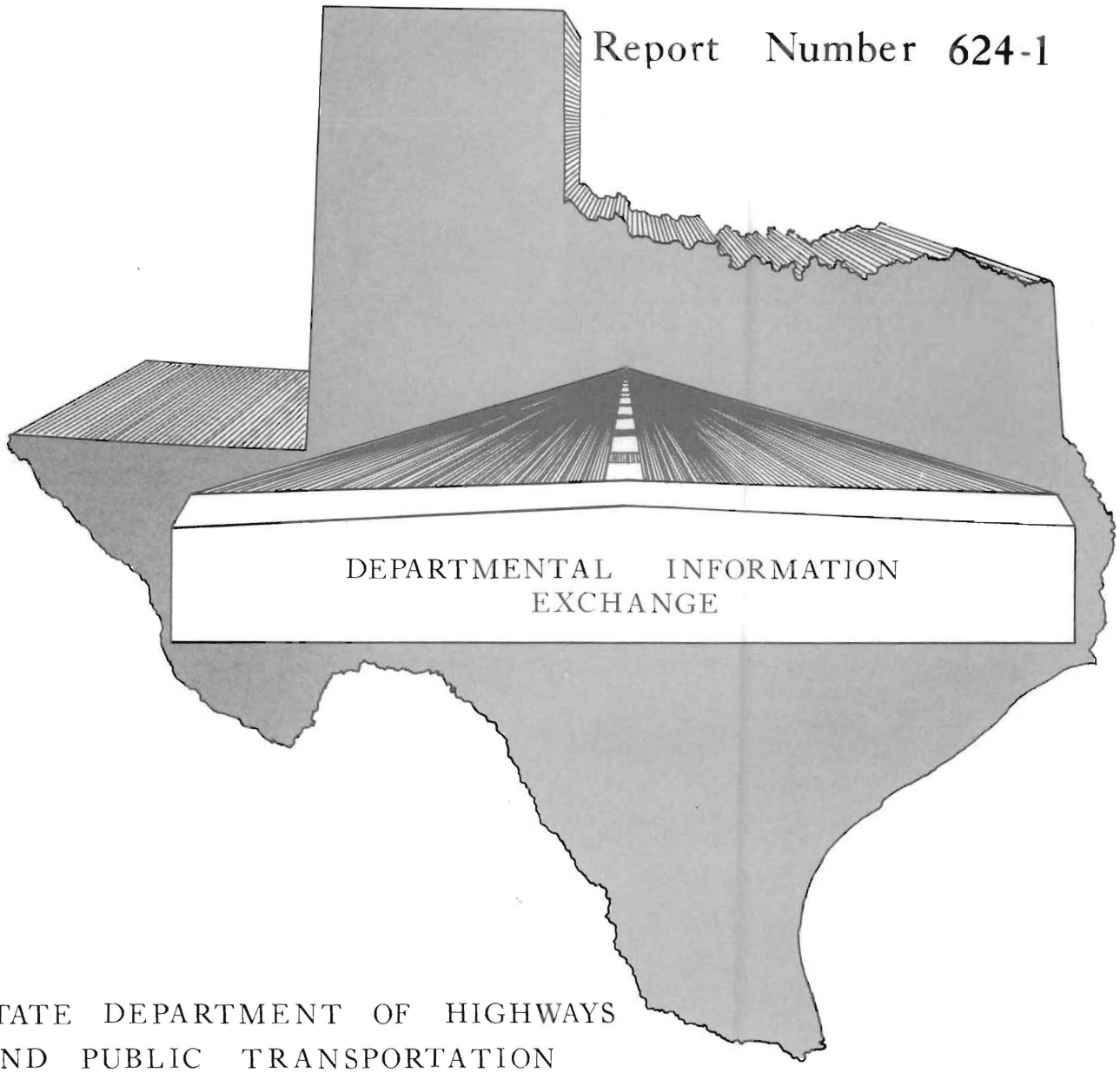
EXPERIMENTAL PROJECTS

AN EXPERIMENTAL SEAL OF POROUS PAVING ON IH-35 S USING NOCOR 690

Report Number 624-1



STATE DEPARTMENT OF HIGHWAYS
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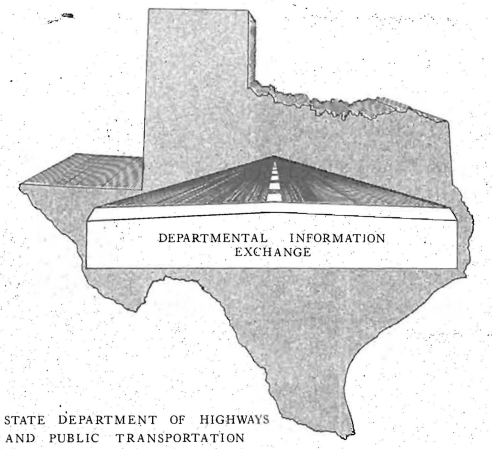

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

EXPERIMENTAL PROJECTS

AN EXPERIMENTAL SEAL

OF

POUROUS PAVEMENT ON IH 35 SOUTH

USING NOCOR 690

A FOLLOW UP REPORT

Report 624-1

Supplement No. 1

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DISCLAIMER STATEMENT

The material contained in this report is experimental in nature and is published for informational purposes only. Any discrepancies with official views or policies of the DHT should be discussed with the appropriate Austin Division prior to implementation of the procedures or results.

Introduction

Waterproofing pavements with dilute solutions of emulsion has been a popular maintenance practice in many areas of the State. One of the negative effects of this method - getting asphalt on vehicles - often overshadows its benefits.

In District 15 during a period when funds were scarce several pavements were sealed with dilute solutions of emulsion. A chemical, NOCOR 690, was added to the solutions to help minimize the negative effects.

What is NOCOR 690?

NOCOR 690 is a product distributed by Cardinal Chemical Company, Odessa, Texas. According to company literature it is a surfactant (Surface Active Agent) derived from the fatty acids in cocoanut oil. It is said to be a wetting agent and a demulsifier. It has further been described as a blend of non-ionic and anioic materials that are soluable in both water and oil.

When NOCOR 690 is used in a mixture of emulsion and water, it reduces the surface tension of the mixture and allows it to enter pores, pinholes and cracks that would normally be bridged over with applications of straight emulsion. The demulsifying properties of the product hastens the break of slow setting emulsions.

