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Slurry Seal Coatings For Delineation On PCC Pavements

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Synopsis

Black traffic lacquer is extensively used on bridge decks for delineation purposes. This material has a relatively short service life, and a study has been performed in an attempt to develop a more satisfactory economical material.

Asphalt emulsion slurry seal and asphalt emulsion polymer slurry seals have been studied in the laboratory by determining the adhesion to a concrete surface. Also the wear resistance of these materials has been determined. Laboratory test results indicate that two of the asphalt emulsion polymer blends produce slurry coats having better adhesive and wear resistance than a control asphalt emulsion slurry coat.

Asphalt emulsion and asphalt emulsion polymer slurry coats have been placed in a field test section. After three months of traffic action, all of the patches are in excellent condition. The lacquer control section shows some evidence of wear, but is still satisfactory for delineation purposes.

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STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

# SLURRY SEAL COATINGS FOR DELINEATION ON PCC PAVEMENTS

SEPTEMBER 1966

66-26

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

August 5, 1966

MR 643301

Mr. J. C. Womack
State Highway Engineer
Division of Highways
Sacramento, California

Dear Sir:

Submitted for your consideration is:

PROGRESS REPORT

ON

SLURRY SEAL SURFACE

COATINGS PROPOSED FOR USE ON

P.C.C. PAVEMENTS FOR

DELINEATION PURPOSES

Study made by .................... Pavement Section
Under general direction of ...... E. Zube
Supervised by .................... J. Skog & G. Kemp
Work done by ..................... R. Morrison
Report by ........................ G. Kemp & J. Skog

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

cc: ACEstep
JEMcMahon
JEWilson
PCSheridan

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## SYNOPSIS

Black traffic lacquer is extensively used on bridge decks for delineation purposes. This material has a relatively short service life, and a study has been performed in an attempt to develop a more satisfactory economical material.

Asphalt emulsion slurry seal and asphalt emulsion polymer slurry seals have been studied in the laboratory by determining the adhesion to a concrete surface. Also the wear resistance of these materials has been determined. Laboratory test results indicate that two of the asphalt emulsion polymer blends produce slurry coats having better adhesive and wear resistance than a control asphalt emulsion slurry coat.

Asphalt emulsion and asphalt emulsion polymer slurry coats have been placed in a field test section. After three months of traffic action, all of the patches are in excellent condition. The lacquer control section shows some evidence of wear, but is still satisfactory for delineation purposes.

## INTRODUCTION

Black traffic lacquer has been extensively used for delineation purposes on PCC bridge decks. This material tends to wear rapidly and repainting creates problems with traffic control, and is also quite costly in terms of maintenance operations. Also skid resistance studies by this department have shown that successive applications of lacquer or other types of paints may fill the striations in the PCC pavement and create a skid hazard.

A number of satisfactory coatings are available for delineation and skid resistance purposes, but they are quite expensive. Therefore, a research project was started in December 1965 to develop a more economical material.

A number of years ago, the City of Los Angeles developed an asphalt emulsion slurry seal for surface treatment work. This material is very economical and also possesses satisfactory skid resistance. It has been used throughout the United States for a surface treatment of existing asphalt concrete surfaces and a specification is incorporated in the 1964 California Division of Highways Standard Specifications. However, there is virtually no information available on the use of this material as a wearing surface over PCC pavements, and some doubt existed on the ability of the material to properly bond to a concrete pavement or to resist wear under heavy traffic movements involving acceleration and deceleration stresses encountered on ramps. Therefore, the initial phase of the project involved a laboratory study of the adhesion to concrete and wear resistance of standard slurry and slurry modified by additions of various additives to the emulsion. The additives added to the asphalt emulsion prior to the preparation of the slurry were recommended by the manufacturer for improving the adhesion and wear characteristics. Eleven materials were received from three different manufacturers. The additives included one Vinyl acrylic copolomer emulsion, one Acrylic based tripolymer emulsion, one Emulsified epoxy resin, three Acrylic polymer emulsions, two Polyvinylacetate copolymer emulsions, and three Polyvinylacetate Homopolymer emulsions.

After the completion of the laboratory study, a field test section was placed on the South Sacramento Freeway, Road 03-Sac-99-PM21, in order to compare the various slurry mixtures with black traffic lacquer under identical traffic conditions.

The purpose of this progress report is to present our initial laboratory and field studies on this project.

## CONCLUSIONS

All of the additives tested were compatible with two manufacturers mixing type emulsions when 10% of the additive was added to the emulsion. In other words, there was no separation of asphalt after addition of the additive. However, some of the additives started to separate from the asphalt emulsion if allowed to stand in an unagitated state for longer than one hour.

All of the additives, except one, improved the laboratory test results for adhesion and cohesion characteristics of a slurry mixture when compared with a control asphalt emulsion slurry. The degree of improvement was dependent on the source of the asphalt emulsion. Generally the adhesion and cohesion improvement was offset to some degree by an increase in abrasion loss. The two Acrylic polymer emulsions were consistent in improving the adhesion, cohesion and abrasion characteristics for slurry prepared from both manufacturer's asphalt emulsion.

The following conclusions are based on the results of observations of the field test patches on Road 03, Sac-99-PM21 after three months under heavy traffic.

All of the field patches are in excellent condition. The adhesion is satisfactory and there is no evidence of wear. The standard asphalt emulsion slurry seal shows no signs of failure even when the tack coat was placed over either a concrete curing seal or black traffic lacquer. It does not appear necessary to sand blast the existing surface prior to application of the tack coat. However, the pavement should be clean. After three months of heavy traffic, the control black lacquer patch is still visible for delineation purposes. Therefore, it will be necessary to continue field observations in order to obtain information on the amount of increase in service life when slurry seal is used for delineation purposes.

All of the slurry seal patches definitely increased the coefficient of friction of the existing PCC pavement. On the other hand, the application of traffic lacquer markedly decreased the friction value.

## RECOMMENDATIONS

These recommendations must be considered as tentative since they are only based on three months of field service life.

