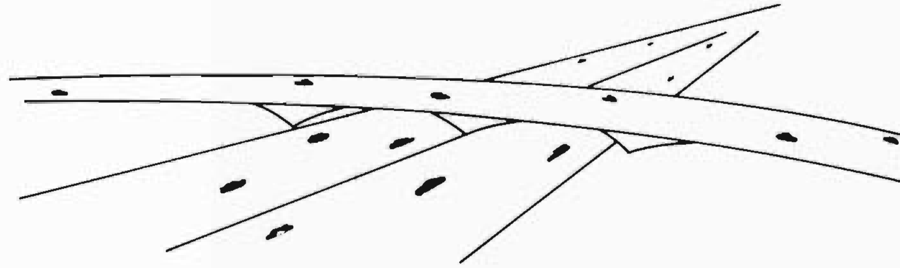


DEPARTMENTAL RESEARCH

Report Number SS 20.0

SPRINKLE TREATMENT FOR ACHIEVING SKID RESISTANT PAVEMENT IN TEXAS

TEXAS HIGHWAY DEPARTMENT

SPRINKLE TREATMENT FOR ACHIEVING SKID RESISTANT PAVEMENT IN TEXAS

by

Richard L. Tyler
Engineering Technician III

Prepared in the Research Implementation Section
under the supervision of

Temple R. Kennedy
Research Operations Engineer

Special Study No. 20.0

Planning & Research Division
Texas Highway Department

August, 1974

SPRINKLE TREATMENT FOR ACHIEVING SKID RESISTANT PAVEMENT IN TEXAS

For many years highway engineers have recognized the importance of skid resistant highways, but the cost of constructing them was often prohibitive commensurate with budgetary restraints and commitments. Knowing that friction is a function of the tire-pavement interface, some highway designers set out to improve the skid characteristics at that interface. They found that lower priced local aggregates could be used for the bulk of the pavement matrix and polish resistant stones could then be spread on and rolled into the upper layer. This process is commonly called "sprinkle treatment" because of the way the polish resistant stones are distributed over the surface.

Variations of the sprinkle treatment have been used successfully in Europe for several years, and test sections have been applied in many states. The State of Virginia, a leader in the use of sprinkle treatment, placed several sections with a number of different type aggregates. Their first experimental pavement was placed in August, 1968.

Skid tests on the Virginia test sections reflected the influence of both the polishable stones and the skid resistant stones since the upper layer of pavement was composed of both types. The treated sections, as expected, had a significantly higher skid resistance than the untreated, homogeneous control sections.

