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16. Abstract

Geotextiles (engineering fabrics) were installed at four locations in Texas to evaluate their potential as cost-effective measures to reduce or delay reflection cracking in asphalt concrete overlays. The overlaid pavements included asphalt concrete, continuously reinforced portland cement concrete, and a freshly cold-milled asphalt concrete. Test pavements were approximately 0.25 mile in length with the fabric installed edge to edge. Nine different types of commercially available geotextiles comprised of nonwoven polypropylene of polyester were tested. One woven experimental product composed of polypropylene and polyester was also tested. Resistance to reflective cracking has been evaluated for up to 10 years. Results, based solely on these test pavements, indicate that geotextiles are not consistently cost-effective methods to address reflective cracking. However, limited evidence indicates geotextiles reduce "pumping" after cracking does occur.

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ENGINEERING FABRICS

AND

ASPHALT OVERLAY PERFORMANCE

by

Joe W. Button
Associate Research Engineer

Research Report 187-17
Research Study 2-9-77/9-187

Sponsored by

Texas State Department of Highways and Public Transportation
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November, 1989

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas

METRIC (SI*) CONVERSION FACTORS

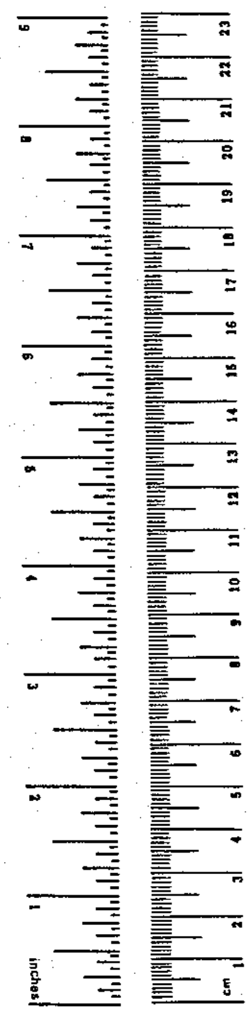
APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	2.54	millimetres	mm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
		AREA		
in^2	square inches	645.2	millimetres squared	mm^2
ft^2	square feet	0.0929	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
mi^2	square miles	2.59	kilometres squared	km^2
ac	acres	0.395	hectares	ha
		MASS (weight)		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		VOLUME		
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.0328	metres cubed	m^3
yd^3	cubic yards	0.0765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

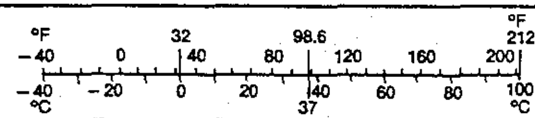
Symbol	When You Know	Multiply By	To Find	Symbol
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

* SI is the symbol for the International System of Measurements



APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
		AREA		
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
km^2	kilometres squared	0.39	square miles	mi^2
ha	hectores (10 000 m^2)	2.53	acres	ac
		MASS (weight)		
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T
		VOLUME		
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



These factors conform to the requirement of FHWA Order 5190.1A.

IMPLEMENTATION

The findings of this study indicate that a fabric applied as an interlayer between an existing pavement and a new asphalt concrete overlay cannot be expected to consistently reduce the severity or delay the appearance of reflection cracking. In some cases, certain types of fabric interlayers did appear to delay the appearance of reflection cracks at the surface of the overlay, however, fabric performance was not uniform at a given location or at different locations. As a result, fabrics were not found to be cost-effective treatments to address reflection cracking.

The study indicated that fabrics may reduce pumping in cracked pavements. The cost-effectiveness of this phenomena was not determined. This finding suggests that further research to estimate the economic benefits may be justified.

This report does not recommend the rejection of existing or proposed specifications or procedures designed for procurement and application of fabrics.

DISCLAIMER

The contents of this report reflect the view of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specifications, or regulations.

There is no invention or discovery conceived or first actually reduced to practice in the course of or under this contract including any art, method, process, machine, manufacture, design or composition of matter, or any new and useful improvement thereof, or any variety of plant which is or may be patentable under the patent laws of the United States of America or any foreign country.

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INTRODUCTION

Fabrics or geotextiles have been applied in an attempt to reduce reflection cracking in bituminous overlays for more than 20 years. Laboratory tests simulating pavement stresses exhibited promising results; however, short-term performance from field trials often appeared less hopeful. Therefore, a comprehensive field and laboratory research program was initiated in 1978 to study the changes that fabrics produce in certain mechanical properties of asphalt mixtures and to evaluate their long-term pavement performance in order to assess their cost-effectiveness as a rehabilitation alternative. The primary objectives of this study were to develop the information necessary to evaluate the performance of geotextiles in asphalt overlay applications in order (1) to determine the extent to which fabrics will economically reduce reflective cracking, (2) to ascertain fabric properties that will optimize field performance, (3) to define satisfactory field installation procedures for utilizing fabrics and (4) to establish realistic specification limits for fabrics and associated materials. This work culminated with the publication of four reports to the State Department of Highways and Public Transportation (SDHPT) (1, 2, 3, 4) and made significant contribution toward three publications in international journals (5, 6, 7). This report is the fifth and last in the series published by the SDHPT that is related to work that originated under study number 2-9-79-261.

Field installations consisting of 8 to 13 one-quarter mile test sections in 4 different areas of the state were constructed. Two projects were constructed in 1979, one in 1980, and one in 1981. The test sections involved placement of a fabric followed by a hot-mix asphaltic concrete (HMAC) overlay. Ten different geotextiles were compared to control sections consisting of either a conventional HMAC overlay with no interlayer or an overlay with a chip seal as an interlayer. All test pavements were installed over cracked asphalt concrete or portland cement concrete pavements to evaluate the relative ability of the interlayer to reduce reflection cracking. Field performance of these test pavements has been evaluated for periods up to 10 years. Laboratory tests were also conducted on all paving materials and reported previously (1, 2).

The purpose of this report is to evaluate the long-term performance of the test pavements, briefly describe the construction of the field installation, and summarize the properties of the construction materials. Although previously reported in References 1 and 2, selected materials properties and pavement construction details are repeated herein for the convenience of the reader.

SUMMARY OF FIELD PROJECTS

Four projects were installed in different geographic and climatic regions of Texas (Figure 1). Within each geographical location, the only variable was the type of geotextile. Ten different fabrics applied to cover the complete pavement width were evaluated. Fabric weights ranged from 3 to 8 ounces per square yard. Typical tack coats to accommodate these fabric weights ranged from 0.20 to 0.40 gallons per square yard, respectively. Specific information about each project is furnished in Table 1. Hot mixed asphalt concrete is designated as HMAC. Type D designates a dense graded surface course of HMAC containing a maximum nominal aggregate size of 3/8 inch. Type B designates a dense graded base or level-up course of HMAC containing a maximum aggregate size of 1 inch. Engineering fabrics installed at each of the four research projects are listed in Table 1 and described in Tables 2 and 3.