Our standard specification slurry seal using only asphalt emulsion as a binder appears to adhere well to PCC pavements if the pavement is clean and a tack coat is applied prior to the slurry mixture. Therefore, it is recommended that this form of treatment be applied to a number of bridges in various areas of the State on an experimental basis. The material should be applied over new construction and on bridges where traffic lacquer has previously been used for delineation purposes. In all cases, traffic lacquer should be placed as a control in an area where both materials have equivalent traffic action.

The success of the field test section to date indicates that further laboratory and field work should be performed on this project. There is evidence that a slurry seal may definitely improve the skid resistance of existing PCC pavements, and may provide an economical wearing surface for PCC pavements that may become a skid hazard from wear and polish. The reluctance to use a black wearing surface over PCC pavements especially on bridge decks indicates that efforts be made to attain a grey appearing mixture. Preliminary studies indicate that this may be feasiable by additions of certain rubber compounds, cement and other pigments.

## LABORATORY STUDIES

### Materials

On the basis of attaining maximum cohesion in the slurry mixture, it was decided to use a low penetration base asphalt in the mixing type emulsion. Therefore, SS-1h emulsion containing 60-70 penetration asphalt was obtained from two different manufacturers.

The additives were selected on the recommendations of the manufacturers for improving adhesion and wear characteristics of the slurry. Eleven materials were received from three different manufacturers. The additives included one Vinyl acrylic copolomer emulsion, one Acrylic based tripolymer emulsion, one Emulsified epoxy resin, three Acrylic polymer emulsions, two Polyvinylacetate copolymer emulsions, and three Polyvinylacetate homopolymer emulsions.

The aggregate used in preparation of all slurry mixtures consisted of 65% crusher dust and 35% plaster sand blended to make the following combined grading which complied with the Standard Specification for Slurry Seal Aggregate.

Combined Grading

| | |
|---|---|
| No. 8 | 100 |
| No. 16 | 76 |
| No. 30 | 42 |
| No. 50 | 23 |
| No. 100 | 14 |
| No. 200 | 9 |

### Preparation of Asphalt Emulsion Additive Blends and Slurry Mixtures

Additive blends were prepared by adding the additive emulsion to the asphalt emulsion and stirring with an electric mixer for one minute.

The slurry was prepared in all cases using 12% of asphalt emulsion either alone or when mixed with 10% additive. The 12% asphalt emulsion figure was determined by using the

California tentative method for design of slurry seal. After a number of preliminary trials, it was decided to use 10% of the various additives. This figure is based on the increase in cost and the problem of possible separation of the asphalt emulsion as larger percentages are used. If it is desired to perform further studies on additives, it will be necessary to try other percentages.

The slurry was prepared in a normal manner. Water was used to dampen the aggregate. The correct amount of asphalt emulsion either alone or blended with the additive was added, and the slurry mix was prepared with a trowel. Mixing was continued until a uniform slurry was obtained.

## Test Methods

The compatibility of the asphalt emulsion additive blend was determined by the standard screen test and a modified settlement test. The settlement test consisted of mixing the emulsion and additive together for one minute with an electric mixer and pouring the blend into a tall stoppered cylinder. The rate of separation of the two emulsions was checked after one, six and twenty-four hours.

Adhesion of the cured slurry seal to concrete and concrete treated surfaces was measured by a modification of a test used by the Chemical Section for measuring the adhesion of epoxy overlays. Immediately after mixing, slurry was placed in a circular mold 1-3/4 in. in diameter and 3/8 in. in height which had previously been placed on a concrete block. After five to fifteen minutes, the rings are removed from the specimen and the block is placed in a 140° F oven for twenty-four hours. At the end of the curing period, the blocks are removed from the oven, cooled, and a 1-3/4 in. diameter disc is attached to the top surface of the slurry seal with epoxy cement. This is cured for twenty-four hours at room temperature and the tensile strength is then determined using a testing speed of 0.05 in. per minute.

The wear characteristic of the slurry seal was determined with a modification of the slurry abrasion test.

This test is used in the design of slurry seal and measures the resistance to abrasion in the presence of water. A circular mold 10 in. in diameter and 1/4 in. high is placed on a disc of roofing felt cut to the outside diameter of the mold. Slurry is placed in the mold and struck off to obtain a level surface. The mold is then allowed to stand for fifteen minutes at room temperature and the mold is removed and the specimen with the supporting disc is placed in a 140°F oven until a constant weight is reached.

The specimen is then removed from the oven, cooled, weighed, and placed in a pan. It is then covered with water and allowed to stand for one hour. At the end of this period, the specimen is abraided for two hours by means of two small diameter wheels equipped with hard rubber tires. The loss in weight is recorded as the abrasion loss.

## Test Results and Discussion

As an aid in the following presentation, Table A provides an identification list for the various additives used in the study.

Changes in asphalt emulsion properties were determined when two mixing type emulsions from two manufacturers were blended with the various additives. In each case, 10% by weight of additive was blended with the emulsion. The results are shown in Table B and Fig. 1. The viscosity of the various blends was not materially changed except for one additive with one of the asphalt emulsions. However, the results indicate that the two emulsions vary in the amount of change in viscosity for a constant addition of any one additive. The results do not indicate any problems in preparation of slurry mixtures because of variations in viscosity of the binder by addition of any of the additives used in this study.

There was no evidence of any actual "break" of the asphalt emulsion on addition of any of the additives. The separation shown in Table B is probably caused by differences in the gravities of the two emulsion systems.

The proposal to add additives to an asphalt emulsion was based on increasing the adhesion at the slurry concrete interface and the wear resistance under traffic. The previously described adhesion test was developed to measure the bond at the surface, slurry interface. The results of this test are shown in Tables C, D and E. In this test, the failure may occur at the interface of the test surface and slurry coat or it may occur within the slurry coat itself. As shown in Tables C and D, most of the adhesion failures (failure at the interface) occurred on wet concrete. A tack coat of mixing emulsion provided much better adhesion. There are definite differences in the adhesive characteristics of the various additives and the results also vary depending on the source of the emulsion. We note that some caution should be used in the interpretation of these results. As an example, Table C shows that the mixing emulsion slurry control had good bond on a tack coat and a tensile strength of 5.9 lb. psi. When 10% by weight of additive R4181 was added to the asphalt emulsion, the resulting bond was good and the tensile strength was increased to 18.8 lb. psi. Such results do not indicate a weaker bond for the control emulsion, but simply show an increase in cohesive strength of the slurry prepared with the additive. It is interesting to note that there is a definite difference in the cohesive strength of slurry coats prepared from the two control emulsions. The results of this phase of the study indicate that a satisfactory bond may be established by using an asphalt emulsion as a tack coat, and that the slurry coat prepared from the asphalt emulsion bonded as well to the tack as slurry coats prepared with additive, asphalt emulsion blends.

