Research of SMA - 13 Asphalt Mixture Proportioning Design on Northern End of the Capital Airport F Sliding

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ABSTRACT: When we go to airport to do something or take plane, we will find that there are a lot of serious rut. the capital F slide northern area reconstruction project is on the construction, so we think we can pass the construction to solve this problem .we research the SMA-13 modified asphalt mixture of capital F slide northern area reconstruction project from any respects, including aggregate, filler, asphalt, fiber and anti-rutting agent, and we hope we can find the best ways to resolve it.
KEYWORD: Runway; the raw materials; mixture test Pavement diseases; track

1 INTRODUCTION

When the inspectors check to the airport, they report the runway always happens to the rut problem (Xiaoming, Huang, 2004). If the problem will not be solved, it will bring serious impacts on the pavement service, and brings serious security hidden danger; Just now the capital F slide northern area reconstruction project is on the construction, so we think we can pass the construction to solve this problem.

2 RAW MATERIALS

2.1 *Asphalt*

Table 1. Cnooc modified asphalt performance test results

Test items		Technical requirements	Test results
Softening point (℃)		>75	84.3
Penetration (25℃, 100g, 5s) (0.1mm)		40~80	53.2
Ductility (5cm/min, 10℃)(cm)		>40	66.7
Filmy heating operational test163℃/5h	Mass loss (%)	<1	0.024
	Penetration ratio (%)	>70	72.5
	Ductility(10℃)(cm)	>30	66.6
Equivalent softening point T_{800} (℃)		>50	55.6
Equivalent brittle point$T_{1.2}$(℃)		<-13	-14.3
Flash point (COC)(℃)		>250	282
Elastic recovery(15℃)		>75	96

We use Cnooc asphalt, and we modify it with 6% SBS modifier, then it will be modified to modified asphalt. We test its performance indicators, the results is shown in table 1.

From the results, it appears that all the performance indicators meet the technical requirements, we can use this asphalt.

2.2 *Coarse aggregate and fine aggregate*

2.2.1 *Coarse aggregate*

There are basalt coarse aggregates (10~15mm, 5~10mm) and limestone (3~5mm) aggregates, we teste the aggregate indexes in accordance with the relevant regulations, the test results are shown in table 2.

Table 2. The Coarse aggregate technical indicators

Aggregate size	Test results	Test items
10~15mm	2.793	Bulk specific gravity
5~10mm	2.724	
3~5mm	2.717	
10~15mm	2.925	Apparent specific gravity
5~10mm	2.924	
3~5mm	2.807	

From the results, it can be get that the bulk specific gravity and the apparent specific gravity all meet the technical requirements, we can use them in the project.

Table 3. The Coarse aggregate Particle gradation

mesh (mm)	P(%)					
	10~15mm		5~10mm		3~5mm	
	Technical requirements	Test results	Technical requirements	Test results	Technical requirements	Test results
16	—		—		—	
13.2	100		—		—	
9.5	100	100	—		—	
4.75	—	100	—		—	
2.36	95~100	85.9	100	100	—	
1.18	0~15	49.7	95~100	96.4	100	100
0.6	0~5	2	0~10	15.7	85~100	99.8
0.3	—	0	0~5	1.6	0~25	32.4
0.15	—	0	—	1.4		6.5
0.075	—	0	—	0	0~5	3.2

From table 3, it can be get that the 2.36mm and 1.18mm passing rate of 10~15mm, the 0.6mm passing rate of 5~10mm and the 0.3mm passing rate of 3~5mm can not meet the technical requirements. So we suggest that we should screen 10~15mm, 5~10mm and 3~5mm until the passing rate meet technical requirements.

2.2.2 *Fine aggregate*

We use 0-3mm fine aggregate, we test their performance indicators as shown in table 4.

Table 4. The Basalt FINE aggregate Particle gradation

mesh (mm)	P(%)	
	Technical requirements	Test results
4.75	100	100
2.36	85~100	83.2
1.18		52.8
0.6	20~50	36.7
0.3		27.3
0.15		22.9
0.075	0~15	18.5

From the results, it can be get that the 2.36mm, 0.6mm and 0.15mm passing rate of 0~3mm can not meet the technical requirements. So we suggest that We should screen 0~3mm until the passing rate meet technical requirements.

2.3 *Filler*

Table 5. The Mineral filler technical indicators

Test items		Technical requirements	Test results
Hydrophilic coefficient		≤1	0.5
Particle gradation	<0.6mm	100	99.4
	<0.15mm	90~100	96.3
	<0.075mm	75~100	83.7
Apparent specific gravity (g/cm^3)		≥2.50	2.776
Water content (%)		≤1	0.12

We use the limestone powder filler, we test its performance indicators as shown in table 5.

From the results, it can be get that all the performance indicators meet the technical requirements, we can use this filler.

2.4 *Fiber*

We use polyacrylonitrile fiber to test, its main technical indicators are shown in table 6.

Table 6. polyacrylonitrie fiber test results

Test items	Technical requirements	Test results
Diameter(μm)	10~25	12.4
Length(mm)	6±1.5	6.3
Tensile strength(MPa)	≥500	525
Elongation at break(%)	≥15	17.8

From table 6, we can see all the indicators of polyacrylonitrile fiber meet the specification requirements, and it can be used in the design and engineering.

2.5 *Anti-rutting agent*

We use haichuan Anti-rutting agent, through results, Adding 0.5% anti-rutting agent of the asphalt mixture we can achieve the best test results. We test its performance indicators, we put the results is shown in table 7.

Table 7. Anti rutting agent basic indexes test results

Test items	Technical requirements	Test results
Density (g/cm^3)	0.9~1.1	0.94
Melt flow rate(190℃, 2.16kg) (g/10min)	≥3	8
Water content (%)	≤2	0.5
Softening point (℃)	110~150℃	141

From table 7, it can be get that all the performance indicators meet the technical requirements, we can use haichuan Anti-rutting agent.