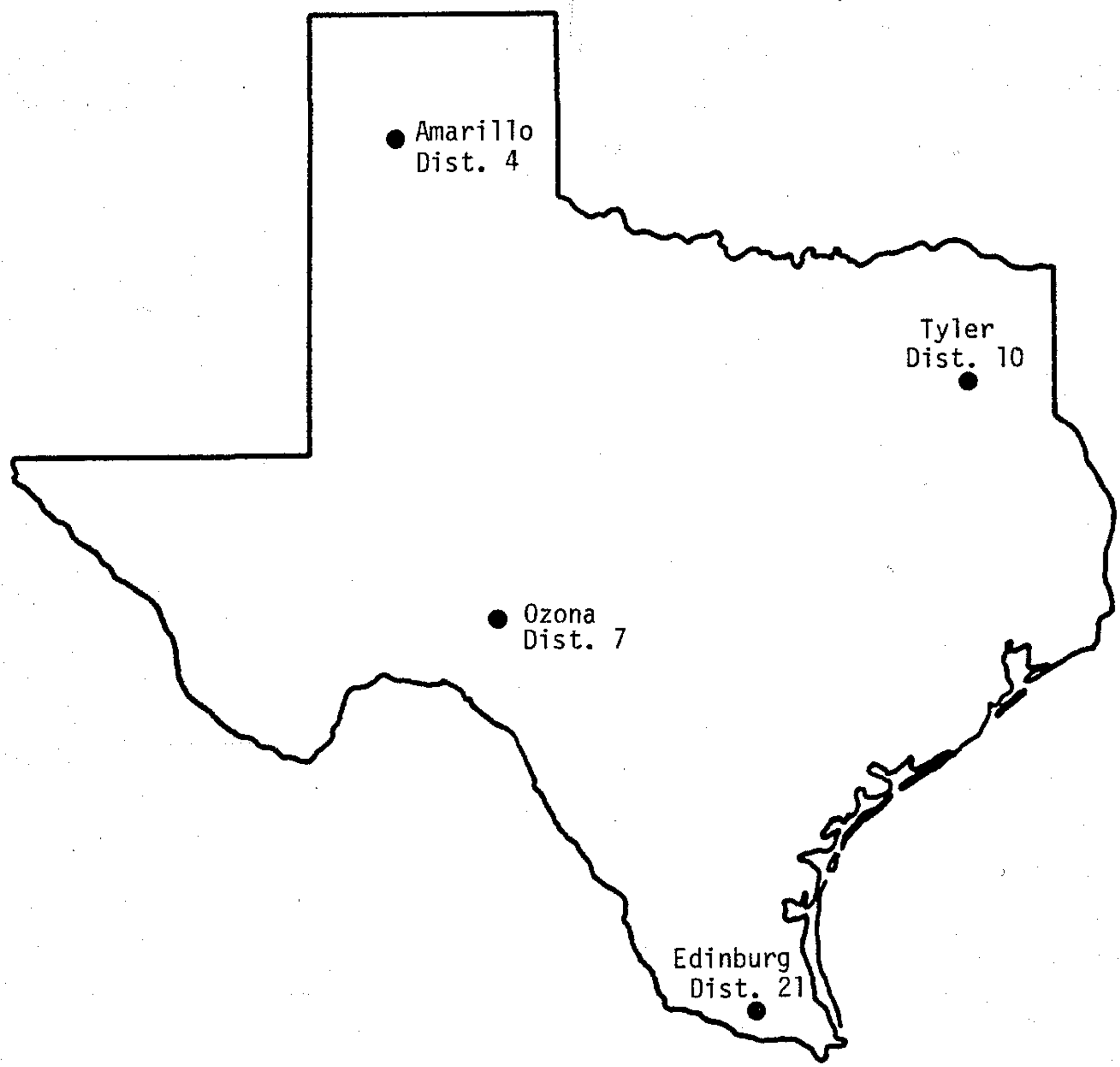

Figure 1. Location of Trial Field Sections.

Table 1. Summary of Fabric Test Pavements (After Reference 2).

Item	West of Ozona	West of Amarillo	Edinburg	East of Tyler	
Highway Designation	IH-10	IH-40	US 281 & SH 107	IH 20	
No. of Lanes each Direction	2	2	2	2	
Existing Pavement					
Layer 1 (top)	3" HMAC	1" HMAC (Type D)	1" HMAC*	8" CRCP	
Layer 2	15" Flex Base	2" HMAC (Type A)	12" Flex Base	RC-2 membrane	
Layer 3	Subbase	12" Flex Base	Subgrade	6" Soil Cement	
Layer 4	--	6" lime Tr.Subgr.	--	Subgrade	
Date of Overlay Construction	Aug-Sept 1979	Sept 1979	Feb 1980	July 1981	
Materials Evaluated	Chipseal (Control) Bidim C-22 Bidim C-34 Old Petromat New Petromat Petromat 8 oz	Control Bidim C-22 Bidim C-34 Old Petromat New Petromat Petromat 8 oz	Control Bidim C-22 Bidim C-34 Old Petromat New Petromat Petromat 8 oz Bidim C-28	Control Old Petromat New petromat Reepav - 3 oz Reepav - 4 oz Crown-Zellerbach Mirafi 900x	
HMAC Overlay	Type D	Type D	Type D	Type B	Type D
Asphalt Type & Grade	AC-10	AC-10	AC-10	AC-20	AC-20
Asphalt Source	Refinery 4	Refinery 15	Refinery 15	Refinery 6	Refinery 24
Aggregate Type	Crsh Limestone + Field Sand	Crsh Limestone + Field Sand + Blow Sand	River Gravel + Sand	Crsh Limestone + Field Sand	Lt wt +conc. Sand + Fld Sand
Asphalt Additives	None	None	None	TexEmuls M-200	Pavebond AP
Thickness	1 3/4-inch	1 1/4-inch	1.6-inch	2-inch	1 1/2-inch
Traffic Data (1980)			(US 281) (SH 107)		
ADT	3,400	7,900	19,500 13,000	14,000	
Percent Trucks	24.1	23.8	3.4 18.2	22	
Equivalent 18D axle loads	5,983	15,468	19,043 1,476	--	
Percent Tandem Axles	90	20	90 40	40	

Table 2. Physical Description of Fabrics Installed in Test Sections (After Reference 2).

Fabric I.D.	Nominal Weight, oz/yd$_2$	Nominal Thickness, mils	Material	Type Construction	Type Filament	Fiber Bonding
Bidim C-22	4	60	Polyester	Nonwoven	Continuous	Needle-punched
Bidim C-34	8	90	Polyester	Nonwoven	Continuous	Needle-punched
Old Petromat	4	--	Polypropylene	Nonwoven	Staple	Needle-punched and heat bonded on both sides
New Petromat	4	--	Polypropylene	Nonwoven	Staple	Needle-punched and heat bonded on one side
Petromat - 8 oz.	8	--	Polyproprylene	Nonwoven	Staple	Needle-punched and heat bonded on one side
Bidim C-28	6	75	Polyester	Nonwoven	Continuous	Needle-punched
Reepav - 3 oz.	3	15	Polyester	Nonwoven	Continuous	Spunbonded and heat bonded
Reepav - 4 oz.	4	17	Polyester	Nonwoven	Continuous	Spunbounded and heat bonded
Crown-Zellerbach	5	60	Polypropylene	Nonwoven	Continuous	Spunbounded and needle-punched
Mirafi 900 X	5	--	Polyester and Polypropylene	Woven	Continuous	Woven

Table 3. Properties of Fabrics as Measured by Texas DHT in Accordance with Specifications in Item 3099 (After Reference 2).

Test Pavement Location	Fabric I.D.	Average Fabric Weight, oz/yd^2	Machine Direction[4] Elongation, percent	Machine Direction[4] Break, pounds	Cross Machine[4] Elongation, percent	Cross Machine[4] Break, pounds	Asphalt Rentention,[2] oz/ft^2	Change in Area,[3] percent
Ozona	Bidim C-22[1]	4.4	85	148	84	128	4.2	0
	Bidim C-34[1]	7.1	91	215	108	211	5.2	0
	Old Petromat[1]	4.2	103	75	65	92	2.2	-2
	New Petromat[1]	4.2	76	121	67	154	3.6	-5
	Petromat - 8 oz.	8.6	78	300+	97	300+	4.9	0
Amarillo	Bidim C-22	--	--	--	--	--	--	--
	Bidim C-34	--	--	--	--	--	--	--
	Old Petromat	4.3	84	91	71	112	2.2	-2.0
	New Petromat	4.3	69	115	82.9	133	3.6	-4.8
	Petromat - 8 oz.[1]	8.4	71	300+	71	300+	4.2	0
Edinburg	Bidim C-22	4.9	95	113	99.8	116	3.6	-2.3
	Bidim C-34	--	--	--	--	--	--	--
	Old Petromat	--	--	--	--	--	--	--
	New Petromat	4.6	104	124	91	186	4.0	-9.0
	Petromat - 8 oz.	--	--	--	--	--	--	--
	Bidim C-28	6.5	83	162	91	113	3.8	0
Tyler	Old Petromat	4.6	90	154	79	110	3.4[1]	0[1]
	New Petromat	4.5	94	81	76	118	2.3[1]	0[1]
	Reepave - 3 oz.	3.0	50	89	59	73	--	--
	Reepave - 4 oz.	4.1	52	116	57	96	1.6	0
	Crown-Zellerbach	5.1	140	117	161	112	3.9[1]	0[1]
	Mirafi 900 X	4.9	58	102	47	76	--	--

1 Only one sample tested.
2 Asphalt required to saturate fabric.
3 Change in area (shrinkage upon exposure to asphalt at 275° F for 60 minutes.
4 Grab tensile test, ASTM D1682

FINDINGS

The four field trials are described in detail in the following paragraphs. They are presented in the chronological order of their installation.

Ozona Tests

An 8.75 mile section of Interstate Highway 10 east of Ozona, Texas, was overlaid with hot mix asphalt concrete (HMAC) in the fall of 1979. Thirteen one-quarter mile (1320 ft.) test pavements were designed and installed to evaluate the comparative ability of fabric interlayers to reduce or delay reflection cracking in an overlay. The geotextiles evaluated included Bidim C22, Bidim C34, Old Petromat, New Petromat, and 8-oz. Petromat. The "control" section contained a conventional seal coat interlayer comprised of AC-5 and precoated grade 3 crushed limestone.

Preconstruction. The existing asphalt concrete pavement structure prior to overlaying is briefly described in Table 1. Transverse, longitudinal, and alligator cracking was prevalent in the travel lane for the entire length of this project. The most severe cracking was in the right wheelpath of the westbound travel lane which was also displaced downward in certain areas. This displacement was apparently due to severe pumping which removed a significant volume of base material. There was very little cracking in the westbound (WB) passing lane. There was significantly less cracking in the eastbound (EB) lanes than in the WB lanes. Although total traffic volume on this roadway is rather low, the percentage of trucks is quite high (Table 1).