Wear resistance was measured by an abrasion test developed in connection with the design of slurry seals. Test results for the various slurry mixes are shown in Table F. Addition of additives appears to have caused a definite decrease in wear resistance when compared with both controls. There are two exceptions, R4184 and R4186, both Acrylic Polymer emulsions. It was believed the gain in cohesive strength might lead to decrease in wear resistance because of possible brittleness of the asphalt-polymer binder combination. Therefore, the tensile strength tests results which indicated a cohesive failure were compared with the wear resistance. The comparison is shown in Table F and Fig. 2. There is no relation apparent, and it appears that the wear resistance is dependent on a number of other parameters.

The laboratory study has indicated the importance of a tack coat for establishing a satisfactory bond between concrete and a slurry coat. Two additives, R4184 and R4186, both Acrylic polymer emulsions when blended with an asphalt emulsion produced slurry coats with satisfactory bond and better wear resistance than the control emulsions. The other additives were not as satisfactory as the emulsion controls.

## Field Studies

### Laying Operations

A location was selected on the South Sacramento Freeway (US 99-50) between Florin Road and 47th Avenue in the northbound #3 lane. The layout of the test section is shown in Fig. 3. This field application was placed on March 22, 1966. The existing surface is Portland cement concrete which has been in use for approximately four years. The surface is quite polished and was not cleaned or prepared in any way prior to the application of a tack coat.

All materials used in the slurry application were prepared prior to leaving for the test area. The emulsion used for the tack coat was diluted with 50% water, and was applied at the rate of 0.10 gal. per sq. yd. On the morning of the field application, mixing emulsion R4171 and additives were combined using 10% additive by weight in the emulsion and a total of 12% emulsion additive binder in the slurry seal.

Wooden frames 2' x 3' x 1/8" were used to serve as boundary areas for the individual test patches.

Prior to placing the slurry patches, the spots for application were centered in the outer wheel track and marked off. The tack coat was applied and allowed to cure for 30 minutes before placing the slurry mix. The frame was positioned and the slurry mix poured in, spread and leveled off. After leveling, the frame was removed and the patches allowed to cure for three hours before allowing traffic over the area. There was no damage to the patches 30 minutes after start of traffic and after 24 hours.

The morning air temperature was 56°F and the pavement temperature was 60°F. By the time traffic was allowed on the test area, the air temperature was 80°F and the pavement temperature was 96°F. It appears that three hours is sufficient curing time before allowing traffic for temperatures indicated.

One of the asphalt emulsion patches within the test area was placed over a coating which had been applied to the PCC surface. The coating was a waxy concrete curing seal which was completely dry before applying the slurry. The application was made in order to test the ability of the slurry to adhere to this coating which may be involved in the application on new construction.

Photos covering various sequences of the field application are shown in Fig. 4.

## Skid Resistance Test Results

One week after placement of the slurry patches, they were checked for skid resistance using the California Skid Tester, Test Method No. Calif. 342. A test was performed at intervals between the slurry patches with one at the beginning, and one at the end, and some between patches to check the original PCC surface. Three checks were made on all patches to determine their coefficient of friction.

Test results are shown in Table H. There was a definite increase in the coefficient of friction on the slurry as compared to the untreated PCC, also the application of traffic lacquer and asphalt emulsion to the existing surface materially lowered the friction factor. The minimum tentative allowable coefficient of friction allowed on new PCC pavements is 0.25.

## Performance Surveys

The following conclusions are based on the results of observations of the field test patches after three months of heavy traffic.

All of the field patches are in excellent condition. The adhesion is satisfactory, and there is no evidence of wear. The standard asphalt emulsion slurry seal shows no signs of failure even when the tack coat was placed over either a concrete curing seal or black traffic lacquer. The control black lacquer patch is still visible for delineation purposes. Therefore, it will be necessary to continue field observations in order to obtain information on the amount of increase in service life when slurry seal is used for delineation purposes.

## Cost Analysis

The cost for furnishing and applying slurry seal at the rate of 7 lbs. per sq. yd. is approximately $0.08 per sq. yd. for fairly large quantities. An additive used at the rate of 10% added to the asphalt emulsion would raise the cost to approximately $0.10 per sq. yd. for the slurry. The cost would probably definitely increase for bridge projects where the cost of spreading odd shaped and small areas would increase labor costs. As an estimate, one might conclude that the cost of the slurry might double to say, $0.16 per sq. yd. If we assume that traffic lacquer costs $3.00 per gal. to the contractor and it is spread at the rate of 10 mils wet thickness, one attains a cost of $0.18 per sq. yd. Therefore, it appears that a slurry coat treatment would definitely be an economical delineation material.

TABLE A

Additive Material Identification List

| Additive Number | Manufacturer | Manufacturer's Identification | Chemical Identification | Price per gal. per 50 gal. |
|---|---|---|---|---|
| R4181 | Jones Dabney Co. | B-2 Cl-122 | Polyvinylacetate Homopolymer Emulsion | $0.18 |
| R4182 | Jones Dabney Co. | B-5652 Polytex 600 | Polyvinylacetate Copolymer Emulsion | $0.175 |
| R4183 | Jones Dabney Co. | B-4354 Polytex 611Q | Emulsified Epoxy Resin | $0.36 |
| R4184 | Rohm & Hass | AC-61 Lot 1017 Rhoplex | Acrylic Polymer Emulsion | $0.24 |
| R4185 | Rohm & Hass | MC-4530 Lot 1021 Rhoplex | Acrylic Polymer Emulsion | $0.201 |
| R4186 | Reichold Chem. | 40-400 Acrylic Emulsion | Acrylic Polymer Emulsion | $0.2375 |
| R4187 | Reichold Chem. | 40-129 Vinyl Acrylic | Vinyl-acrylic Copolymer Emulsion | $0.2225 |
| R4188 | Reichold Chem. | 40-305 P.V.A. Homopolymer | Polyvinylacetate Homopolymer Emulsion | $0.2025 |
| R4189 | Reichold Chem. | 40-310 P.V.A. Homopolymer | Polyvinylacetate Homopolymer Emulsion | $0.2125 |
| R4190 | Reichold Chem. | 40-120 P.V.A. Copolymer | Polyvinylacetate Copolymer Emulsion | $0.20 |
| R4193 | Jones Dabney Co. | Cl-301 | Acrylic based Tripolymer Emulsion | $0.1825 |