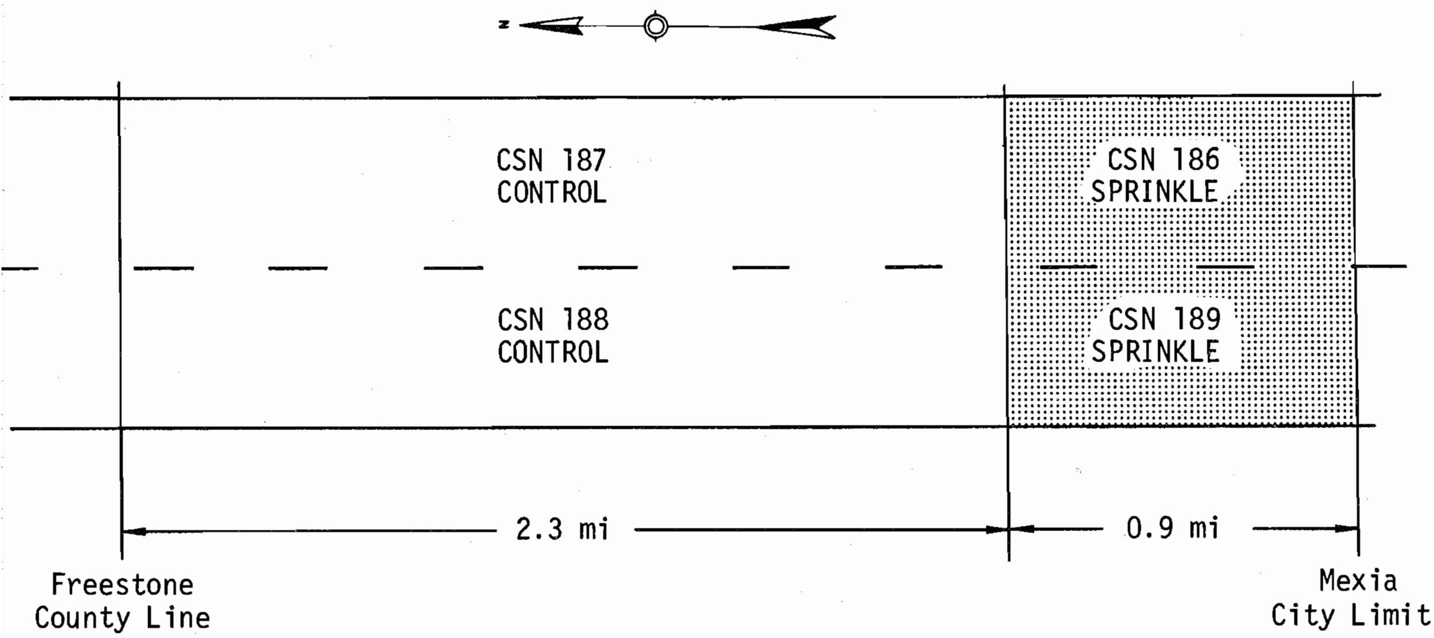
The construction procedure utilizes ordinary maintenance equipment such as a mixer, grader or front-end loader, a spreader, and a vibratory power roller. Since the objective in treating a pavement is to provide a more skid resistant riding surface, any rock can be used which will not polish readily and which has been known to increase the skid resistance significantly. For initial testing, the Virginia engineers selected granite, crushed gravel, sand, slag, and synthetic aggregates. The size ranged from three eights of an inch to sand sized particles.

The most desirable asphalt to use for precoating is one which will have enough residual stickiness to hold it in the pavement surface but not so much as to cause difficulties (balling or matting) during the sprinkling operation. Virginia personnel used a maintenance mixer to precoat the various aggregates with MC-70 asphalt.

The mix should be windrowed or stockpiled for several weeks prior to application. During the storage period, the coated aggregate needs to be bladed and worked each day in order to facilitate the escape of volatiles.

Various sprinkling mechanisms have been tried, but the spin type spreader (the type which is used to broadcast sand or deicing chemicals) seems to distribute the aggregate evenly and at a desirable rate. The stones are sprinkled directly behind the lay-down machine and rolled into the hot asphaltic concrete.

Texas Highway Department District No. 9 pioneered the use of sprinkle treatment in this State. In the summer of 1972, District 9 personnel placed one 0.9 mile section (two lanes wide) of sprinkle treated hot mix asphaltic pavement on State Highway 14 north of Mexia. Average daily traffic was approximately 2700 vehicles.



The test sections and control sections are in Limestone County on Control-Section 93-4.

The aggregate which was used for treating this test section was Type "F", grade 4 synthetic, and it was precoated with EA-11M emulsion. Gradation of Type "F", grade 4 synthetic, found in the 1962 edition of Texas' Standard Specifications for Road and Bridge Construction, is as follows:

	Percent by Weight
Retained on 5/8" sieve	0
Retained on 1/2" sieve	0-2
Retained on 3/8" sieve	5-25
Retained on No. 4 sieve	85-100
Retained on No. 10 sieve	98-100

District 9 maintenance personnel windrowed 35 cubic yards of the synthetic aggregate in the maintenance yard. Two hundred - sixty gallons of the emulsified asphalt was applied using a tank truck with spray bar by driving astride the aggregate windrow. Since the emulsion was not diluted, the stones began sticking together in a thick mat. To overcome this problem, a 4:1 mixture of 200 gallons of water/50 gallons of EA-11M emulsion was applied one week after the initial coating. The material was bladed and mixed each day for a week, and then another coating of 200 gallons of water/50 gallons of EA-11M emulsion was applied. This, too, was followed by daily blading and mixing for one week. The daily mixing helped to break up the mat as well as facilitate the escape of volatiles. District 9 personnel suggested that for future operations, mixing the emulsion with at least 50 percent water would prevent the stones from sticking together.

