FINAL REPORT

SURVEY FOR REACTIVE BLENDS OF ASPHALT AND ANTISTRIPPING ADDITIVES

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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SUMMARY

When subjected to elevated temperatures, some blends of asphalts and antistripping additives undergo a reaction that causes the additive to be ineffective. The frequency of occurrence of reactive asphalt-additive blends used by the Virginia Department of Highways and Transportation was determined to ascertain the level of testing that is necessary to prevent acceptance of their use in asphaltic paving mixtures.

Samples of asphalt cement were collected, combined with the two additives used most frequently by the Department, heat treated, and tested. Bottle and stripping tests were used to evaluate the reactivity of the blends.

Although approximately 50% of the asphalts reacted with an additive, the reactions were not detrimental when normal additive doses were used. It was concluded that no modifications to the present test procedures and frequency of tests are needed.

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BACKGROUND

Chemical antistripping additives are used to promote adhesion between the binder and the aggregates in asphaltic mixes. Generally, aggregates are hydrophilic (water-loving) and asphalts are hydrophobic (water-hating); therefore, water can displace asphalt and cause a loss of bond at the asphalt-aggregate interface. Most of the antistripping agents used to overcome this problem are fatty amines derived from beef tallow; however, other types of chemical agents are used occasionally. When a small amount of an amine additive is blended with asphalt, it acts as a bridge between the aggregate and asphalt surfaces and promotes the bond between the two.(1)

Amine additives can be stored at ambient temperatures indefinitely without a loss in effectiveness; however, when stored in hot asphalt at temperatures greater than 100°C (212°F) the amine can become inactive. It is reported that 50% of the amine can be inactivated in 24 hours at 120°C (248°F) and 100% of its effectiveness can be lost in a few hours at 180°C (356°F). In light of these facts, Virginia permits the use of only "heat stable" additives because asphalt-additive blends sometimes are stored for extended periods at high temperatures when equipment at the hot mix plant fails or unfavorable weather interrupts paving.

PURPOSE AND SCOPE

The purpose of this investigation was to determine about how often reactive combinations of asphalts and additives are used in paving mixtures in Virginia. Asphalt samples were obtained statewide and tested with the two additives used most frequently in Virginia. The results were used to determine the frequency of testing necessary to prevent the use of reactive blends.

MATERIALS

Thirty-two samples of asphalt cement with no additive were obtained throughout the 1981-82 construction seasons by inspectors at various asphalt terminals. Two antistripping additives, Pave Bond AP Special and Kling Beta XP-251, were blended with each of the asphalt cements and the blends then were subjected to heat treatment and testing.

Aggregate that has a history of stripping was used in the stripping test. The mix gradation and asphalt content are listed in Table 1.

Table 1. Gradation and Asphalt Content

Sieve	Percent Passing
1/2	100
4	60
30	22
200	5
Asphalt content = 6.0%	

PROCEDURE

Prior to testing, the asphalt-additive samples were treated in an oven at 325°F (162°C) for 120 hours. Following this treatment, a stripping test currently being implemented in Virginia was used to determine whether the asphalt-additive combinations had been rendered ineffective. Because this stripping test is rather lengthy, a quick bottle test was used to screen the numerous asphalt-additive samples. Six of the asphalt-additive blends showing the most detrimental reactivity as determined by the bottle test were then tested with the stripping test to determine whether the reactivity was sufficient to render them ineffective.

Bottle Test

The bottle test has been used by several state agencies and producers of additives to detect the presence of additive in asphalt-additive blends. Since it had been determined in a prior study(2) that the test indicated an additive was ineffective in concentrations less than 0.1%-0.2%, a 0.2% concentration was used in an attempt to detect a minimum asphalt-additive reaction at a high storage temperature.

The Virginia test procedure (VTM-55) used is described in the Appendix. The degree of coating of the sand was observed rather than attempting to classify the coating as pass or fail, which is normally done. A pass or fail classification would have resulted in too many blends to be evaluated with the stripping test.