Prior to application of the overlay, the cracking patterns in three representative 100 foot segments of pavement within each test section were carefully mapped by hand. These crack maps were later used to determine the extent of reflection cracking.

Construction. After patching the existing pavement to repair localized failures, a predetermined quantity of asphalt tack (AC-20) was applied to the pavement surface. A small tractor with special attachments was used to apply the fabric to the tacked pavement within 2 to 20 minutes after the asphalt tack was applied. A pneumatic roller was employed to ensure good bond between the fabric and the pavement surface. Transverse fabric joints were typically overlapped 6 inches and tacked with emulsified asphalt. Following a light application of sand, the test sections were opened to traffic for a period of one to three weeks. An HMAC overlay was placed on each test section at a rate of approximately 180 pounds per square yard (about 1 3/4 inches compacted thickness).

Soon after application of Bidim C22 and C34, they were observed to "fluff up" due to the action of traffic. It appeared that the tires became sticky due to tracking in asphalt sprayed outside the edge of the fabric or asphalt which bled through the fabric. The sticky tires subsequently pulled up the fibers near the surface of the fabric, thus giving the fluffed appearance. The continuous filament Bidim products were most susceptible to this phenomena, but a notable quantity of fibers were completely removed from all the fabrics and deposited alongside the roadway. After a few hours and a light application of sand, the fabric was once again pressed flatly onto the pavement surface by traffic.

Visual inspection during construction showed that New Petromat did not slip as much under the wheels of the pneumatic roller as did the Old Petromat. This was particularly noticeable when utilizing the pneumatic roller on a grade. Old Petromat was manufactured with a "glaze" (thermally bonded) on both sides of the fabric; whereas, New Petromat has the glaze on one side and is "fuzzy" on the other side. The fuzzy side was designated by the manufacturer to be placed next to the asphalt tack on the old pavement surface to reinforce adhesion at the interface during construction. The fuzzy side provides a greater effective surface area of the fabric which offers better adhesive and shear strength. This field observation is supported by laboratory shear test results reported by Button et al (8).

Blisters in one fabric, up to approximately 6 inches in diameter, were observed in one isolated area (not in a test section). This segment of fabric was installed on a surface-dry pavement shortly after a shower. It is postulated that moisture in small crevices in the pavement was sealed in by the fabric-asphalt membrane. The trapped moisture was later vaporized due to heating by the sun on the dark fabric surface, thus forming the blisters. The blisters were slit to allow the vapors to escape and pressed down prior to application of the HMAC overlay.

Post Construction. By February of 1980, after a severe winter, a few transverse cracks had appeared in the shoulder in certain areas of the eastbound travel lane. The cracks did not continue into the travel lane. No fabric was installed in the shoulders. It was therefore, reasonable to assume that the fabrics and the seal coat were delaying reflection cracking. However, other observations have indicated that the kneading action of traffic will delay the appearance of reflected transverse cracks. Cracks began to appear in the travelway about 3.5 years after construction.

Transverse, longitudinal, and total reflection cracking computed as a percentage of the original cracks of similar type were plotted as a function of time for the 10-year evaluation period. These data were collected in three representative 100-foot segments of pavement in the WB and EB lanes. These plots are shown in Figures 2 through 7. In the WB lanes, the Petromat products most often exhibited the best resistance to reflective cracking; however, their performance is not a notable improvement over that of the seal coat interlayer or the Bidim products. Although little cracking has occurred to date in the EB lanes, the seal coat interlayer is outperforming the fabrics interlayers. Observations after rainfall indicate the fabrics may be reducing pumping well after cracks appear at the pavement surface.

Amarillo Tests

A 13.2 mile section of Interstate Highway 40 near Vega, about 25 miles west of Amarillo, Texas, was overlaid with HMAC in the summer and fall of 1979. An area containing eight 1/4-mile test sections was designated as a field trial to evaluate five different geotextiles (Table 1). The existing pavement was asphalt concrete. Different fabric combinations were placed in the EB and WB lanes.

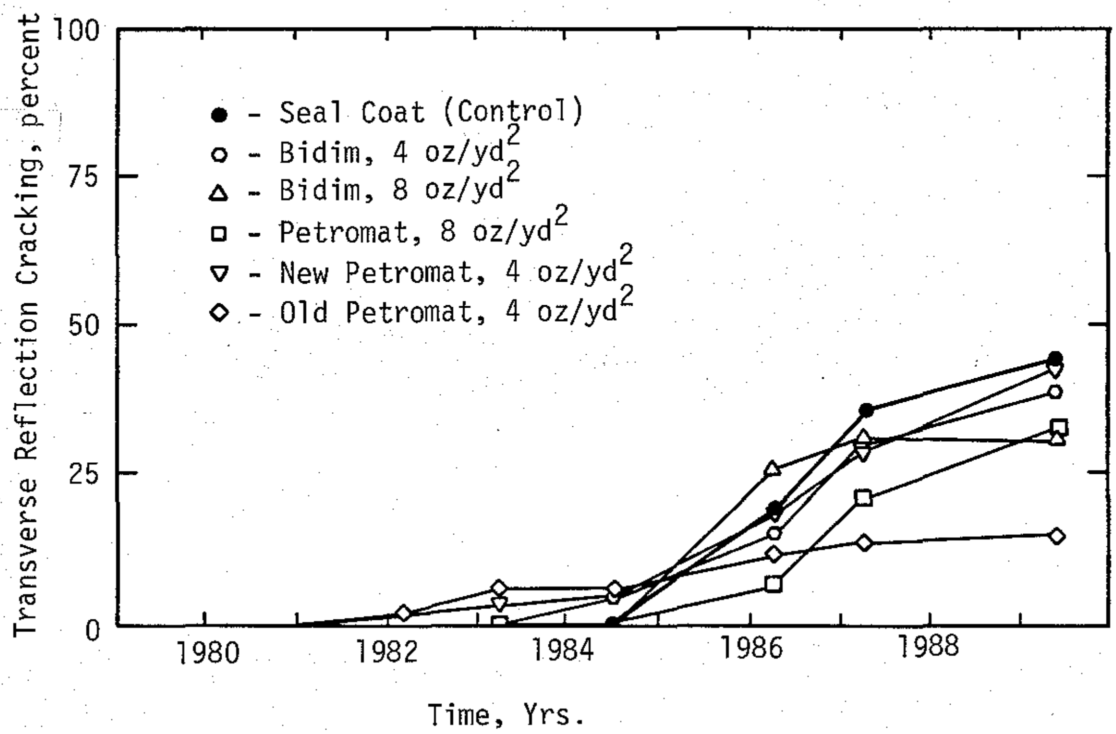

Figure 2. Percent Transverse Reflection Cracking as a Function of Time for Westbound Test Pavements on IH-10 Near Ozona, Texas.

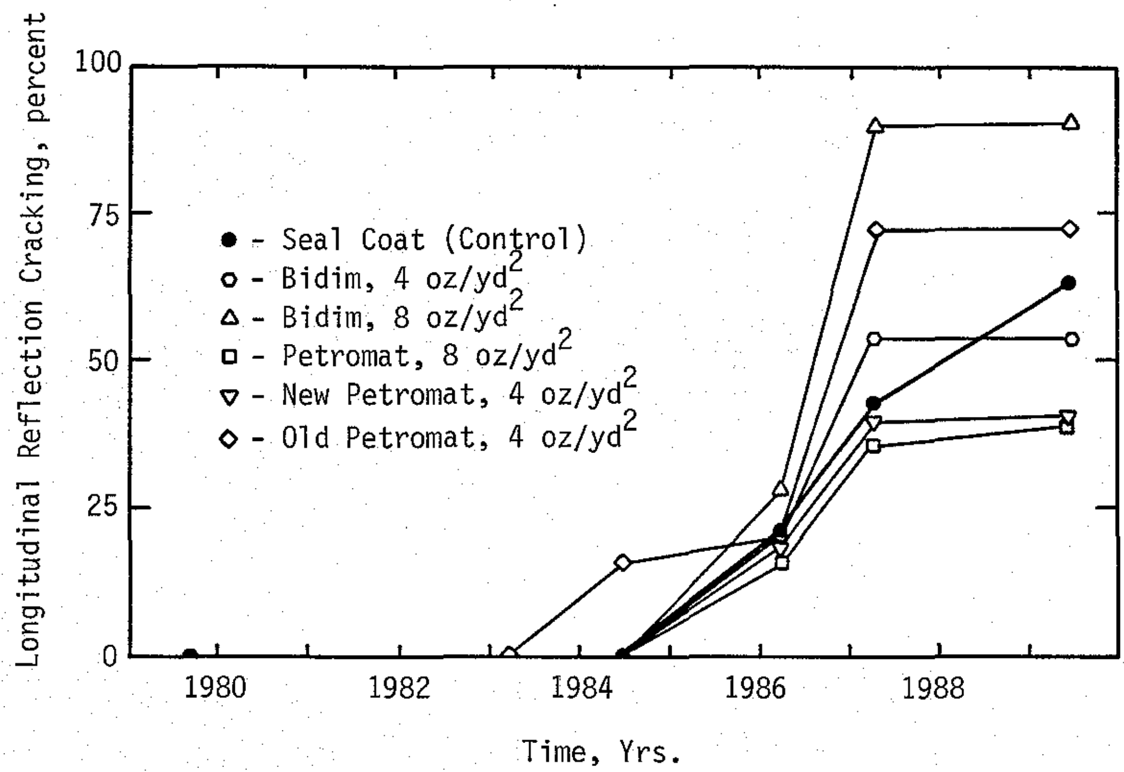

Figure 3. Percent Longitudinal Reflection Cracking as a Function of Time for Westbound Test Pavements on IH-10 near Ozona, Texas.