To demonstrate the effects of emulsion, a small amount of an 8% mixture of EA-11M and water can be poured onto a dry cracked pavement. Normally the solution will form beads much like the beads that form when water is put on a newly waxed auto. The emulsion will eventually break and form an asphalt film on the pavement surface. To illustrate the effects of NOCOR the same demonstration can be done. However, after the beads form, several drops of straight NOCOR 690 can be applied. An instantaneous break in the emulsion will usually result and penetration of the solution into the surface should occur. The breaktime and penetration will depend on the weather and properties of the water and emulsion. See Appendix A for a demonstration.

Mixing Procedures and Application Rate

The procedures used to combine water, emulsion and a surfactant can have an effect on the results obtained from the solution. For our work, EA-11M was used. Experimentation has revealed that best results are obtained when one-half the water needed is loaded into a distributor before adding the EA-11M. Next NOCOR 690, diluted in five gallons of water, is added followed by the remaining water. Normally, only about three pints of NOCOR 690 is needed per 1000 gallons of 8% EA-11M solution. This solution, applied at 0.15/SY should not run off a pavement except on super-elevated curves.

Experiences with Emulsion Waterproofing

About 76 lane miles of pavement on IH 35 in La Salle County have been waterproofed with emulsion.

Nine miles of the main lanes on IH 35 between Cotulla and Artesia Wells was waterproofed by maintenance forces during August, 1976. Emulsion waterproofing was found to be the most economical method at the time for preventing the disintegration of calcarious asphalt stabilized base caused by the intrusion of water.