## TABLE B

### Viscosity and Settlement Characteristics of Mixing Emulsion, Additive Blends

| Emulsion Number | Additive Number | Percent Additive By Weight | Visc. at 77°F. ASTM 244-49 Orig. | Visc. at 77°F. ASTM 244-49 Orig.+Add. | Sieve Test ASTM D244-49 | Settlement 1 hr. | Settlement 6 hr. | Settlement 24 hr. |
|---|---|---|---|---|---|---|---|---|
| R4171 | R4181 | 10 | 28 sec. | 27 sec. | 0 | Very light separation | Light separation | Heavy separation |
| " | R4182 | " | " | " | 0 | No separation | Light separation | Light separation |
| " | R4183 | " | " | 53 sec. | 0 | No separation | No separation | No separation |
| " | R4184 | " | " | 18 sec. | 0 | Very light separation | Light separation | Heavy separation |
| " | R4185 | " | " | 20 sec. | 0 | " | " | " |
| " | R4186 | " | " | 23 sec. | 0 | No separation | No separation | Very light separation |
| " | R4187 | " | " | 26 sec. | 0 | Light separation | Light separation | Heavy separation |
| " | R4188 | " | " | 32 sec. | 0 | No separation | Light separation | Light separation |
| " | R4189 | " | " | 32 sec. | 0 | No separation | No separation | Light separation |
| " | R4190 | " | " | 25 sec. | 0 | No separation | Light separation | Light separation |
| " | R4193 | " | " | 20 sec. | 0 | Light separation | Light separation | Heavy separation |

TABLE B (Contd)

| Emulsion Number | Additive Number | Percent Additive By Weight | Visc. at 77°F. ASTM 244-49 Orig. | Orig.+Add. | Sieve Test ASTM D244-49 | Settlement 1 hr. | 6 hr. | 24 hr. |
|---|---|---|---|---|---|---|---|---|
| R4172 | R4181 | 10 | 24 sec. | 27 sec. | 0 | No separation | No separation | No separation |
| " | R4182 | " | " | 25 sec. | 0 | " | " | " |
| " | R4183 | " | " | 27 sec. | 0 | " | " | " |
| " | R4184 | " | " | 21 sec. | 0 | " | " | Light separation |
| " | R4185 | " | " | 27 sec. | 0 | " | " | " |
| " | R4186 | " | " | 21 sec. | 0 | " | " | Very light separation |
| " | R4187 | " | " | 22 sec. | 0 | " | " | " |
| " | R4188 | " | " | 23 sec. | 0 | " | " | " |
| " | R4189 | " | " | 25 sec. | 0 | " | " | No separation |
| " | R4190 | " | " | 23 sec. | 0 | " | " | Very slight separation |
| " | R4193 | " | " | 20 sec. | 0 | " | " | No separation |

TABLE C

Adhesion Test Results

Emulsion No. 4171
Effective Area of Test 2.40 sq. in.
Curing Time 24 hrs. at 140°F

| Sample Number | Wet Surf. lb. per sq. in. | Tack Coat lb. per sq. in. | Remarks |
|---|---|---|---|
| Emulsion Control | 5.4 | 5.9 | Bond good on tack. 30% bond break on wet surface. |
| Additive R4181 | 16.7 | 18.8 | Bond good on both surfaces. |
| R4182 | 16.5 | 20.8 | Bond good on both surfaces. |
| R4183 | 6.0 | 8.1 | Bond good on tack. Some bond break on wet surface. |
| R4184 | 10.5 | 15.2 | Very slight bond break on tack. Some bond break on wet surface. |
| R4185 | 14.9 | 14.3 | 50% bond break on tack. Broke at bond on wet surface. |
| R4186 | 8.4 | 10.6 | Bond good on tack. Slight bond break on wet surface. |
| R4187 | 20.1 | 20.7 | Bond failed on tack. Bond failed on wet surface. |
| R4188 | 22.4 | 18.8 | Bond good on tack. Slight bond failure on wet surface. |
| R4189 | 18.6 | 18.4 | Bond good on tack. Bond failed on wet surface. |
| R4190 | 13.9 | 18.1 | Bond good on tack. Bond failed on wet surface. |
| R4193 | 8.6 | 10.7 | Bond good on tack. Bond good on wet surface. |

TABLE D

Adhesion Test Results

Emulsion No. 4172
Effective Area of Test 2.40 sq. in.
Curing Time 24 hrs. at 140°F

| Sample Number | Wet Surf. lb. per sq. in. | Tack Coat lb. per sq. in. | Remarks |
|---|---|---|---|
| Emulsion Control | 9.3 | 11.1 | Bond good on both surfaces. |
| Additive R4181 | 19.9 | 22.4 | Bond good on tack. Bond failed on wet surface. |
| R4182 | 18.7 | 14.9 | Bond good on tack. Bond failed on wet surface. |
| R4183 | 6.1 | 9.6 | Bond good on tack. 30% failed on wet surface. |
| R4184 | 16.0 | 15.2 | Bond good on tack. 50% failed on wet surface. |
| R4185 | 16.2 | 12.8 | Bond good on tack. Bond failed on wet surface. |
| R4186 | 15.3 | 12.7 | Bond good on both surfaces. |
| R4187 | 20.6 | 25.0 | 20% bond break on tack. Bond failed on wet surface. |
| R4188 | 25.6 | 14.3 | Bond failed on both surfaces. |
| R4189 | 30.5 | 25.2 | Bond good on tack. Bond failed on wet surface. |
| R4190 | 26.8 | 21.8 | Bond failed on both surfaces. |
| R4193 | 15.5 | 16.8 | Bond good on tack. 30% bond failure on wet surface. |

