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16. ABSTRACT

Introduction:

In our design procedure for asphaltic mixtures, visual observations are made on compacted specimens for evidence of excess asphalt. This involves observing the upper surface and interior of a freshly broken specimen for evidence of "flushing" or "bleeding". These observations coupled with the air void contents of the test specimens are used in the determination of the maximum asphalt content, for noncritical mixtures. A noncritical mixture is one which does not show a significant drop in stability prior to a "flushing" condition on the upper surface of the compacted specimen.

It is apparent that the degree of "flushing" is dependent on the personal judgment of the viewer. This may lead to differences in the recommended asphalt content when designs are performed in different laboratories. Therefore, it was desirable to develop a quantitative method for detecting a "flushing" condition of the compacted specimens used in the design of an asphaltic paving mixture.

This report presents the preliminary work on the development of a quantitative method for detecting "flushing".

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Final Report

Flushing of Pavements

Introduction

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It is apparent that the degree of "flushing" is dependent on the personal judgment of the viewer. This may lead to differences in the recommended asphalt content when designs are performed in different laboratories. Therefore, it was desirable to develop a quantitative method for detecting a "flushing" condition of the compacted specimens used in the design of an asphaltic paving mixture.

This report presents the preliminary work on the development of a quantitative method for detecting "flushing".

Conclusion

Preliminary tests indicate that a quantitative method may be developed for determining the degree of "flushing" of specimens manufactured with the kneading compactor.

Recommendation

Future studies should be performed to determine the factors influencing the test result and the repeatability and reproducibility.

Development of Test

One of the most obvious physical indications of surface "flushing", noted during routine testing, has been the tendency of a thin manila disc to stick to a "flushed" or "bleeding" surface of a test specimen. This manila disc has traditionally

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been placed on the surface of a compacted specimen to prevent the steel follower, used in the stabilometer test, from sticking to the specimen. It was thought that perhaps this disc could be removed and that the weight of the retained asphalt could be used as an indicator of the degree of flushing. Unfortunately, when sufficient pressure to provide a detectable stain was applied, the disc invariably stuck fast to the surface and tore upon removal. However, an extraction filter paper, applied with pressure, did obtain a sufficient stain without the tearing problem. The diameter of the filter paper was reduced to 3 inches to avoid any possible hangup on ridges caused by compaction.

Although the filter paper after testing was well tinged, the weight of the asphalt on the paper was very slight. In most cases, it ranged from .05 gram to about 0.5 gram, with an occasional specimen as high as 1.0 gram. The routine scales in this laboratory and in the districts are not sensitive enough to weigh these small amounts with any degree of accuracy. The stain itself, however, is quite an impressive record of the degree of surface "flushing". With the striking contrast between black and white of the tinged filter paper, it appeared that a measurement of reflected light might produce a numerical value that would be descriptive of the "flushing" condition.

It was decided to attempt to measure the reflected light with an Esna Reflex Photometer (Figure 1). This machine consists of a metal tube about 6 feet long and 6 inches in diameter. Except for one end, the tube is sealed against light. Metal windows along the tube are opened to permit a sample to be placed within, then closed and a light is projected onto the specimen from an end of the tube. The reflected light from the specimen is received in photo cells located around the light lens. The photo cells are connected to a metering device which is set at 0.3 micro amps full scale. The device has a scale which can be read in micro amps of light reflected. The observation angle may be varied; however, for this series of tests the angle was kept at $1/2^{o}$. (This is the angle of the light reflected back off the stained blotter to the photo cells.) The Esna Unit cost is $1,500. However, it is estimated that a simple photometer may be built for approximately $300 for district use.

A set of filter paper discs were shaded black in increments of 25%, 50%, 75% and 100%, to serve as standards along with an all white disc (Figure 1). These standards were to be compared with the asphalt stained discs obtained in normal compacting process.

A series of specimens were compacted with the California kneading compactor using various grades of asphalts.

The upper face of each specimen was visually graded as to the degree of "flushing". It was noted immediately after compaction that with increased "flushing", a problem arose. This problem consisted of a slight pickup by the heel of the compactor shoe. The result was a depressed area about 1" in diameter in the center of the briquette. This condition would not allow the blotter paper to properly contact the surface. A white spot was left on the paper (exact location varied depending on placement of the paper on surface). To compensate for this spot, a small black disc about 1-1/4" in diameter was placed over the white spot before measuring the reflected light. A black disc of the same diameter was also placed on all standards prior to measurements. (Figure 1)

On the basis of these preliminary studies the following test procedure was developed:

1. Compact asphalt concrete specimens using the kneading compactor as per California Test Method 304.

2. Place a three inch diameter piece of white filter paper, (E and D Filter Paper No. 652) on the surface of the compacted specimen within its mold and then place a 4000 gram weight on the filter paper.

3. Place in a 140^{o}F oven for 1-2 hours.

4. Remove weight and filter paper from specimen and place 1-1/4" diameter black spot in center of filter paper.

5. Place filter paper in the reflex photometer and with 1/2^{o} observation angle obtain percentage of reflected light in terms of percentage white.