The regular asphaltic concrete pavement was Type "D" hot mix. The rock, a relatively inexpensive river gravel, was obtained near the job site.

The precoated synthetic material was sprinkled behind the asphalt paver at a rate of 2½ pounds per square yard. A twin type turntable sand spreader was used for distribution; this type of spreader helps break up any balled material. The truck was backed along approximately

50 feet behind the paver. Immediately after sprinkling, the synthetic aggregate was rolled into the pavement surface with a vibratory power roller. There was some concern that the aggregate distributor truck would leave tracks in the finished pavement, but none was observed after compacting with the roller. It was estimated that at least three fourths of the sprinkled aggregate adhered to the surface of the hot mix.

The District maintenance forces did not make any special purchase of material or equipment for this experimental work. They used materials which were available from their maintenance storage. Other sizes or gradings of aggregate could be considered, and other aggregate types are available which possess good skid resistant qualities. Precoating asphalts other than EA-11M have been used successfully by other states and nations. The vibratory power roller was used because that was what the contractor was using for the regular type "D" hot mix; other types of power rollers could be just as effective.

District 9 personnel offered the following suggestions for future sprinkle treatment operations:

(1) The aggregate should be dampened before precoating with an emulsion.

(2) EA-11M asphalt should be diluted with at least 50 percent water before precoating.

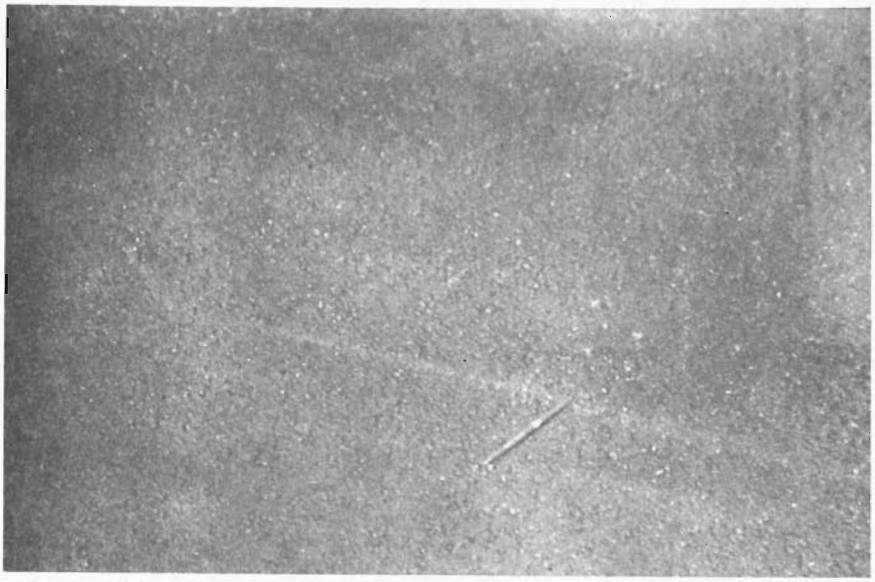
(3) MC-30 cutback asphalt should be tried as a primer (precoat) and it should be applied at the rate of 3 gallons per cubic yard of aggregate.

(4) Consideration could be given to using plant processed precoated lightweight aggregate.

(5) A pneumatic roller should follow the vibratory power roller.