TABLE E

Adhesion Test Results
on Slurry Mixtures

| Additive Classification | Additive No. Emulsion Control | Emulsion R4171 Wet Surf. lb. per sq. in. 5.4 | Emulsion R4171 Tack Coat lb. per sq. in. 5.9 | Additive No. Emulsion Control | Emulsion R4172 Wet Surf. lb. per sq. in. 9.3 | Emulsion R4172 Tack Coat lb. per sq. in. 11.1 |
|---|---|---|---|---|---|---|
| Polyvinyl-acetate Homopolymer Emulsion | R4181 | 16.7 | 18.8 | R4181 | 19.9 | 22.4 |
| | R4188 | 22.4 | 18.8 | R4188 | 22.1 | 24.9 |
| | R4189 | 18.6 | 18.4 | R4189 | 23.8 | 24.5 |
| Polyvinyl-acetate Copolymer Emulsion | R4182 | 16.5 | 20.8 | R4182 | 18.7 | 14.9 |
| | R4190 | 13.9 | 18.1 | R4190 | 26.8 | 21.8 |
| Emulsified Epoxy Resin | R4183 | 6.0 | 8.1 | R4183 | 6.1 | 9.6 |
| Acrylic Polymer Emulsion | R4184 | 10.5 | 15.2 | R4184 | 16.0 | 15.2 |
| | R4185 | 14.9 | 14.3 | R4185 | 16.5 | 13.7 |
| Vinyl-acrylic Copolymer Emulsion | R4187 | 20.1 | 20.7 | R4187 | 20.6 | 25.0 |
| Acrylic Based Tripolymer Emulsion | R4193 | 8.6 | 10.7 | R4193 | 15.5 | 16.8 |

TABLE F

Abrasion Test Results
on Slurry Mixtures

| Additive Identification | Emulsion R4171 Additive Number | Emulsion R4171 Average Loss-Gms. | Emulsion R4172 Additive Number | Emulsion R4172 Average Loss-Gms. |
|---|---|---|---|---|
| Emulsion Control | ------ | 47 | ------ | 38 |
| Polyvinyl-acetate Homopolymer Emulsion | R4181 | 83 | R4181 | 60 |
| | R4188 | 33 | R4188 | 36 |
| | R4189 | 25 | R4189 | 55 |
| Polyvinyl-acetate Copolymer Emulsion | R4182 | 82 | R4182 | 54 |
| | R4190 | 43 | R4190 | 69 |
| Emulsified Epoxy Resin | R4183 | 106 | R4183 | 47 |
| Acrylic Polymer Emulsion | R4184 | 24 | R4184 | 4 |
| | R4185 | 48 | R4185 | 71 |
| | R4186 | 22 | R4186 | 20 |
| Vinyl-acrylic Copolymer Emulsion | R4187 | 35 | R4187 | 66 |
| Acrylic Based Tripolymer Emulsion | R4193 | 49 | R4193 | 46 |

TABLE G

Comparison of Abrasion Loss With Cohesion of Slurry Mixes

| Additive Identification | Additive Number | Cohesion lb. per sq. in. Wet Surface | Cohesion lb. per sq. in. Tack Coat | Abrasion Loss-Gms. | Cohesion lb. per sq. in. Wet Surface | Cohesion lb. per sq. in. Tack Coat | Abrasion Loss-Gms. |
|---|---|---|---|---|---|---|---|
| Emulsion Control | ------ | ---- | 5.9 | 47 | 9.3 | 11.1 | 38 |
| Polyvinyl-acetate Homopolymer Emulsion | R4181 | 16.7 | 18.8 | 83 | ---- | 22.4 | 60 |
| | R4188 | ---- | 18.8 | 33 | ---- | ---- | 36 |
| | R4189 | ---- | 18.4 | 25 | ---- | 25.2 | 55 |
| Polyvinyl-acetate Copolymer Emulsion | R4182 | 16.5 | 20.8 | 82 | ---- | 14.9 | 54 |
| | R4190 | ---- | 18.1 | 43 | ---- | ---- | 69 |
| Emulsified Epoxy Resin | R4183 | ---- | 8.1 | 106 | ---- | 9.6 | 47 |
| Acrylic Polymer Emulsion | R4184 | ---- | ---- | 24 | ---- | 15.2 | 4 |
| | R4185 | ---- | ---- | 48 | ---- | 12.8 | 71 |
| | R4186 | ---- | 10.6 | 22 | 15.3 | 12.7 | 20 |
| Vinyl-acrylic Copolymer Emulsion | R4187 | ---- | ---- | 35 | ---- | ---- | 66 |
| Acrylic Based Tripolymer Emulsion | R4193 | 8.6 | 10.7 | 49 | ---- | 16.8 | 46 |

## TABLE H

Skid Resistance Test Results for
Slurry Seal Test Section
South Sacramento Freeway Between
Florin Road and 47th Avenue

| Patch No. | Slurry Test Result | P.C.C. | Remarks |
|---|---|---|---|
| | | .22 | P.C.C. ahead of patches |
| 1 | .36 | | DOL control |
| 2 | .34 | | R4186 Acrylic Emulsion |
| 3 | .35 | | R4185 Acrylic Polymer Emulsion |
| 4 | .37 | | R4184 Acrylic Polymer Emulsion |
| 5 | .36 | | R4187 Vinyl-Acrylic Copolymer Emulsion |
| 6 | .38 | | R4193 Acrylic Based Tripolymer Emulsion |
| | | .27 | P.C.C. between 6 and 7 |
| 7 | .34 | | R4181 Polyvinyl acetate Homopolymer Emulsion |
| 8 | .34 | | R4188 Polyvinyl acetate Homopolymer Emulsion |
| 9 | .37 | | R4189 Polyvinylacetate Homopolymer Emulsion |
| 10 | .30 | | R4182 Polyvinylacetate Copolymer Emulsion |
| 11 | .35 | | R4190 Polyvinylacetate Copolymer Emulsion |
| 12 | .34 | | R4183 Emulsified Epoxy Resin |
| | | .29 | P.C.C. between 12 and 13 |
| 13 | .33 | | R4171 control |
| 14 | .34 | | R4172 control |
| 15 | .35 | | R4171 control on curing seal |
| 16 | .12 | | Emulsion on traffic lacquer |
| | | .26 | P.C.C. between 16 and 17 |
| 17 | .13 | | Traffic lacquer |
| | | .21 | P.C.C. |

