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John Skog

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Division of Highways
Materials and Research Department

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Introduction

One of the simplest types of highway construction is the placement of a seal coat. Generally, some form of bituminous binder is spread on the existing pavement, followed by a single application of screenings. The screenings are rolled and, after a short curing period, traffic is again routed over the pavement.

Although it is quite simple to lay a seal coat, many failures result from lack of construction control or improper weather conditions. The failure of a seal coat, besides presenting an unsightly appearance, may also lead to a serious reduction in skid resistance. The repair of a failure is a difficult operation.

The Materials and Research Department has been aware of the need for studies on seal coat design and construction, and investigations have been performed at various times during the past twenty-five years. This final report will summarize studies performed under Research Project R-34018.

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State of California
Department of Public Works
Division of Highways
Materials and Research Department

June 17, 1965

Lab. Auth. R-34018

Mr. L. R. Gillis
Assistant State Highway Engineer, Operations
Division of Highways
Sacramento, California

Dear Sir:

Submitted for your consideration is:

FINAL REPORT

on

FIELD AND CORRELATED LABORATORY

STUDIES ON SEAL COATS.

Study made by ..... Pavement Section
Under general direction of ..... Ernest Zube
Supervised by ..... John Skog
Report by ..... John Skog

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

cc: JFJorgensen
ELTinney
ACEstep
Districts

State of California

Highway Transportation Agency

Memorandum

To : Mr. G. A. Hill
Planning
Attention C. G. Beer

Date: July 29, 1965

File : Non Participating
M&R R34018

From : John L. Beaton
Department of Public Works—Division of Highways
Materials and Research Department

Subject:

Please find attached four copies of a final report entitled, "Field and Correlated Laboratory Studies on Seal Coats", submitted in accordance with Circular Letter 64-64.

The report was approved for distribution by L. R. Gillis, Assistant State Highway Engineer, Operations, in a memorandum dated July 20, 1965.

Original Signed
JOHN L. BEATON

JOHN L. BEATON
Materials and Research Engineer

JS:EA
Att.

FORM WH-38B

State of California
Department of Public Works
Division of Highways
Materials and Research Department

June 17, 1965

Lab. Auth. R-34018

Mr. L. R. Gillis
Assistant State Highway Engineer, Operations
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OUTLINE

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- A. Method for checking transverse and longitudinal spreads of asphalt distributors.
- B. Degradation of screenings due to rolling and traffic.
- C. Absorptiveness and permeability of pavements.
- D. Studies on bituminous binders.
  1. Development of test methods for measuring rate of curing of binder and adherence of screenings.
  2. Laboratory and field studies on Cationic Type emulsion, and Rubberized Anionic Type emulsion.
- E. Seasonal effects on performance of seal coats.
  1. The development of the Atmometer for measuring evaporation rate.

INTRODUCTION

One of the simplest types of highway construction is the placement of a seal coat. Generally, some form of bituminous binder is spread on the existing pavement, followed by a single application of screenings. The screenings are rolled and, after a short curing period, traffic is again routed over the pavement.

Although it is quite simple to lay a seal coat, many failures result from lack of construction control or improper weather conditions. The failure of a seal coat, besides presenting an unsightly appearance, may also lead to a serious reduction in skid resistance. The repair of a failure is a difficult operation.

The Materials and Research Department has been aware of the need for studies on seal coat design and construction, and investigations have been performed at various times during the past twenty-five years. This final report will summarize studies performed under Research Project R-34018.

CONCLUSIONS

The following conclusions are presented from the results of our investigations performed under Project R-34018 in previous years.

A. A method for determining the transverse and longitudinal spread rates of bituminous distributors has been developed and requirements have been written into the Standard Specifications.

B. The present standard Los Angeles Rattler Test and Wet Shot Test do not provide adequate indications of the degree of degradation during construction rolling and traffic movement.

C. A rapid test for determining the permeability of asphalt concrete pavements has been developed.

D. Test methods have been developed for measuring the rate of curing of the binder and the "keying" tendencies of screenings. A method involving a shaking test may provide the field engineer with information regarding the time of opening to high speed traffic. However, further field correlation studies are required.

Cationic and Rubberized emulsions have not shown any marked advantages over the standard anionic type, when compared in test sections where all factors are held constant.

E. All of our field studies clearly confirm the long-held opinion that that with proper construction conditions, the most important variable influencing screening retention are the weather conditions during the first 48 hours of high speed traffic movement.

