Laboratory Evaluation of GSB–78

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Six series of tests were performed on the product GSB-78 marked "standard formula". They were concerned with specifications, wear-ability or resistance to abrasion, coating and stripping, compatibility with asphalt, water absorption and shrinkage (contraction) cracks. The methods of tests and results are discussed separately in the following sections.

1. **Specification Tests**: Results of specification tests by standard ASTM methods confirmed that, except for viscosity, the material tested met all the specification requirements. The viscosity of the sample was 3 centistokes high at 140° F which was undoubtedly due to loss of volatiles during storage in the local dealer's tanks and through transferring and handling of the material.

2. **Resistance to Abrasion:** One of the requirements of a pavement surface sealer and binder is its traffic abrasion resistance. Two methods were used to evaluate the wear resistance of GSB-78 treated specimens: Wet track abrasion test (WTAT) commonly used for testing slurry seals and shaker durability test developed at Kansas Highway Department and modified at ISU for the same purpose.
Two types of slurry seal specimens were prepared with two aggregate blends (both with SS – 1h emulsion), each at 3 levels of asphalt contents making at total of six slurry mixes. For each slurry seal mix, two 3/8 in. x 10 in. slurry WTAT mats and two ¼ in. x 4 ins. Shaker specimens were made and cured.
Wet track abrasion test specimens were abraded for 5 min. with loaded rubber hose and shaker specimens were abraded with 9 steel balls (1/2 in. dia.) 50 g. silica sand and 50 g. water for 60 min. by shaking vertically at ½ in. amplitude and at a rate of 1140 rpm.
After initial abrasion, one of the paired specimens for both WTAT and shaker test (6 pairs each) was treated with GSB-78 at an application rate of 0.12 gal/sq. yd. and cured for 24 hrs. at 140°F. WTAT and shaker test (30 min.) were repeated and wear (abrasion loss) was determined. Results are tabulated in the following tables:

Abrasion Resistance

Aggregate Consisting of No. 8 Garner Limestone

Percent of SS1-h in Specimens			
Sample	**8**	**10**	**12**
Shaker Loss in Grams GSB-78 Treated	1.7	1.0	0.7
Not Treated	2.2	1.6	0.8
WTAT Loss, G/ft. GSB-78 Treated	2.1	1.8	2.8
Not Treated	154.4	86.3	59.7

Aggregate Consisting of 70% Limestone and 30% Sand

Percent of SS1-h in Specimens			
Sample	**12**	**15**	**18**
Shaker Loss in Grams GSB-78			
Treated	1.7	1.0	0.7
Not Treated	2.2	1.6	0.8
WTAT Loss, G/ft.			
GSB-78 Treated	2.1	1.8	2.8
Not Treated	154.4	86.3	59.7

Conclusions: ***GSB-78 treated specimens showed definite superior abrasion resistance to those not treated.*** The generally accepted criterion for good slurry seal is maximum WTAT loss of 75 g/ sq. yd. Photo 1 shows WTAT specimens before abrasion test. The GSB-78 treated specimen has a rich, black and tough appearance both before and after WTAT.

Coating and Stripping Tests: To be effective as surface seal material, it has to be a good binder and adhesive for all types of aggregates and resistant to stripping by water. To evaluate these qualities of Gilsonite Sealer "N" Binder, aggregate coating and stripping tests were performed. A hydrophobic limestone and a hydrophilic siliceous aggregate (quartzite) were completely coated (at room temperature) with about 3 to 10% of three different binders: Gilsonite, MC-250 cutback and CSS-1h quick-set cationic emulsion. Coated aggregated were cured 24 hrs. at140° F and 2 types of stripping tests were run.

a.) Static immersion stripping test(ASTM D1664) in which coated aggregates were immersed in distilled water at 77° F for 24 hrs. and, with the coated aggregates under water, the total area of the aggregate on which the bituminous film is retained is estimated visually.