Two applications of an 8% solution of EA-11M and surfactant were placed at a rate of 0.15 Gal/SY per application. The total cost of the materials used was about 1¢ per square yard figuring the cost of NOCOR 690 at $8.25 per gallon and EA-11M at $0.35 per gallon. Residual bitumen for the total application was about 0.015 Gal/SY. No reports of asphalt splashed on vehicles were received. A slight reduction in the pavement's skid number was experienced; this was only a temporary condition. Additionally it was found that the emulsion solution used caused damage to the distributor. The distributor's pump was designed to handle warm to hot fluids; the cool (air temperature) fluid imposed too heavy a load on the pump. This was presented in Experimental Projects Report 624-1, June 1977.

With previous experiences in mind about 40 lane miles of raveling ACP on IH 35 was treated with emulsion during the fall of 1978. Four applications of an 8% solution of EA-11M and surfactant was placed at a rate of 0.15 Gal/SY. The solution was placed with a gravity flow 4000 gallon capacity water truck. The uniformity of application was a function of the cleanliness of the nozzles on the spray bar. On this particular project the NOCOR was not introduced into the solution until about 10 minutes before application. The mechanical condition of the pulling unit prompted fears that a break in the solution might occur if the truck broke down on its way to the project site. Late introduction of the surfactant did not significantly alter the breaktime or penetration of the solution into the pavement. Traffic often was able to move onto the treated areas within 20 minutes.

Summary

Emulsion waterproofing has proved to be an economical method of temporarily sealing some roads in District 15. With the addition of a wetting agent the inherent properties of the emulsion were enhanced while the negative aspects often associated with the method were diminished.

APPENDIX A

A DEMONSTRATION OF HOW NOCOR 690 WORKS

To illustrate on a small scale how NOCOR works, a very simple demonstration can be done.

1. Make a solution of emulsion and water in a graduated cylinder. Use about 8 ML EA-11M and 92 ML of water. Mix it well.

2. Pour the solution on an ACP or LRA speciman similar to the ones used for stability tests. If the speciman is very dry, the solution should form beads similar to water poured on a freshly waxed auto. A break in the emulsion will eventually occur.

3. Pour the solution on another ACP speciman. Dip a screwdriver, pencil or similar tool into some straight NOCOR 690. Apply one or two drops of the NOCOR to the emulsion solution on the specimens. This should cause an instantaneous break; the size of the emulsion-water beads should expand and the entire solution penetrate the speciman in several minutes.

4. A demonstration similar to the above can also be done on a dry pavement.

AN EXPERIMENTAL SEAL

OF

POROUS PAVEMENT ON I.H. 35 S.

USING NOCOR 690

Control 18, Section 1

LaSalle County

Experimental Projects Report
624-1

A NARRATIVE REPORT

BY

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June 1977

DISCLAIMER STATEMENT

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A NARRATIVE REPORT

In August, 1976, applications of emulsion and water mixture were applied to the driving lanes of a nine mile section of IH 35 between Cotulla and Artesia Wells in La Salle County.

This mixture of emulsion and water was an 8% solution, i.e., 80 gallons of EA-11M was mixed with 915 gallons of water. To this mixture was added three pints of Nocor 690 diluted in five gallons of water.

Nocor 690 is manufactured by the Cardinal Chemical Co., Odessa, Texas. Derived from cocoanut oil, it is said to be a wetting agent and also a demulsifier. When used in a mixture of emulsion and water, it is said that it reduces the surface tension of the mixture to allow it to enter minute pores, pinholes and cracks that would normally be bridged over with a normal application of straight emulsion; further, it is said that the demulsifying properties hastens the break or set of a slow setting emulsion.

This particular section of IH 35 had become a constant maintenance problem. The surface course was a hot mix, Item 340, Type "D", open-graded to provide good friction qualities. It was soaking up rainfall water and allowing the water to penetrate the black base. The black base, Item 292, constructed with a flint and calcareous base was rapidly disintegrating due to stripping action caused by the intrusion of the water.

Extensive patching operations had been underway for several months when the

availability of Nocor 690 became known to us. Simple tests performed in the laboratory convinced us that it did reduce the surface tension of water, and probably would perform as expected on the roadway. Faced with the need to seal the equivalent of tnirty six lane miles, and not having the money for a conventional seal coat, we decided to give Nocor 690 a try.

We arrived at a procedure of placing 500 gallons of water in the distributor, and then adding 80 gallons of EA-11M. Then the dilution of three pints of Nocor 690 and five gallons of water was added. The remaining 415 gallons of water was then added, and the mixture circulated and mixed for 15 minutes before application.