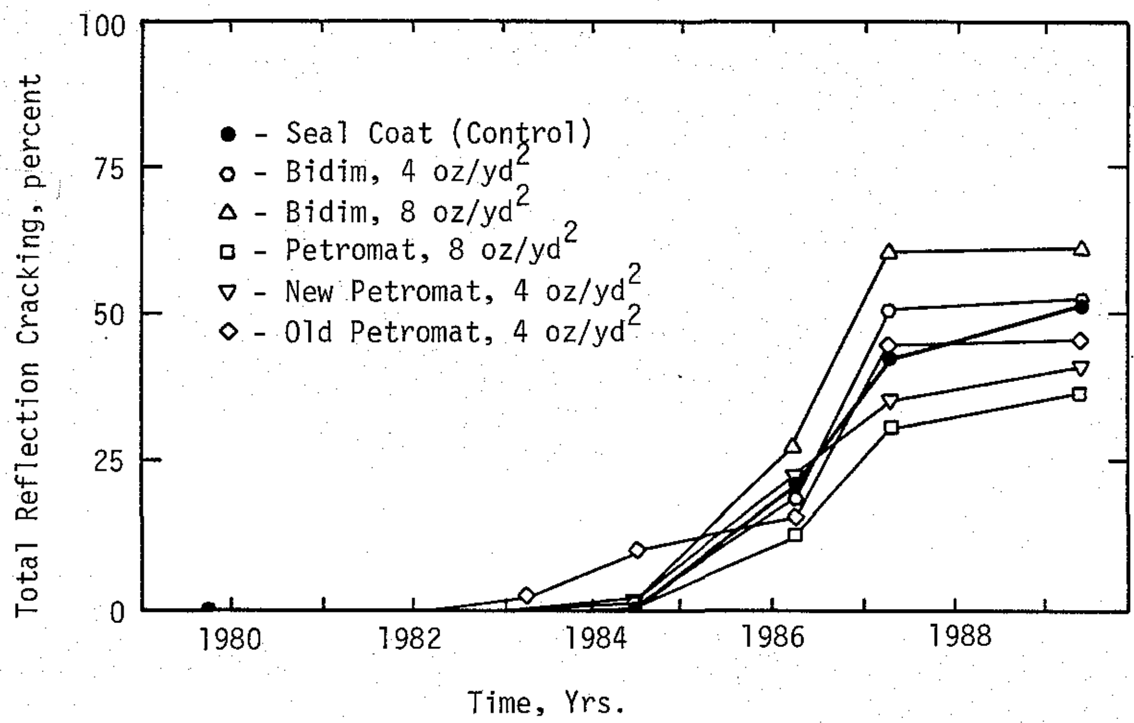

Figure 4. Percent Total Reflection Cracking as a Function of Time for Westbound Test Pavement on IH-10 Near Ozona, Texas.

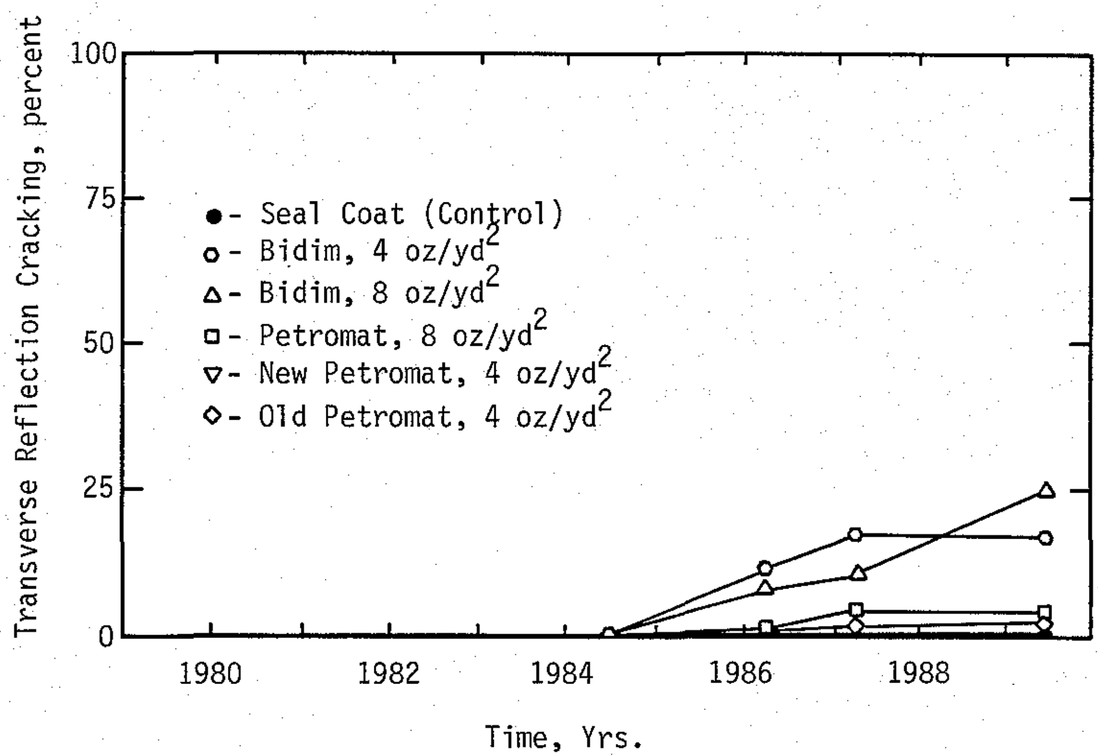

Figure 5. Percent Transverse Reflection Cracking as a Function of Time for Eastbound Test Pavements on IH-10 near Ozona, Texas.

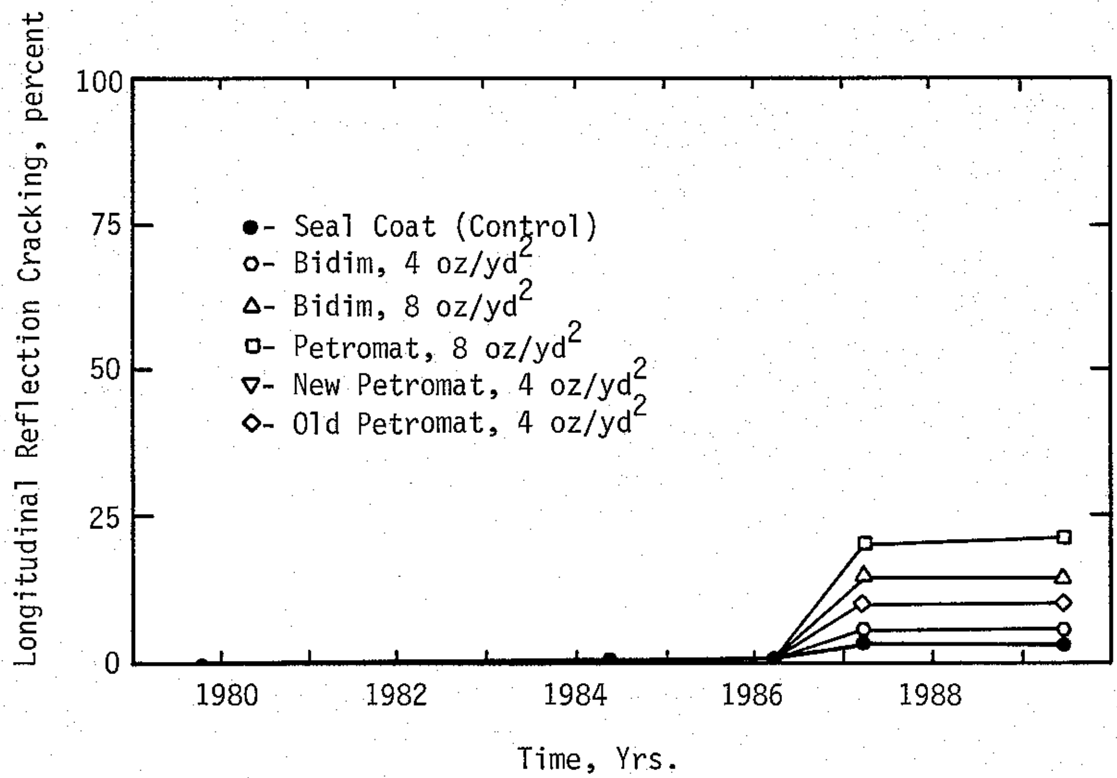

Figure 6. Percent Longitudinal Reflection Cracking as a Function of Time for Eastbound Test Pavements on IH-10 near Ozona, Texas.