## CHANGE IN VISCOSITY OF MIXING TYPE EMULSION ON ADDITION OF 10% BY WEIGHT OF VARIOUS ADDITIVES

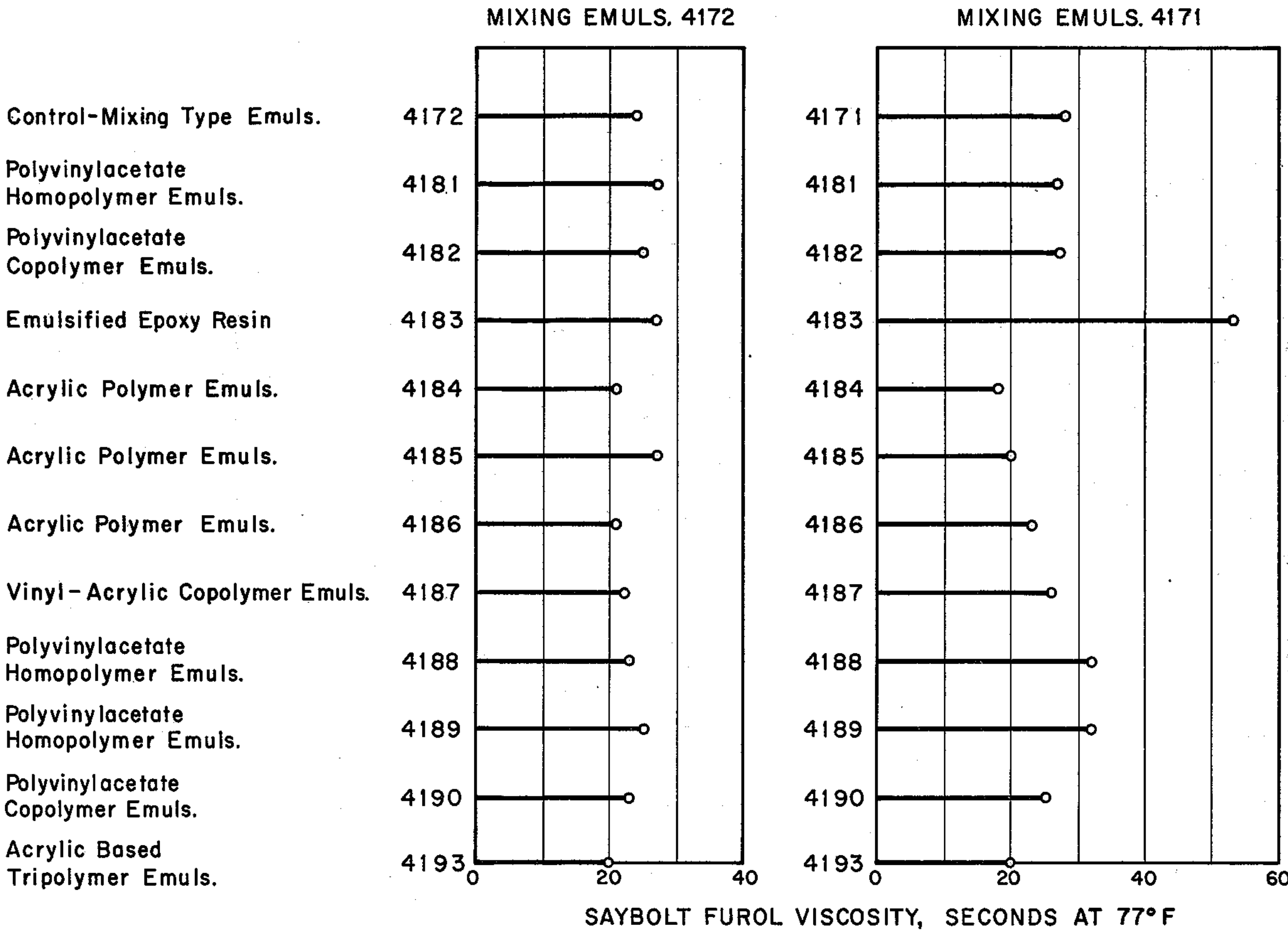



FIGURE 1

# COMPARISON OF ABRASION LOSS WITH COHESION OF SLURRY MIXES PREPARED WITH DIFFERENT