3 MIX DESIGN OF SMA-13 ASPHALT MIXTURE

3.1 *The determination of aggregate gradation ratio*

The aggregate gradation ratio of SMA-13 asphalt mixture is formed with t five different raw materials. We choose three mix designs. All the mix designs and raw materials are shown in table 8, table 9 and figure 1.

Table 8. SMA-13 ratio of mineral aggregate gradation (%)

Specifications	10~15 mm	5~10 mm	3~5 mm	0~3 mm	filler
Coarse gradation	15	24	10	26	5
Middle gradation	15	24	10	26	5
Fine gradation	15	24	10	26	5

Table 9. SMA-13 mineral synthesis aggregate gradation

Mesh size(mm)	coarse	middle	fine	upper	lower
26	100.0	100.0	100.0	100	100
19	100.0	100.0	100.0	100	100
16	100.0	100.0	100.0	100	100
13.2	92.8	93.0	93.1	100	90
9.5	73.4	74.0	74.5	65	45
4.75	28.1	29.9	31.7	34	22
2.36	18.8	19.9	21.0	27	18
1.18	15.4	16.0	16.6	22	14
0.6	13.7	14.1	14.5	19	12
0.3	12.9	13.2	13.5	16	10
0.15	12.4	12.6	12.9	14	9
0.075	10.6	10.8	11.0	12	8

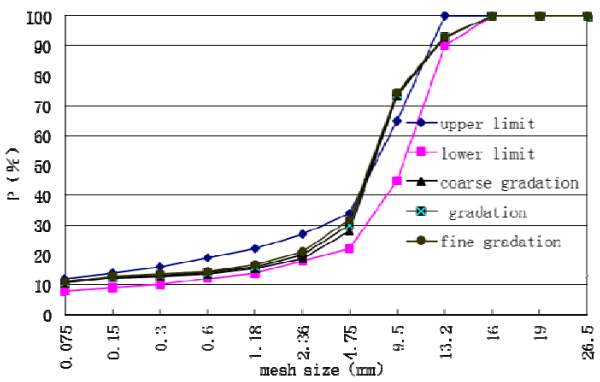

Figure 1. SMA-13 grading curve

Table 10. The Marshall test results of different asphalt aggregate ratio

items	loose unit weight (g/cm^3)	passing rate of 4.75 mm (%)	bulk specific gravity of above 4.75mm (g/cm^3)	P_{CA}	VCA_{DRC}
coarse	1.606	28.1	2.797	0.678	42.59
middle	1.615	29.9	2.795	0.661	42.21
fine	1.622	31.7	2.780	0.644	41.65

Content of coarse aggregate PCA and Clearance rate VCADRC of more than 4.75mm in three mixtures are tested in table 10.

Based on the experience of previous similar airport engineering, we use ratio of 6.0% as a first try oil-stone ratio in Marshall Design method, and then mold specimens in accordance with the specification requirements, measure the physical indexes of the specimens. Specific data are shown in table 11.

Table 11. Performance of the first grading

Test items	Coarse gradation	Middle gradation	Fine gradation
Bulk specific gravity(g/cm^3)	2.454	2.460	2.468
Theoretical density(g/cm^3)	2.566	2.565	2.565
VV (%)	4.38	4.10	3.78
VMA (%)	16.51	16.33	16.08
VFA (%)	73.5	74.9	76.5
VCA_{mix} (%)	40.50	41.79	42.79
VCA_{DRC} (%)	42.59	42.21	41.65
MS (KN)	8.09	8.28	9.13
FL (0.1mm)	27.4	26.4	28.4

According to the relevant specifications, the coarse grading is the best grading.

3.2 *The determination of the optimum proportion*

Table 12. The Marshall test results of different asphalt aggregate ratio

Test items	Oil-stone ratio (%)			Specification requirements
	5.7	6.0	6.3	
Bulk specific gravity(g/cm^3)	2.438	2.445	2.461	—
Theoretical density(g/cm^3)	2.577	2.566	2.556	—
VV (%)	5.4	4.7	3.7	3~4
VMA (%)	16.8	16.8	16.5	≥16.5
VFA (%)	67.9	71.9	77.5	-
VCA_{mix} (%)	40.30	40.30	40.09	≤VCA_{DRC}
VCA_{DRC} (%)	42.19	42.19	42.19	—
MS (KN)	8.33	7.81	7.54	≥6
FL (0.1mm)	29.5	28.3	27.6	—

We select 3asphalt aggregate ratio of Marshall test and calculate their physical indicators in order to determine the optimum proportion, the test results are shown in table 12.

According to the requirements of the relevant specification, calculated the optimum proportion of 6.1%.

3.3 *The optimum proportion of validation*

In the optimum asphalt aggregate ratio of 6.1%, we make Marshall Specimen and the dynamic stability

of specimen, then test their Physical and mechanical performance. The results is shown in table 13.

Table 13. The Road performance verification test results

Test items	Test results
△M(%)	0.07
△S(%)	3.5
DS(time/mm)	10299
MSo(%)	86.6
TSR(%)	84.8
Cw(mL/min)	36.7
TD(mm)	0.82

From the results, it can be get that all the test results can meet the requirements of related technologies.

4 CONCLUSION

In combination with the capital F slide northern area reconstruction project, in order to solve the serious rut of SMA - 13 asphalt mixture, we achieve these important ways.

First: Starting from the raw material, we should choose the qualified raw materials.

Second: we should choose good aggregate gradation.

Third: In order to obviously improve the dynamic stability of mixture, it is reasonable to adding anti-rutting agent.

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