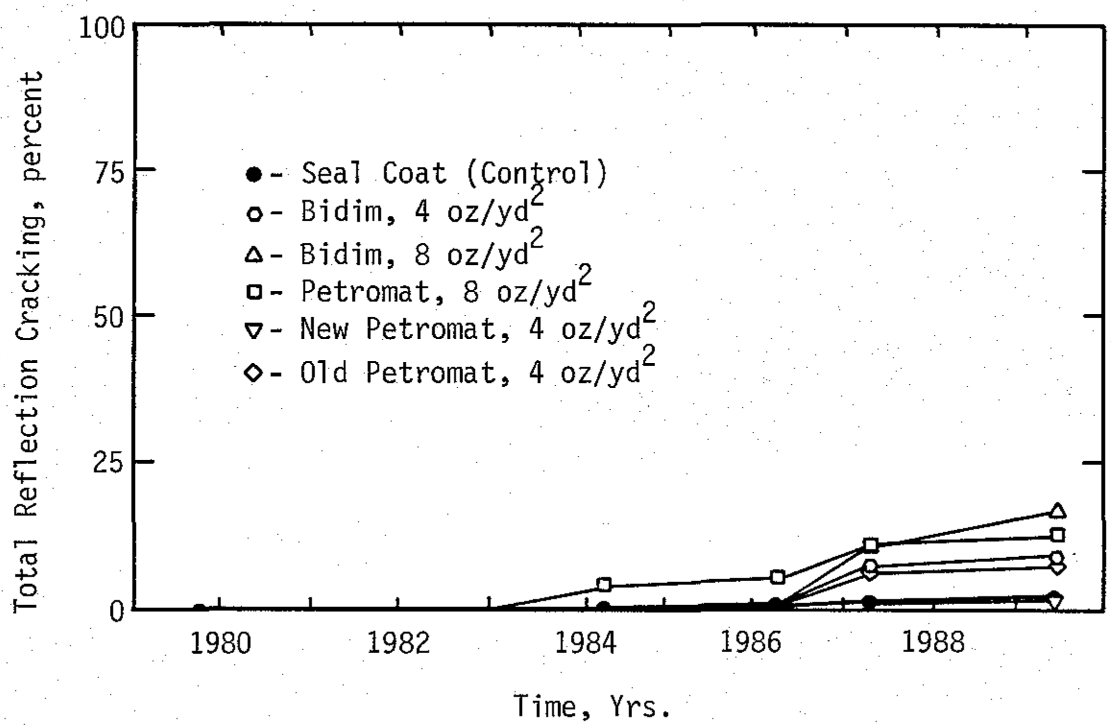

Figure 7. Percent Total Reflection Cracking as a Function of Time for Eastbound Test Pavements on IH-10 near Ozona, Texas.

Preconstruction. In the summer of 1978, a seal coat was applied using Grade 3 precoated crushed stone. This construction project was not designated as a field trial for this study until after the seal coat was placed. Consequently, the researcher was unable to record the location of the cracks in the existing pavement. However, verbal communication with the District Construction Engineer and an exhaustive series of photographs prepared by Texas DHT personnel revealed that, originally, there was considerable fatigue cracking in the travel lane with some thermal (transverse) cracking and moderate rutting throughout the project.

There was concern about placing the fabrics directly on this abrasive surface, since the action of traffic during construction in conjunction with the highly textured surface might damage the fabric. Therefore, a level-up course of HMAC was placed in May, 1979.

Construction. The fabrics and HMAC overlay were placed in September, 1979 about 4 months after the level-up course. Fabric was applied to both the travel and the passing lanes following application of an appropriate quantity of asphalt tack (AC-10). The fabric was rolled using a pneumatic roller. It was noted during construction that the thick fabrics (8 oz/yd^2) were installed with significantly less wrinkles than similar thinner fabrics (4 oz/yd^2). Fabric construction joints were tacked using a slow setting anionic emulsion. After applying sand to the fabric surface, to aid in absorbing excess asphalt tack, the roadway was opened to traffic. Soon after the areas containing Bidim C22 and C34 were opened to traffic, the fabrics were observed to "fluff up," as previously reported. The fabrics were exposed to traffic for 2 to 7 days before placing the HMAC overlay. The overlay was placed on each section at 125 pounds per square yard (about 1.25 inches). Control sections contained only a light tack between the level-up and the final overlay.

Post Construction. Three 100-foot segments of pavement in each test section have been monitored periodically to evaluate the ability of the fabrics to reduce cracking. After seven months in service, following the severe winter of 1979-80, a visual evaluation revealed a considerable quantity of cracks. Figures 8 through 13 show the cracks have continued to grow but at a slower rate. Since original crack patterns were not recorded, only crack length is shown in the figures and not percentage refection cracking. In 1985, the pavements were heater scarified to a depth of 0.75 inches, an asphalt rubber seal consisting of 0.65 gallons per square yard of binder and 1 cubic yard of grade 3 precoated aggregate per 75 square yards of surface was applied, and then overlaid with 2 inches of Type D HMAC.

Prior to the maintenance activity in 1985, the control pavements exhibited about the same or less cracking than the sections containing a fabric. After the maintenance activity in 1985, the control pavements, on the average, exhibited more cracks in the new surface than the pavement sections containing a fabric. However, in most cases, the differences in crack lengths between the different sections are not considered to be significant. (The nature of these data did not lend itself to a formal statistical analysis). In these tests, the 8-ounce-per-square-yard products exhibited the best resistance to cracking in the overlay applied in 1985 but not in the original overlay. No single type of fabric consistently improved resistance to cracking throughout the 10-year evaluation period.

Observations within a few days after rainfall and snowfall indicate the fabrics reduce pumping which implies that several years after cracks appear the asphalt impregnated fabric is acting as a moisture barrier. Admittedly, these observations of pumping have been sporadic and may be biased since the observer knew where the fabrics were located.

Edinburg Tests

In February, 1980, seven geotextile test pavements and a control section were installed on US 281 and SH 107 in the downtown area of Edinburg, Texas.

Preconstruction. Prior to construction, 1 3/4 to 3 inches of the existing asphalt concrete were removed by cold milling to preserve the curbline. The resulting surface texture was quite rough. Cracking patterns visible at the pavement surface prior to milling were mostly of the fatigue

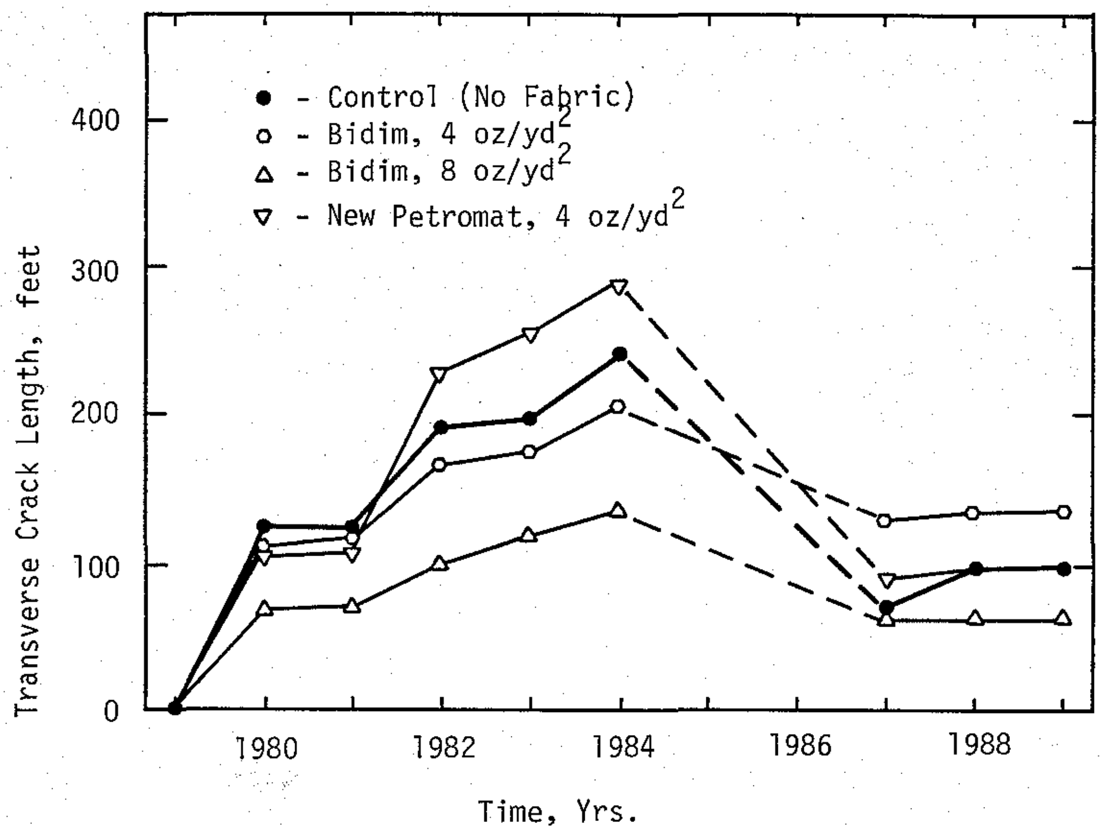

Figure 8. Length of Transverse Cracks in Eastbound Lanes as a Function of Time - IH 40 near Amarillo, Texas (600 lane feet).

