

# Construction Technology of Recycled Micro-surfacing of Yong wu Highway

He Jiang

Highway Institute of Chang'an University, Xi an, Shanxi, China 710064

610981300@qq.com

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**Abstract.** This paper introduces design of mix proportion of recycled Micro-surfacing technology mixing with a certain amount of Recycled Asphalt Mixture (referred to as the RAP) and its application in preventive maintenance for Yunnan Yong wu highway.

## Introduction

Recycling Micro-surfacing is a preventive maintenance technology using Recycled Asphalt Mixture to replace new aggregates on the base of Micro-surfacing.

Compared with the mixture design of Micro-surfacing, the design of Recycled Micro-surfacing mainly increases the evaluation and test of Recycled Asphalt Mixture, determining the blending ratio of Recycled Asphalt Mixture and new aggregate by choosing the type of modified asphalt emulsion, estimating the amount of new asphalt, determining optimum asphalt content, making comprehensive evaluation of construction and pavement performance [1].

Yongren-Wuding Expressway is an important section of the country's western development channel of Lanzhou-Mohan highway in Yunnan Province. After the operation of nearly seven years, slight ruts and longitudinal cracks appear, which greatly affect its safety and comfort. The preventive maintenance scheme of recycled micro-surfacing of MS-3 was chosen to solve this problem.

## Raw material selection

**Mineral aggregate.** Recycled Asphalt Mixture (RAP) mainly comes from pavement surface course and the milling velocity should be controlled between 4 to 8 meters per minute. After screened the RAP by using crushing and screening equipment, the size of 0 to 9.5 mm can be used.

**Modified asphalt emulsion.** The complex formulations of modified asphalt emulsion by using MWV emulsifier MQ3 (0.7%) add emulsifier MQ65 (0.8%). The modifier is SBR latex (solids content 60%), and the content in emulsified asphalt is 3%. the test of residue bitumen content is as follows: the content 65.4%, ductility 24.0cm, penetration 55.3 (0.01mm), softening point 66.0 °C.

## The gradation design of recycled micro-surfacing mixture

The addition ratio of RAP initially selected was 30%, the gradation as follows: RAP (0-10mm): basalt (5-10mm): basalt (3-5mm): limestone (0-3mm) = 30%: 10%: 0%: 60%.

**Cohesion torque test.** The initial setting time and opening traffic time of recycled micro-surfacing mixture is primarily evaluated by cohesion torque test, which has a significant impact on whether the micro-surfacing can meet the requirements of opening traffic earlier. The results of cohesion torque test are show in Table 1.

**Table 1 Cohesion torque test**

The amount of modified asphalt emulsion (%)	The amount of water (%)	The amount of cement (%)	Cohesion torque after 30min	Cohesion torque after 60min	remark
9	8	1.5	1.53(45min)	1.71 (some loose particles in surface)	
9.5	8	1.5	1.35(35min)	1.63 (some loose particles in surface)	Specimens after molding drying in the sun indoors
10	8	1.5	1.44	1.51 (some cracks in surface)	
10.5	8	1.5	1.47	1.57 (some cracks in surface)	

NOTE: Too much water leads strength increasing slowly after 30min, but from the appearance of the specimen, the cohesion torque is better when the amount of modified asphalt emulsion is less than 9.0%.

**Wet track abrasion test.** the optimum amount of modified asphalt emulsion in micro-surfacing mixture is determined by wet track abrasion test and load wheel test . The results of wet track abrasion test are shown in Table 2.

**Table 2 Wet track abrasion test (Wear area of rubber tube is 0.035m<sup>2</sup>)**

The amount of modified asphalt emulsion (%)	The amount of water (%)	The amount of cement (%)	m <sub>a</sub>	m <sub>b</sub>	The abrasion value after soaking in water for 1 hour(g/m <sup>2</sup> )	Means
8	8	1.5	1009.52	993.38	461.14	448.0
			998.48	983.17	437.43	
			1019.13	1003.54	445.43	
8.5	8	1.5	1036.64	1023.15	385.43	405.2
			1028.31	1013.54	422.00	
			1029.85	1015.56	408.29	
9	9	1.5	997.10	986.22	310.86	305.8
			1018.99	1008.32	304.86	
			1038.00	1027.44	301.71	
9.5	9	1.5	1031.35	1027.55	108.57	129.8
			1032.51	1027.50	143.14	
			1053.82	1049.00	137.71	
10	9	1.5	1059.91	1056.52	96.86	105.2
			1033.19	1029.58	103.14	
			1053.18	1049.13	115.71	