RESULTS AND DISCUSSION

A. Methods for Checking Transverse and Longitudinal Spreads of Asphalt Distributors

A very important part of the design of a seal coat is the thickness of the film of bituminous binder. Variations from the design film thickness may lead to loss of screenings or flushing of the binder to the surface. In either case, serious failures may result from improper distribution of the binder in the field.

The most common method of measuring the spread rate is by "stabbing" gauging the tank. However, this method provides no information on the transverse uniformity, and the longitudinal rate may vary from the average determined by the tank gauge. Therefore, a method was needed to measure both the transverse and longitudinal variations in spread rate. A number of methods were investigated (1) (2) prior to adoption of the present procedure covered by California Test Method 339. On the basis of field checks on distributors, variations for transverse and longitudinal spread rates are now provided in the Standard Specifications.

B. Degradation of Screenings Due to Rolling and Traffic

Degradation of screenings during rolling operations and under traffic may be sufficient to change the design grading on which the thickness of the film is based. This may lead to flushing of the binder. Eleven different jobs were used in an attempt to correlate the Los Angeles Rattler and Deval Wet Shot Tests with the degradation during rolling and traffic action (1). The percent increase in surface area during rolling under field conditions was comparatively small on all jobs. There was no apparent correlation when results from the Wet Shot Test or Los Angeles Rattler Test at 100 or 500 revolutions were compared with the amount of degradation during rolling.

Traffic degradation was measured on these jobs after nine months of service. The results of the Los Angeles Rattler and Wet Shot Tests were compared with the decrease in quantity due to loss of screening and the increase in surface area due to degradation. Some relationship was noted when the Rattler results at 100 and 500 revolutions were compared with the decrease in the quantity of screenings.

C. Absorptiveness and Permeability of Pavements

A number of tests were developed in the attempt to measure absorptiveness of the pavement, but none proved feasible (1). The desire to measure permeability of the pavement as an aid to deciding when to apply a seal coat led to the development of the water permeability test for this purpose (1). This test was later used in our extensive investigation on compaction of asphaltic concrete.

D. Studies on Bituminous Binders

1. Development of test methods for measuring curing and adherence of screenings.

A very important factor in the success or failure of a screening seal coat is the curing period following placement. At the present time, this is controlled by specification requirements regarding opening to traffic movement. However, a much better approach would be to provide the Engineer with a simple field test for determining when a seal coat may carry high speed traffic.

Our first apparatus for this purpose is described in detail in references (1 & 3). The centrifuge test provided a means for laboratory studies, but could not be correlated with field results and was abandoned. Later, a shaking apparatus was built and studied in the laboratory (4). The unit shows promise of providing measurements of curing of the binder as well as the part played by the screenings in resisting traffic stresses. The unit should be tested in the field on future seal coat test sections. An investigation of this type will be performed under a separate project number. Laboratory tests (4) clearly indicate that the "natural keying" tendency of screenings from different sources may be of great importance in the ability of the seal coat to resist traffic stresses during the first 24-48 hours after completion of construction.

2. Laboratory and Field Studies on Cationic Type Emulsion, and Rubberized Anionic Type Emulsion.

Some years ago the American Bitumuls and Asphalt Co. introduced Cationic Type Emulsions. The reported advantage for this type emulsion over the Standard Anionic type was the faster rate of separation in the presence of aggregate surfaces having a negative charge. We have made a rather extensive field and laboratory study of the Cationic High Viscosity Type Emulsion for seal coat work, (5, 6, 7). A tentative specification for this type of emulsion has also been developed, (8). Our field experiences to date do not indicate

any marked advantages of Cationic type over the Standard Anionic type. There are indications that the Cationic type will separate a little faster than the Anionic type during unfavorable weather. However, under unfavorable weather conditions, serious failures were encountered in test sections with both types of emulsion.

Field and laboratory studies on Rubberized Emulsions have been performed (9, 10, 11, 12). The results from field trials do not indicate any improvement in screening retention when rubberized emulsion test sections were compared with adjacent control sections. With favorable weather, both control and rubberized sections produced excellent seal coats. Unfavorable weather produced failures in both rubberized and control sections.

E. Seasonal Effects on Performance of Seal Coats.

The results of field studies involving carefully controlled test sections have clearly indicated the importance of favorable weather conditions during seal coat construction. Also, an analysis of failures occurring in normal construction (1) has confirmed the importance of weather conditions.

In order to determine the effect of weather conditions on seal coat performance, we have developed an apparatus (Atmometer) for measuring the evaporation rate (13, 14, & 15). This single value is the result of a combination of factors, such as humidity, temperature, and cloud cover. It, therefore, provides a good measure of changes in the binder which lead to proper screening retention.

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