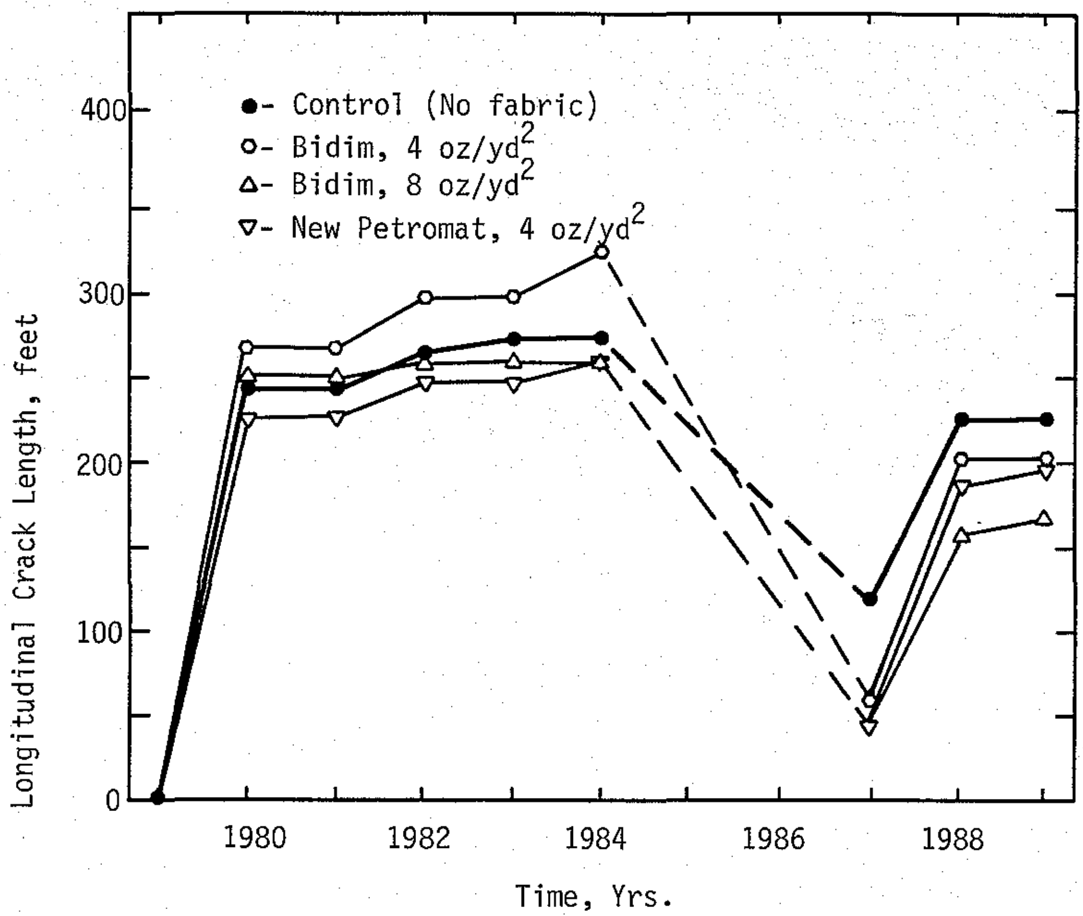

Figure 9. Length of Longitudinal Cracks in Eastbound Lanes as a Function of Time - IH 40 near Amarillo, Texas. (600 lane feet).

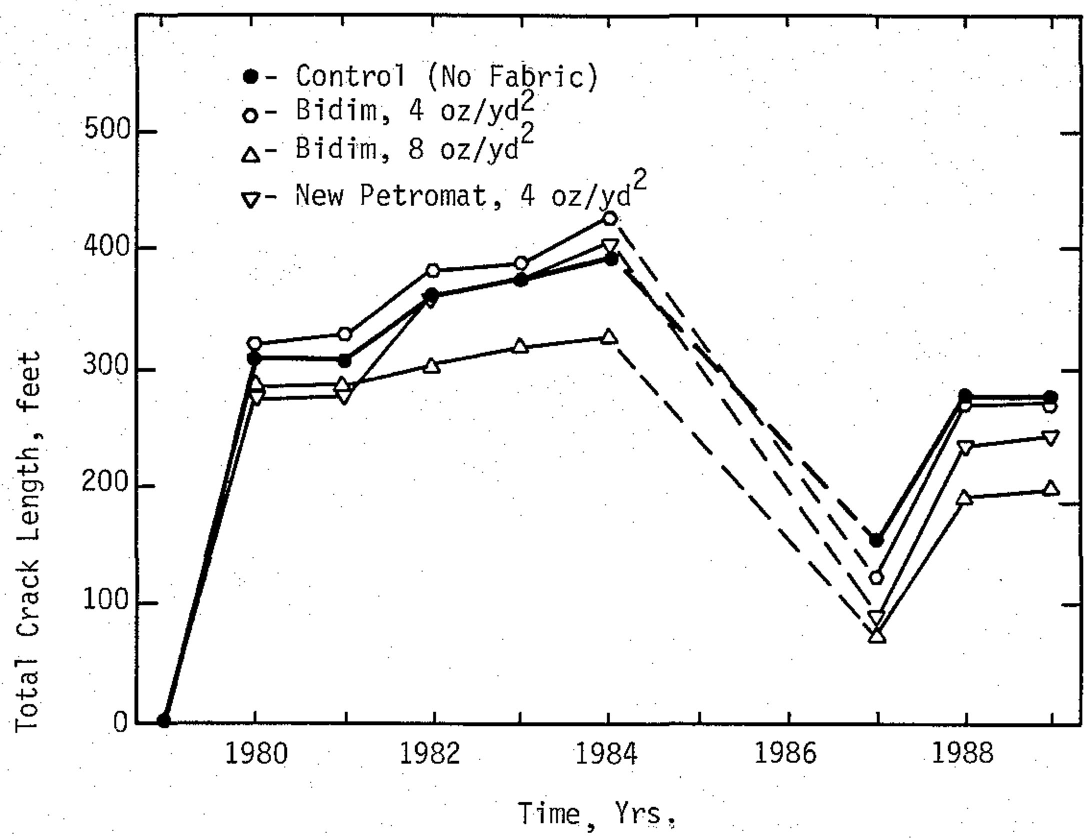

Figure 10. Total Crack Length in Eastbound Lanes as a Function of Time - IH 40 near Amarillo, Texas. (600 lane feet).