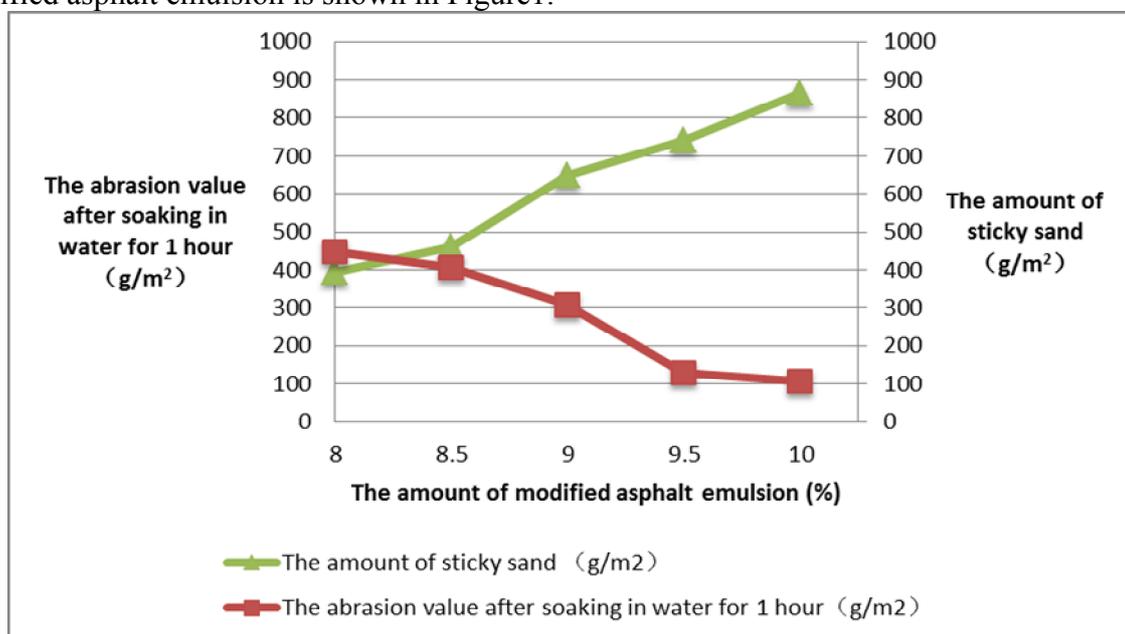
From Table 2, with the increase in the amount of modified asphalt emulsion, the abrasion value after soaking in water for 1 hour decreases, but according to the specification [2], abrasion value should not be greater than 540g / m<sup>2</sup>, the law is clearly visible. When the amount of modified asphalt emulsion is 8.0% - 8.5%, all the abrasion values meet the requirements, so that the amount of modified asphalt emulsion can be reduced in micro-surfacing mixture.

**Load wheel test.** The results of load wheel test are shown in Table 3.

**Table 3 Load wheel test (Rolling area of rubber wheels is  $0.0081\text{m}^2$ )**

The amount of modified asphalt emulsion (%)	The amount of water (%)	The amount of cement (%)	G1	G2	The amount of sticky sand ( $\text{g}/\text{m}^2$ )	Means
8	8	1.5	542.17	545.26	381.48	393.83
			536.26	540.71	549.38	
			534.36	536.39	250.62	
8.5	8	1.5	561.69	565.8	507.41	459.67
			529.62	532.5	355.56	
			551.36	555.54	516.05	
9	8	1.5	575.14	580.66	681.48	649.79
			598.15	602.84	579.01	
			602.12	607.7	688.89	
9.5	8	1.5	574.93	580.48	685.19	741.15
			582.45	587.52	625.93	
			589.41	596.8	912.35	
10	8	1.5	578.29	584.55	772.84	866.26
			560.52	567.48	859.26	
			606.1	613.93	966.67	

From Table 3, with the increase in the amount of modified asphalt emulsion, the amount of sticky sand increases, according to the specification [2], the amount of sticky sand should not be less than  $450\text{g}/\text{m}^2$ , the law is clearly visible. When the amount of modified asphalt emulsion is more than 8.5 %, the amount of sticky sand significantly exceeds regular requirements. The curve of the amount of modified asphalt emulsion is shown in Figure 1.



**Figure 1 the curve of amount of modified asphalt emulsion**

Figure 1 shows that the optimum amount of modified asphalt emulsion is 8.0%- 8.5%, the paper takes the median value of 8.3%. After six days of soaking, the wet track abrasion test results are shown in Table 4.

**Table 4 The wet track abrasion test after six days of soaking  
(Wear area of rubber tube is  $0.035\text{m}^2$ )**

The amount of modified asphalt emulsion (%)	The amount of water (%)	The amount of cement (%)	$m_a$	$m_b$	The abrasion value after soaking in water for 6 days( $\text{g}/\text{m}^2$ )	Means
8.3	8	1.5	1070.9	1062.18	249.14	
			1070.81	1061.51	265.71	275.52
			1058.94	1048.03	311.71	

From Table 4, when the amount of modified asphalt emulsion is 8.3%, all the abrasion values after soaking in water for 6 days can meet the specifications[2] requires (less than 800), indicating that when the amount of modified asphalt emulsion is 8.3% ,the mix design can meet the construction requirements.

### Conclusions

Compared with the micro-surfacing mixture without RAP, RAP decreased the amount of modified asphalt emulsion in micro-surfacing mixture, the abrasion value and the amount of sticky sand also can meet regulatory requirements.

Considering the test results and the situation of the RAP after secondary crushing and screening, the optimum amount of modified asphalt emulsion is 8.3 % (The weight ratio of modified asphalt emulsion and aggregate).

Final gradation: Basalt (5-10mm): limestone (0-3mm): RAP (0-9.5mm): cement (additive): water (additive): modified asphalt emulsion = 10%: 60%: 30%: 1.5%: 8%: 9.0%。

The amount of cement and water can be slightly adjusted according to current temperature and the state of slurry at construction site.

### References

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