Effects of various polymers on quick-set/quick-traffic emulsified asphalt micro-surfacing mixes - Part II

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Experimental Design

Since the objective of this study was to examine the effects that different polymers would have on a micro-surfacing mix, an attempt to eliminate all other variables from the mix design was made. In practice some small variation in emulsifier level was necessary[1] but major variables were controlled. The asphalt used in this study was an AC-20 from Texas Fuel and Asphalt, Corpus Christi, Texas. It has a softening point of 119^0F and a penetration of 75.

The aggregate was an International Slurry Seal Association type 3 ("Joplin Chat") from Bingham Gravel and Sand, Barton Springs, Kansas. The mineralogy of this material is primarily chert. The gradation of this material and the ISSA type 3 specification is shown in Table 1.

Table 1:Aggregate Characteristics

Sieve Size		Specification	Joplin Chat
		PER CENT PASSING	
3/8	inch	98-100	99
No.	4	70-90	86
No.	8	45-70	58
No.	16	28-46	40
No.	30	19-34	26
No.	50	12-25	16
No.	100	7-18	11
No.	200	5-15	7

The emulsifier for this study was Catimuls 404, from ScanRoad, Inc., Waco, Texas. Average dosage level was kept the same for all emulsions. Some minor variation was necessary to achieve a stable emulsion with some of the polymers.

If the polymer to be tested was a solid, it was mixed into the base asphalt using a Ross high-shear blender. If the polymer was a latex, it was mixed into the soap solution prior to emulsification. Polymer amounts were varied to achieve a final level of 2.0% polymer solids in the emulsion residue.

The emulsions for this study were produced on a SERP laboratory emulsion mill, manufactured by ScanRoad, Inc., Waco, Texas. The asphalt temperature was about l40-150C, the soap solution was about 45-55C. Mill gap was 0.012 inches, and mill temperature was held at 90^0C. Emulsions were allowed to cool overnight before testing.

The mix design used in this study is shown in Table 2.

Table 2 : Micro-Surfacing Mix Design (by weight of dry ingredients)

Joblin Chat Aggregate	98%
Type I Portland Cement	2%
Polymer Modified Emulsion	11%
Water	10-11%

The polymers used in this study are shown in Table 3

Table 3 : Polymers Used in the Study

Latex Types	Manufacturer	Brand name	% Solids	Type
SBR	BASF (Polysar)	298	62	Cationic
Natural	Guthrie	Centrifuged	62	Anionic
Neoprene	Dupont	115	47	Nonionic
Neoprene	Dupont	671A	59	Anionic

Solid Types	Manufacturer	Brand Name	Melt Index	% Vinyl Acetate
SBS	Fina	Finaprene		
EVA	Dupont	40W	55	41
		150W	45	33
	Exxon	100	2500	<103 grade
		103	45	>100 grade

Laboratory mixes containing the various polymers were prepared on a 1 quart scale using a Hobart mixer. Samples for cohesive strength and wet-track abrasion tests (WTAT) were prepared from these sample batches. WTAT and cohesive testing were performed on the samples in accordance with ASTM procedure D3910. Marshall Testing was performed in accordance with AASHTO 245.

<u>Results of the Studv</u>

The results of this study indicate that with the test criteria selected, a number of polymers are good candidates for micro-surfacing, and that the chemical variation between differing "grades" of polymer can effect performance. Table 4 & 5 list the test results of this study.

Several interesting features come to light. For this asphalt aggregate combination, good test results are obtained without the addition of any polymer. We conclude from this data that the Marshall test as is presently run does not demonstrate the benefit of the polymer addition. This appears to be a failure of the test method, since the physical data (pen and 5oftening point) clearly indicate substantial change in the asphalt's properties.

Table 4 : Test Results of Various Polymers for Microsurfacing

Polymer	Cohesion kg/cm		WTAT loss g/sq ft		Marshall Stability lbs
	30min	60min	1 hour	6 day	
ISSA Spec	12 min	20 min	75 max		1800 min
Natural	16	18	15	41	3300
SBR	16	21	11	15	2540
SBS	12	17	23	28	4000
Neoprene 115	11	12	73	96	3215
Neoprene 671	8	12	27	40	2400
EVA D-40W	13	16	44	93	3530
EVA D-150W	13	16	51	56	3380
EVA E-100	12	15	48	135	3003
EVA E-103	11	17	33	95	3600
Unmodified AC-20	14	17	19	44	3130

Table 5 : Physical Characteristics of Microsurfacing Asphalts and Emulsions

Asphalt/Polymer	Pen	Softening Point F
AC-20 Base	75	119
AC-20 residue	75	119
AC-20 + SBS	55	144
AC-20 + SBS (residue)	70	136
AC-20 + SBR (residue)	73	139
AC-20 + Natural Rubber (residue)	73	135
AC-20 + Neoprene 115 (residue)	86	124
AC-20 + Neoprene 671 (residue)	66	122
AC-20 + EVA D-40W	62	122
AC-20 + EVA D-40W (residue)	66	122
AC-20 + EVA D-150W	68	122
AC-20 + EVA D-150W (residue)	81	127
AC-20 + EVA E-100	60	129
AC-20 + EVA E-100 (residue)	68	127
AC-20 + EVA E-103	61	124
AC-20 + EVA E-103 (residue)	69	123

Conclusions

The testing conducted for this test indicates that several polymers can successfully perform in micro-surfacing mixes. Field results on these types of materials indicate good field performance for a variety of mix and polymer designs, and test results such as those used in this paper have not been shown to unequivocably mirror field performance.

The results of the Marshall testing do not indicate the benefit to the mix design from the polymer addition. A better test method will need to be found to properly demonstrate the benefits to be gained from the use of polymer-modified micro-surfacing.

Test results in other asphalts will depend on polymer compatibility, and could vary substantially from those presented here. Test results with other aggregates could also vary considerably. A mix design with the specific asphalt, aggregate and polymer must be performed prior to undertaking this kind of job.