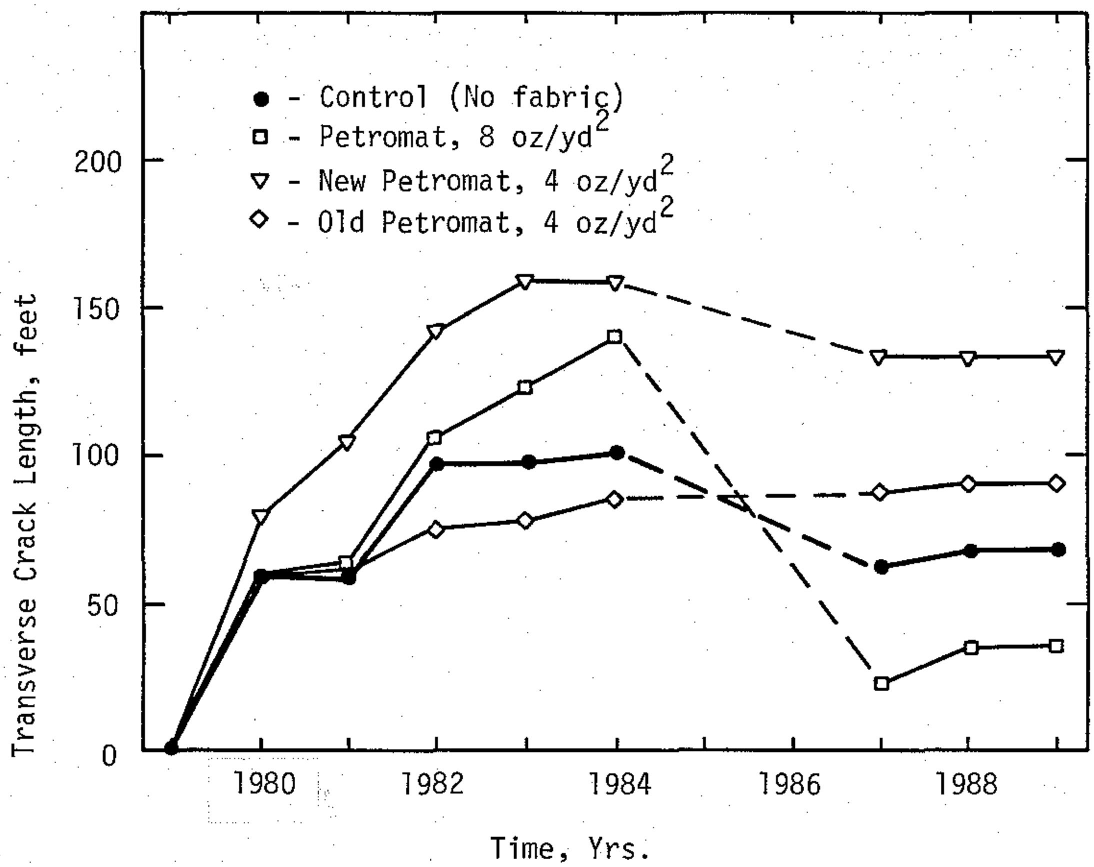

Figure 11. Length of Transverse Cracks in Westbound Lanes as a Function of Time - IH 40 near Amarillo, Texas (600 lane feet).

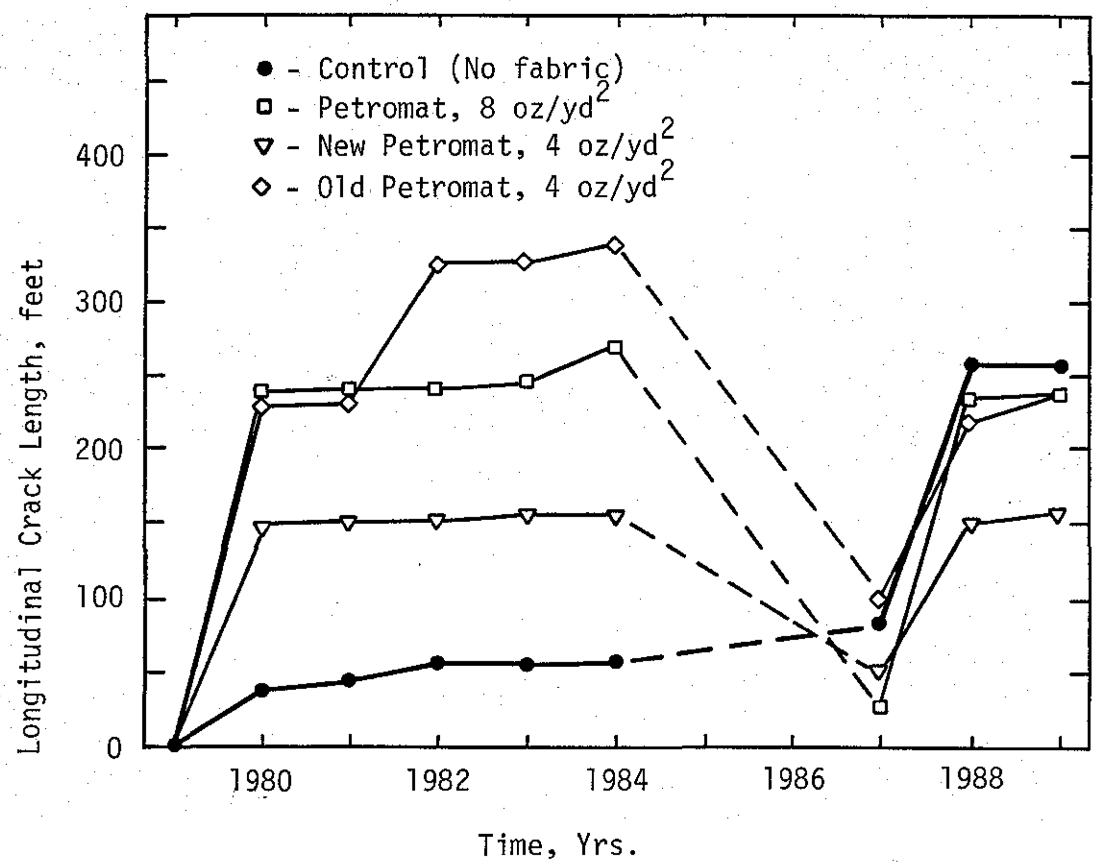

Figure 12. Length of Longitudinal Cracks in Westbound Lanes as a Function of Time - IH 40 near Amarillo, Texas (600 lane feet).

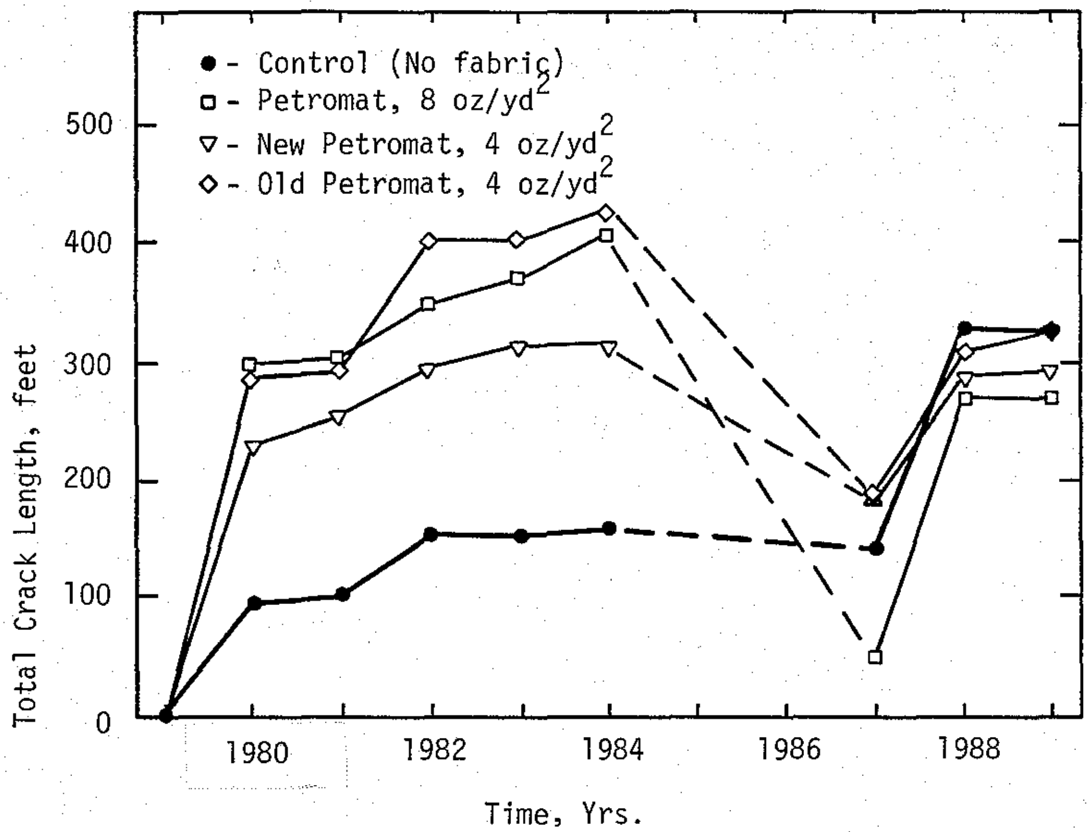

Figure 13. Total Crack Length in Westbound Lanes as a Function of Time - IH 40 near Amarillo, Texas (600 lane feet).

variety with some transverse cracks in isolated areas. Cracking patterns were extremely variable from one location to another and ranged in intensity from almost none in a 100-foot length to continuous, severe alligator cracking in one or both wheelpaths. There was evidence of rutting and pumping in isolated areas. Cracking patterns were no longer visible after the milling operation.

Construction. Since the test sections are located in an urban area, they are exposed to a considerable quantity of shear forces produced by acceleration, deceleration and turning movements of traffic. The fabrics were applied curb to curb directly onto the highly textured milled surface after application of predetermined quantities of an asphalt tack coat (AC-10). The fabrics were exposed to traffic for periods ranging from one day to two weeks. Fluffing of the fabrics due to traffic was again observed.