The mixture was first applied at a rate of 0.15 gal/s.y. This was generally the correct rate, except on super-elevated curves where the mixture had a tendency to run across the lane reserved for traffic, and gave us the potential of washing cars. We changed to a rate of 0.10 gal/s.y., and did not have that problem. A total of 0.30 gal/s.y. of the mixture was applied to the pavement surface in either two or three applications. Some areas were covered with that amount in one day, other areas were covered in two days.

Almost immediately upon application, we could see the mixture actually running or flowing to the pinholes, cracks, and other depressions in the surface of the pavement, and actually disappearing into them, leaving only a thin film on the surfaces of the exposed aggregates.

We had previously made a brief study of the porosity of the pavement surface and had compared visually appearing porous areas to other areas that appeared to be less porous. Such a study can be made with a

minimum of equipment. A 1/30 cu. ft. compaction mold may be placed on the pavement, with the contact surface coated with petroleum jelly, to make for a watertight connection. The mold is then filled with water and time observations are made to record how rapidly this known volume of water is absorbed into the pavement surface. Upon completion of the total application of 0.3 gal/s.y., we checked previously referenced areas and found a marked improvement of the porosity to have been imparted by the application of the mixture.

Apparently this product does have demulsifying properties. Time and again we observed the slow setting emulsion to break in about 35 minutes, and, generally, it was possible to drive over a fresh shot of mixture about an hour after application without your vehicle being spattered with emulsion.

We feel this treatment saved the majority of the pavement through the wet winter of 1976, and spring of 1977, by effectively sealing it, and thereby preventing the intrusion of water through it into the black base below. It is true that patching has been necessary on some areas that were so badly distressed before being treated.

We purchased 55 gallons of Nocor 690 at a price of $8.25 per gallon, delivered to San Antonio. The EA-11M emulsion cost $0.35 per gallon delivered to Pleasanton. Based on the percentages in the mixture, and discounting the cost of water, the following costs have been determined:

Cost of materials (Nocor 690 and EA-11M)

Rate of mixture: 0.10 gal/s.y. = $0.003 s.y.
Rate of mixture: 0.15 gal/s.y. = $0.005 s.y.
Rate of mixture: 0.30 gal/s.y. = $0.01 s.y.

One error was made during this work by not heating the mixture. We could see no need for heat, and we circulated the mixture for fifteen minutes at a no heat condition before application. Toward the end of the work, the pressure pump on the distributor went out and had to be replaced. We were later told by the sales representative that the pump is designed to handle warm to hot fluids; that cold fluids impose too heavy a load on the pump. Perhaps if we had heated the mixture to about 150° F., we would not have had that problem.

Considering the amount of emulsion in the mixture and the rates of application, the amount of residual bitumen actually applied is as follows:

Rate of applied residual bitumen:

Rate of mixture: 0.10 gal/s.y. = 0.0052 gal/s/y/ residual bitumen
Rate of mixture: 0.15 gal/s.y. = 0.0078 gal/s.y. residual bitumen
Rate of mixture: 0.30 gal/s.y. = 0.0156 gal/s.y. residual bitumen

We observed what appeared to be the majority of the mixture being absorbed into the porous mat; yet, there was a small amount of mixture, and therefore, residual bitumen left on the surface of the exposed aggregate. This was another error on our part, in that we failed to consider the effect this very thin film of residual bitumen would have on the friction qualities of this roadway. This was evidenced by skid testing after treatment of this 3600 A.D.T. facility. The skid values dropped appreciably and stayed down until traffic wore off the film left on the exposed aggregate.

Silica sand, close by in abundant quantities, should have been placed on the freshly treated surface. Traffic over the sand would probably have rapidly worn off the residual bitumen, and prevented a slick

condition that caused us much concern. The cost of the sand would probably have been about $0.03 s.y.

We believe this experiment was a success, and that the intrusion of rainwater through a porous asphaltic surface may be stopped by applications of Nocor 690, emulsion, and water, as described herein. We would urge that sand be applied to prevent the loss of frictional qualities of roadway surface.