ADDITIVES

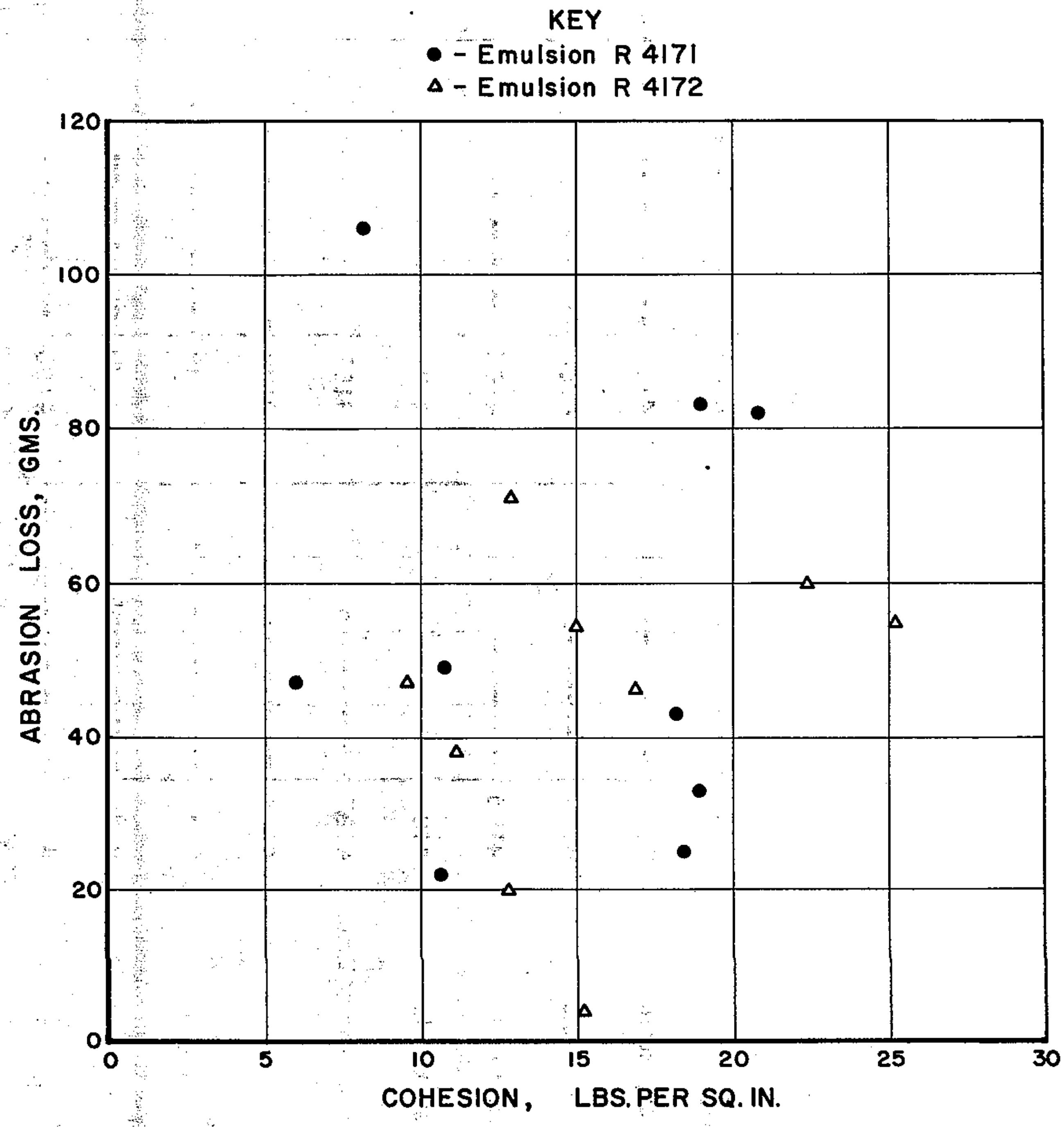



FIGURE 2

## FIELD TEST SECTION
## SOUTH SACRAMENTO FREEWAY
## BETWEEN FLORIN ROAD AND 47TH AVENUE

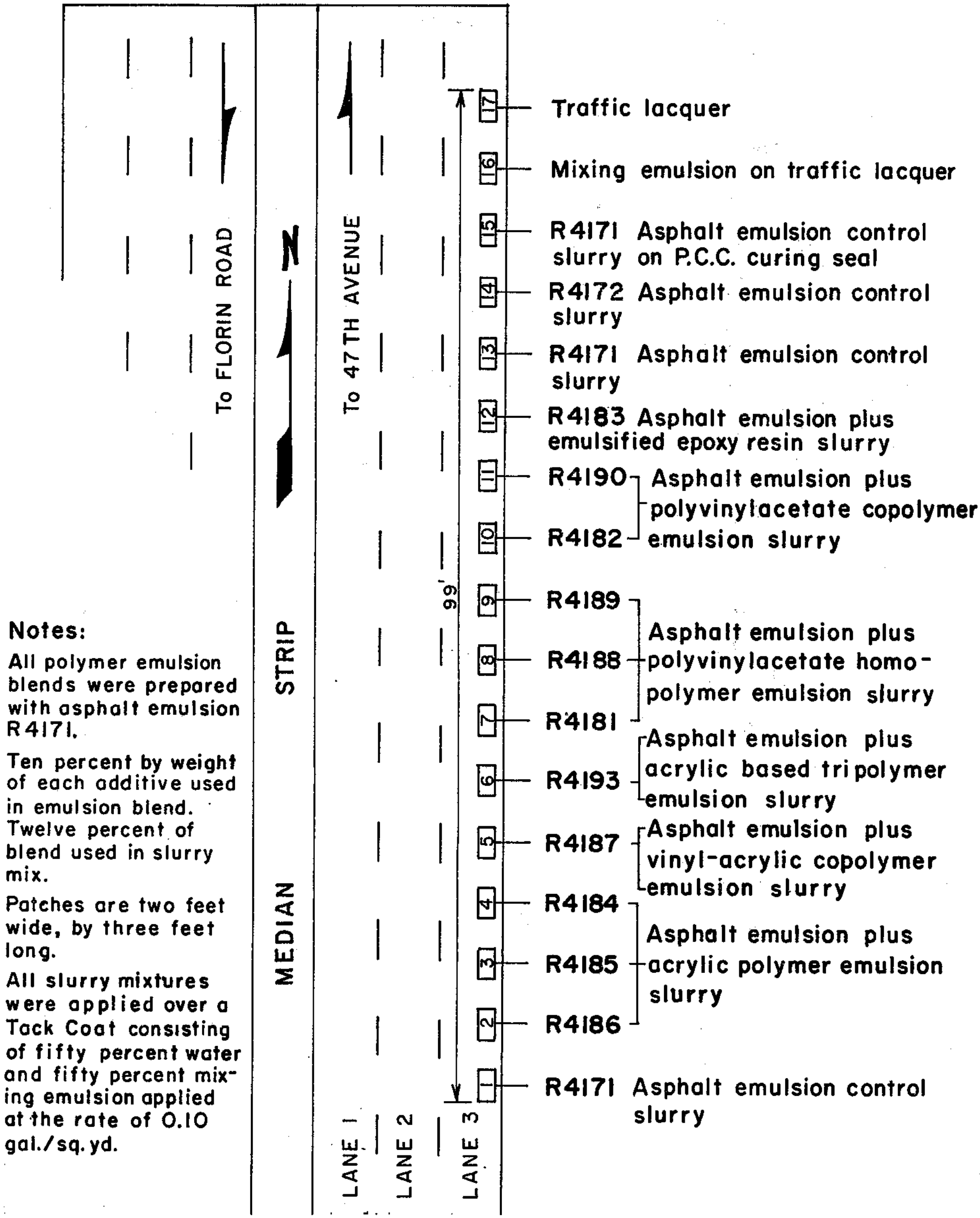
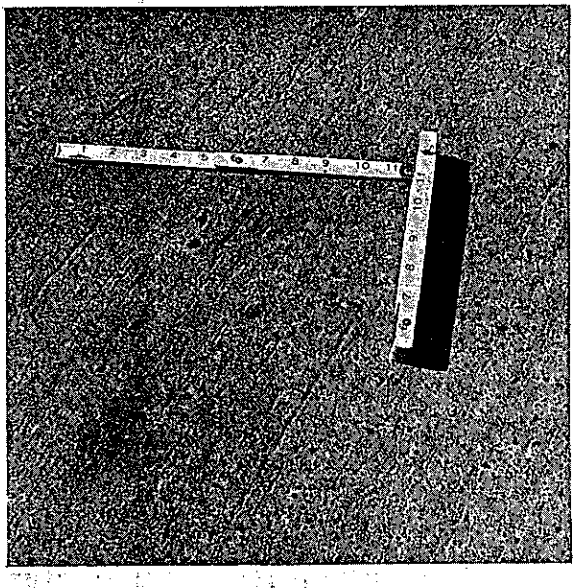