b.) Boiling immersion stripping test is similar to ASTM D1664 (and which is being proposed as an ASTM standard test) but retained coated area was estimated immediately after boiling the coated aggregate in water 1 min. The results are presented in the following table:

Limestone Aggregate Coating and Stripping Test

Binder Type Used & Percentage of Aggregate Coated			
	GSB-78	**Cutback Asphalt**	**Asphalt Emulsion**
Static Immersion	100%	100%	100%
Boiling Immersion	100%	90%	95%

Quartzite Aggregate Coating and Stripping Test

Binder Type Used & Percentage of Aggregate Coated			
	GSB-78	**Cutback Asphalt**	**Asphalt Emulsion**
Static Immersion	100%	50%	95%
Boiling Immersion	100%	5%	95%

Conclusion: ***The superior coating and stripping resistance characteristics of GSB-78 when compared with both cutback asphalts and asphalt emulsions, especially with respect to hydrophilic aggregates, is evident in both tests*.**

4. **Water Absorption and Permeability**: To determine the sealing and waterproofing abilities of GSB-78 several asphalt concrete and slurry seal samples were treated with GSB-78 and 24 hr. water absorption determined and compared with water absorption of identical samples without treatments. The asphalt concrete samples were field cores aged 42 months. Treated samples were dipped in GSB-78 for 10 sec., drip dried and cured for 24 hrs. at140 °F The slurry seal samples were abraded shaker durability samples (1/4 in. x 4 in. diameter) and treated with GSB-78 at an application rate of 0.12 gal/sq. yd. and cured in the same manner. Water absorption of asphalt concrete pavement cores was determined by 24 hr. immersion and that for slurry seal samples was determined by allowing water to stand in the cans (coated with slurry seals) for 24 hrs. The results are tabulated in the following table:

Water Absorption Test (Percentage Absorbed)

Asphalt Cement Samples		
	Asphalt Concrete A	**Asphalt Concrete B**
GSB Treated Sample	0.37%	0.16%
Untreated Sample	0.54%	0.28%

Slurry Seal Samples				
	A	**B**	**C**	**D**
GSB Treated Sample	2.3%	0.7%	0.9%	2.5%
Untreated Sample	2.9%	1.4%	1.1%	3.3%

5. **Compatibility of GSB-78 with Asphalt**: One of the requirements of an asphalt surface treatment material is to be compatible and to be able to penetrate and establish strong bond with the existing asphalt pavement and binder. GSB-78 treated WTAT specimens were broken and examined under the microscope.

Conclusion*: No boundary interface could be observed, indicating that GSB-78 had formed, with existing asphalt, an integral part of the binder.*

6. **Shrinkage (Contraction) Cracks and Flexibility**: It was a concern that the use of GSB-78 in regions where the climate is severe in terms of freezing and thawing cycles may cause temperature induced contraction/shrinkage cracks because of the apparent low ductility which is usually associated with low flexibility and brittleness in asphalt.

   Ductility test was performed on the residue since it is usually contained in specifications for paving asphalt cements and cutbacks. The lack of ductility of this material may cause some concern among highway engineers. Several GSB-78 treated WTAT specimens were exposed to 10 cycles of freezing (at -20° F) and thawing (at 77° F). No cracks were observed even for slurry seal specimens that exhibited hairline cracks before treatment with GSB-78.

   To test the flexibility of cured GSB-78 film, several specimens were prepared by dipping 41 mm x 20 mm x 0.15 mm stainless steel plates into GSB-78, drip drying and curing in oven at 140° F for 24 hrs. The GSB-78 coated plates were bent and flexed at room temperature. No cracks were observed. The film flexing tests were repeated after the films (and plates) were first conditioned to -10° F and 30° F. Again the films were able to deflect without cracking.

   Summary Conclusion: ***From the above tests, it is concluded that the product GSB-78 when applied to existing asphalt surface at a recommended rate, will form a non-sticky, homogeneous, tough, impervious and extremely abrasion resistant seal.***