the same after mixing talcum powder and BRA. So, if it is used for packing, BRA can replace some or all of filler like the talcum powder, etc.

III. CONCLUSION

Determine the preparation conditions of BRA modified asphalt: heat matrix asphalt to 135°C, according to a certain ratio to add BRA, and mix 0.5h, lead BRA evenly distribute in the matrix asphalt.

Determine the experiment conditions of SBS and BRA composite modified asphalt: heat matrix asphalt to 135°C, add a relevant ratio of BRA, mix 0.5h, making BRA uniformly distributed within the matrix asphalt, and then heat to 185°C, mix with a certain ratio of SBS, mixing 2h, SBS uniformly distributed in modified asphalt.

The size of BRA should be selected within 0.075mm.

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