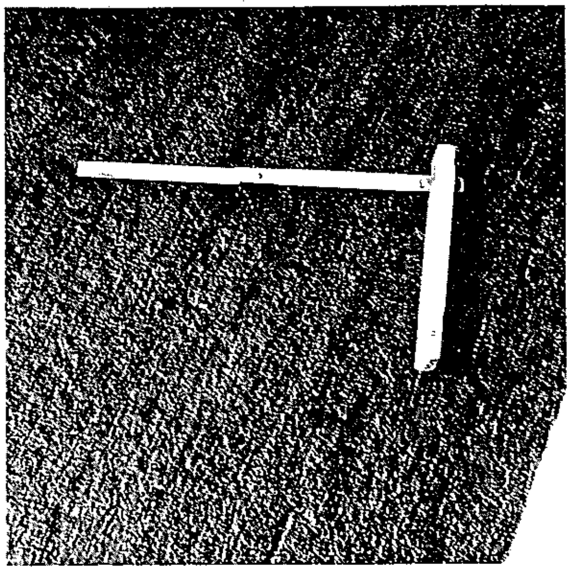

FIGURE 3

# SLURRY TEST SECTION

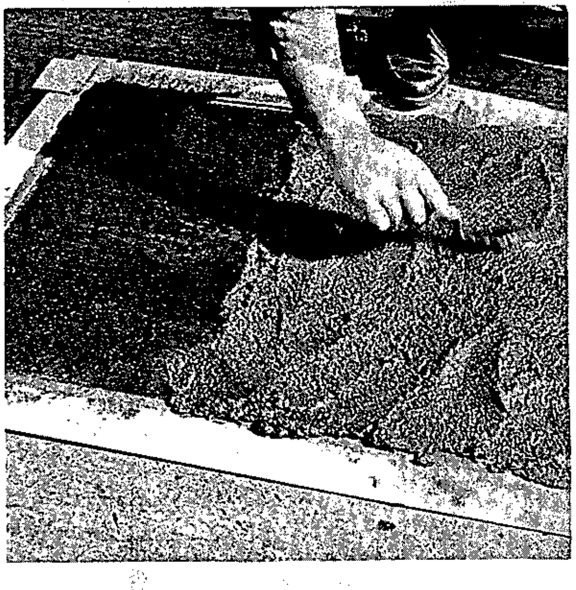
## SOUTH SACRAMENTO FREEWAY
## BETWEEN FLORIN ROAD AND 47 TH AVENUE



P.C.C. Before Tack Coat



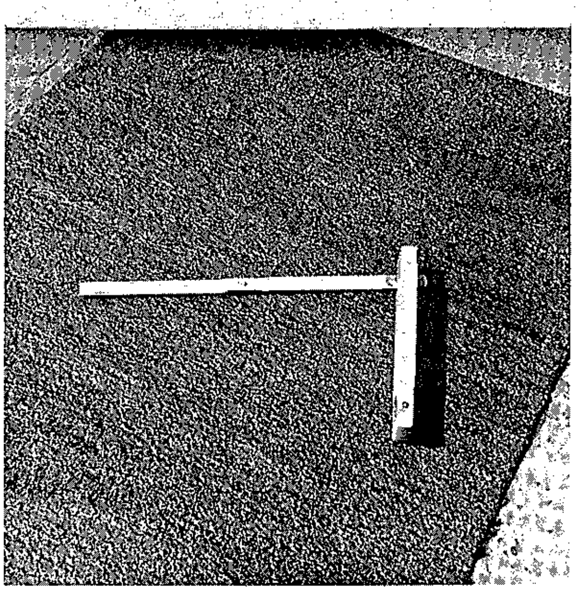
P.C.C. After Tack Coat



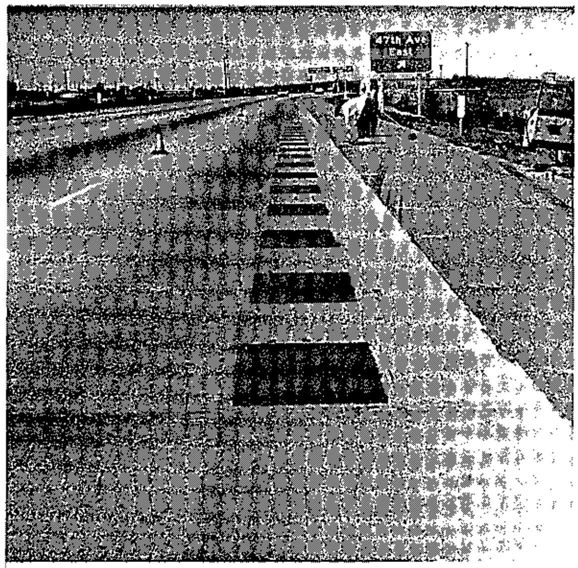
Applying Slurry Mix

Spreading and Leveling
Slurry Mix

FIGURE 4



Closeup of Slurry Patch
After Curing




Overall of Test Area

FIGURE 4