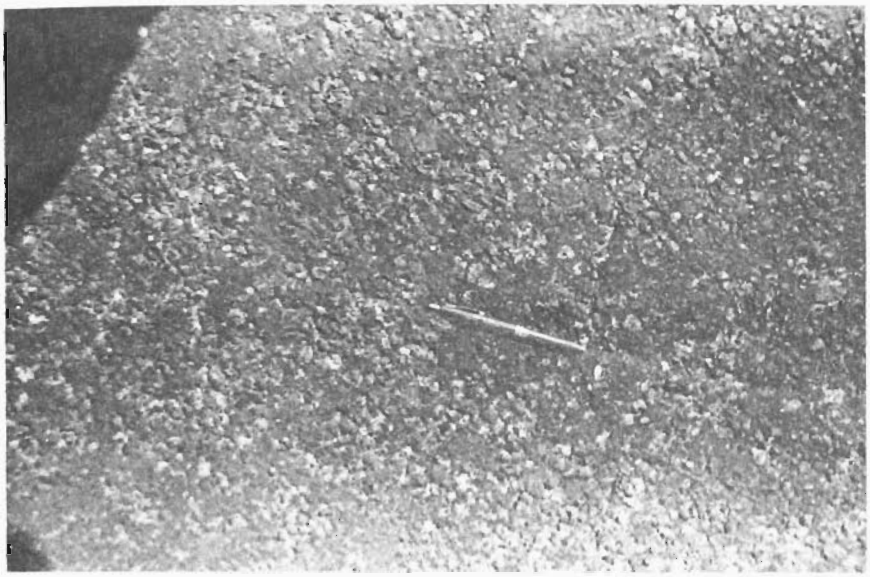
Total cost for the Mexia test section was $548.73 or about 4 1/3 cents per square yard, but no detailed cost comparisons were made between the regular hot mix, a skid resistant hot mix and the sprinkle treated hot mix. However, minimal labor, equipment and material are required to place such an effective, skid resistant surface as this.

The surface of the sprinkled section exhibited some irregularities when compared to the control. The synthetic, polish resistant aggregate was lighter in color and was noticeable upon cursory inspection. The general appearance was somewhat mottled. The most important difference, however, was the texture. A skid resistant, nonpolishable stone inherently has microtexture; and a large macrotexture results when skid resistant stones are rolled into the surface of a hot mix.



Control Section
Type "D" ACP using River Gravel

Sprinkled Section
Type "F", grade 4 Synthetic
Rolled into the Type "D" ACP



Sprinkled Section
Type "F", grade 4 Synthetic
Rolled into the Type "D" ACP

The following tables of skid history show that the sprinkle treated section of roadway has maintained significantly higher skid resistance than the untreated section. The treated section shows no distress or deterioration, and this is evidenced by the latest skid results. The average skid number of the treated section was 16.5 higher than the average skid number of the control section after two years of service.

Date of Test	Total Traffic	Section 186 "Treated"		
		Highest SN	Average SN	Lowest SN
9/72	103,000	58	52	44
7/73	580,000	53	46	37
4/74	719,000	45	42	39
7/74	855,000	48	44	37
Date of Test	**Total Traffic**	**Section 187 "Control"**		
		Highest SN	Average SN	Lowest SN
9/72	103,000	41	37	36
7/73	580,000	38	32	30
4/74	719,000	28	26	25
7/74	855,000	32	30	28

Date of Test	Total Traffic	Section 189 "Treated"		
		Highest SN	Average SN	Lowest SN
9/72	103,000	58	54	50
7/73	580,000	52	47	42
4/74	719,000	53	46	37
7/74	855,000	58	50	39
Date of Test	**Total Traffic**	**Section 188 "Control"**		
		Highest SN	Average SN	Lowest SN
9/72	103,000	42	41	40
7/73	580,000	32	30	27
4/74	719,000	28	27	26
7/74	855,000	32	31	28

In summary, the benefit/cost ratio of sprinkle treatment is very large. Sprinkle treatments can be used to provide skid resistant surfaces for new hot mix asphaltic pavements which are composed of low cost, locally available, though polishable aggregates. The cost of providing skid resistant surfaces with sprinkled stones is relatively inexpensive. The amount of skid resistant synthetic stone used was only 2½ pounds per square yard. The process of sprinkling skid resistant stones is simple and can be performed with ordinary maintenance equipment.

ACKNOWLEDGEMENTS

Special appreciation goes to Mr. Elton B. Evans, District Engineer, Waco, and his staff, Messrs. Robert E. Burns, Robert L. McKinney, George G. Cleveland, and James P. Ledbetter of Texas Highway Department, District 9. These Engineers progressively pioneered the use of sprinkle treatment in Texas, and they supplied much of the data for this report.

References to the Virginia Department of Highways' experiences with sprinkle treatment were taken from "Use of A Sprinkle Treatment to Provide Skid Resistant Pavements" by J. H. Dillard and G. W. Maupin, Jr.