6. If the percentage of white is less than a tentative 80%, then repeat the test in triplicate and report the average.

Test Results and Discussion

Initial studies have been completed on the preliminary test method. Asphalt concrete mixes were prepared with different grades of asphalt, 60-70, 85-100, 120-150 and 200-300 and three asphalt contents using one aggregate source. The results on two different days are shown in Table I together with the normal visual estimate of the degree of "flushing". The results for a single day are shown in Figure 1.

The quantitative data are in agreement with the visual estimate for the degree of "flushing". There is a greater drop in readings when one moves from a slight to a heavy "flushing" state than exists from none to a slight state. This is a definite advantage since it provides a fairly large range in readings between a slight and heavy "flushing" state.

Experience with the visual estimate method indicates that a quantitative reading of 80% ± 2% will provide the upper asphalt content for an asphalt concrete mixture.

These preliminary results must be confirmed by further studies involving stability and void determinations. However, the results are most encouraging and may provide a quantitative method for determining the maximum asphalt content of noncritical paving mixtures.

Implementation

The results of this preliminary study can be implemented by the formulation of a more complex and thorough study. If further study confirms the value of this test method, benefit will be derived by the prevention of "flushing" pavements.

Table I

Reflected Light Measurements to Determine Degree of "Flushing" of Kneading Compactor Specimens

Asphalt		Test Date = 12/5/69			Test Date = 11/21/69		
%	Grade	Visual Estimate of "Flushing"	Reflected Light Reading	Relative % White	Visual Estimate of "Flushing"	Reflected Light Reading	Relative % White
5.0	60-70	None	0.077	98.5	-	-	-
5.0	85-100	"	0.076	97.0	-	-	-
5.0	120-150	"	0.074	94.1	-	-	-
5.0	200-300	"	0.073	92.7	-	-	-
5.5	60-70	None	0.074	94.1	None	0.074	94.1
5.5	85-100	Slight	0.068	85.3	Slight	0.072	91.3
5.5	120-150	"	0.066	82.4	"	0.065	80.7
5.5	200-300	"	0.052	61.8	Heavy	0.040	44.2
6.0	60-70	Heavy	0.043	48.5	Heavy	0.048	55.8
6.0	85-100	"	0.040	44.1	"	0.041	45.6
6.0	120-150	"	0.036	38.2	"	0.044	50.0
6.0	200-300	"	0.037	39.7	"	0.038	41.2

Notes

1. All measurements made with black center button in place on stained filter paper.
2. Relative % White (Esna Photometer) $= \frac{\text{Reading - Black Constant}}{\text{White Constant-Black Constant}} \times 100$

$$= \frac{\text{Reading} - 0.010}{0.078 - 0.010} \times 100$$

3. All tests on 3/4" Max., Med. Grading.

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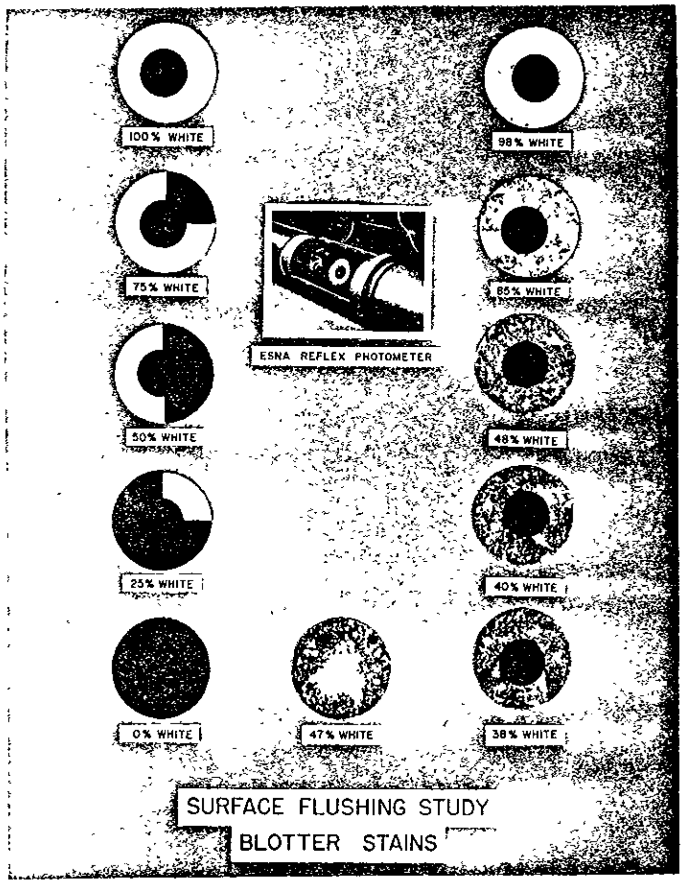
Figure 1



Stained Filter Papers and Standards

(Note how lower filter paper appears without black dot in center.)