Stripping Test

A stripping test modified from the one developed under NCHRP Project 4-8(3) was used to test six of the asphalt-additive blends identified by the bottle tests as possibly being reactive.[3,4] The tensile strength ratio (TSR), which is the ratio of the preconditioned strength to the dry strength, was used to predict stripping susceptibility. A normal dose of additive (0.5%) was used for the stripping tests.

Results

Approximately one-half of the bottle tests indicated a reaction that had reduced the effectiveness of the antistripping additive. The samples that were affected were not related to brand of asphalt, terminal location, or type of additive.

The stripping test results are listed in Table 2. The TSRs, which were excellent, ranged from 0.88 to 0.96. Normally, values greater than 0.75 are considered satisfactory. This aggregate with no additive usually produces a mix with a TSR of approximately 0.4. Although the bottle tests indicated that reactions occurred for about one-half of the asphalt-additive blends, these reactions were not detrimental to the additive.

Table 2. Stripping Test Results

Sample	TSR
10B	0.93
11B	0.94
14B	0.95
21B	0.89
25B	0.96
28B	0.88

CONCLUSIONS

1. From the results of bottle tests, it can be expected that additives will react with asphalt in approximately one-half of the blends used in Virginia.

2. Based on the results of the stripping tests, it is concluded that the reactions are not detrimental at additive doses normally used.

3. Additives will not become inactivated under normal conditions of use in Virginia.

RECOMMENDATION

The results of this investigation indicate that present test procedures and frequency of testing are sufficient to prevent acceptance of reactive blends of asphalts and additives.

It is recommended that no extraordinary testing be conducted to monitor reactive blends.

REFERENCES

1. "Anti-Stripping Agents for Bituminous Surfacings," Technical Bulletin 1, Scanroad International Pte Ltd, Singapore, October 1982.

2. Maupin, G. W., Jr., Final Report — Detection of Antistripping Additives With Quick Bottle Test, Virginia Highway and Transportation Research Council, October 1980.

3. _______, "Implementation of Stripping Test for Asphaltic Concrete," Transportation Research Record 712, 1979.

4. Lottman, Robert P., "Predicting Moisture-Induced Damage to Asphaltic Concrete," National Cooperative Highway Research Program Report 192, 1978.

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APPENDIX

Detection of Antistripping Additives in Asphalt Cements (Quick Bottle Test)

Designation: VTM-55

1. Scope

This method covers the procedure to be used in rapidly determining the presence of an antistripping additive in asphalt cements.

2. Apparatus

a. 4 oz. (0.1 liter approximately) glass bottle with a screw cap.

b. Glass or wood stirring rod.

c. Medicine dropper.

d. Paper towels.

e. Clean 1 qt. (0.9 liter approximately) test can.

f. Balance with a capacity of at least 100 grams, sensitive to 0.1 gram.

g. Standard Ottawa sand (ASTM C 190 sand, 20-30 mesh).

h. Distilled or demineralized water.

i. Solvent Naphtha (VM & P).

3. Procedure

a. Place 20 grams ± 1 gram of the standard Ottawa sand in the 4 oz. (0.1 liter approximately) bottle, and add enough distilled or demineralized water at room temperature to cover the sand 1/2 inch (12.7 mm).

b. Heat the asphalt to be tested until thoroughly liquid. Weigh 100 grams ± 1 gram and cool to 175° to 200°F (79.4° to 93.3°C). Slowly add 36 grams ± 1 gram of the solvent naphtha. The solvent will vaporize rapidly at this temperature, so this step should be done where there is good ventilation and no open flames. Some reheating of the mixture may be required on a hot plate. This results in a cutback. Check the weight (mass) of the solvent-asphalt mixture when blending is finished to ensure proper amount of solvent. Add any amount of solvent needed to attain the 36 ± 1 gram required. Normally, reheating will not be required at this point.

Quick Bottle Test (continued)

c. When the mixture has cooled to 140° to 150°F (60° to 65.6°C), add 1 gram ± 0.2 gram of the prepared cutback material onto the surface of the water.

d. Place cap on bottle and shake vigorously for 30 seconds.

e. Remove cap and pour off excess water.

f. Dump the sand on a paper towel and observe the degree of coating.