An HMAC overlay was placed on each test section at a rate of 160 pounds per square yard (about 1 5/8 inches in thickness after compaction). Seven 1500-foot test sections containing a fabric and one 385-foot control section containing no fabric were built.

Due to heavy, prolonged rainfall immediately after application of certain fabrics, it became necessary to replace the fabric in a few areas prior to application of the HMAC overlay.

Post Construction. Minor cracking began to appear within 3 months after construction. Initially, pavement distress appeared as longitudinal cracks and block or alligator cracking in or near the wheelpaths thus indicating their association with traffic loadings and insufficient base stiffness. Low stability of the river gravel overlay mixture led to plastic deformation to the extent that the overlay was milled off and replaced in 1985, thus terminating the experiment.

Annual inspections of the test pavements were performed from 1980 to 1984 to quantify pavement distress. Cracks were mapped and compared to the cracking patterns in the original pavement surface. Most of the cracking that appeared was confirmed to be reflection cracking. Figures 14 through 17 show percent reflection cracking as a function of time for longitudinal,

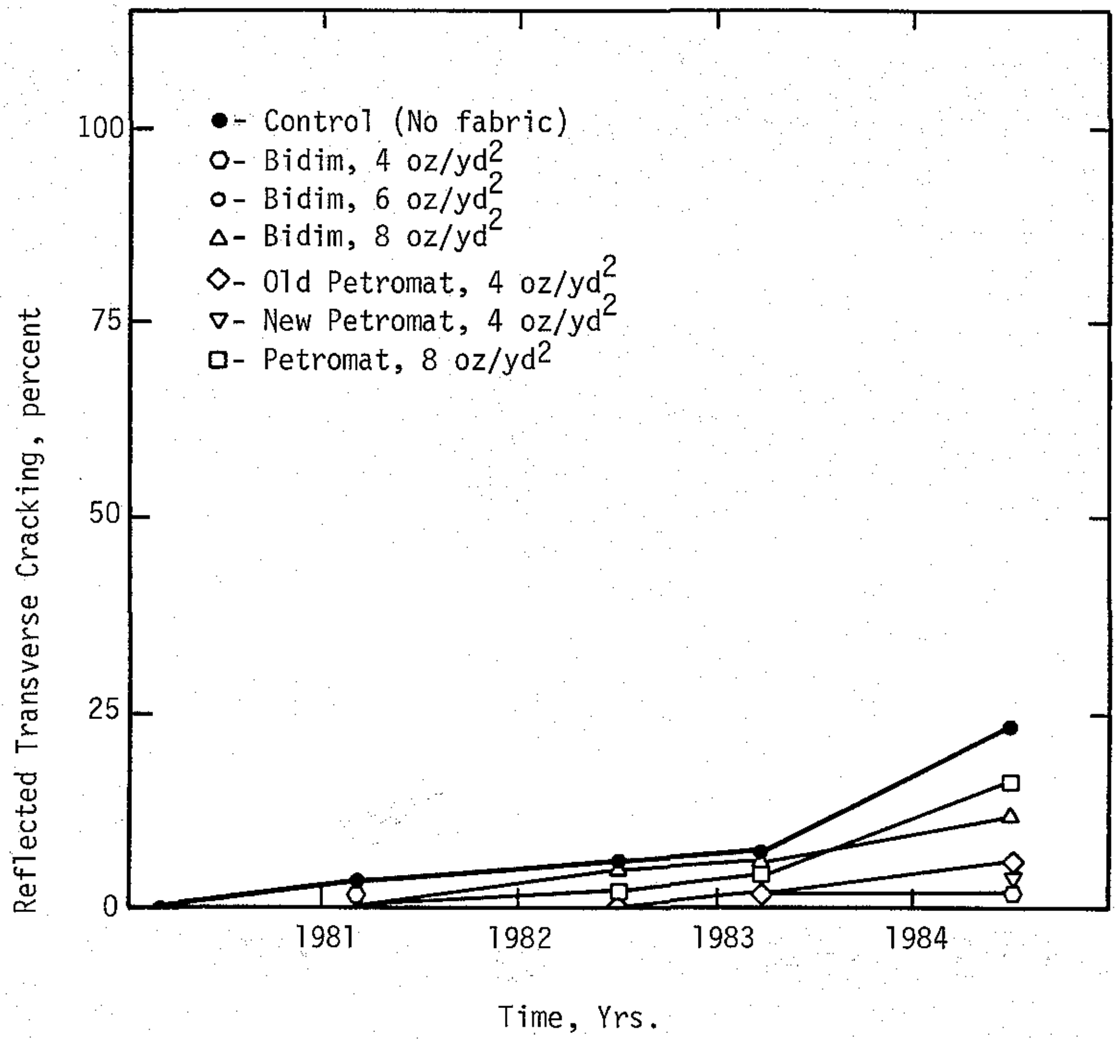

Figure 14. Length of Transverse Reflection Cracking as a Function of Time for Pavements in Edinburg, Texas.

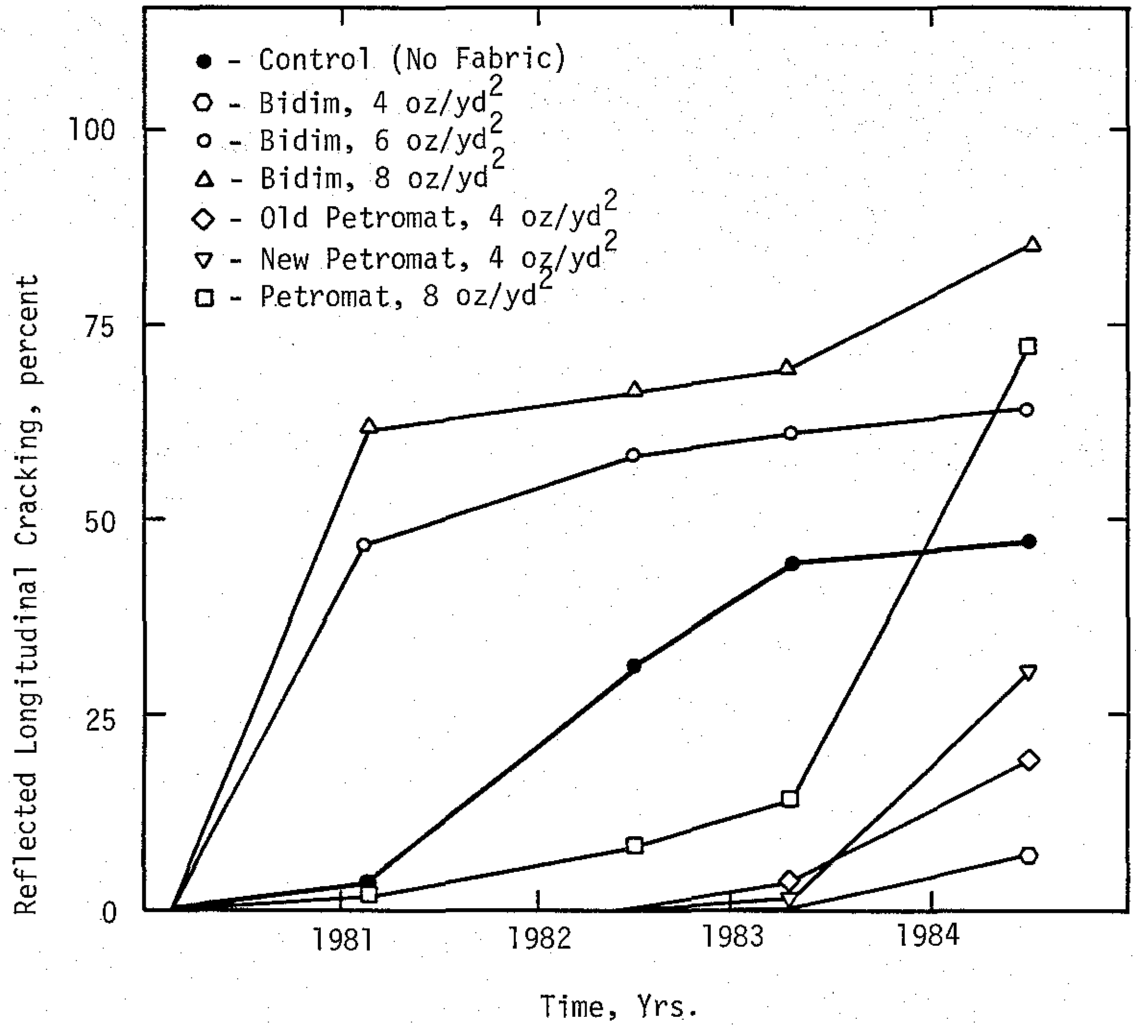

Figure 15. Length of Longitudinal Reflection Cracking as a Function of Time for Pavements in Edinburg, Texas.

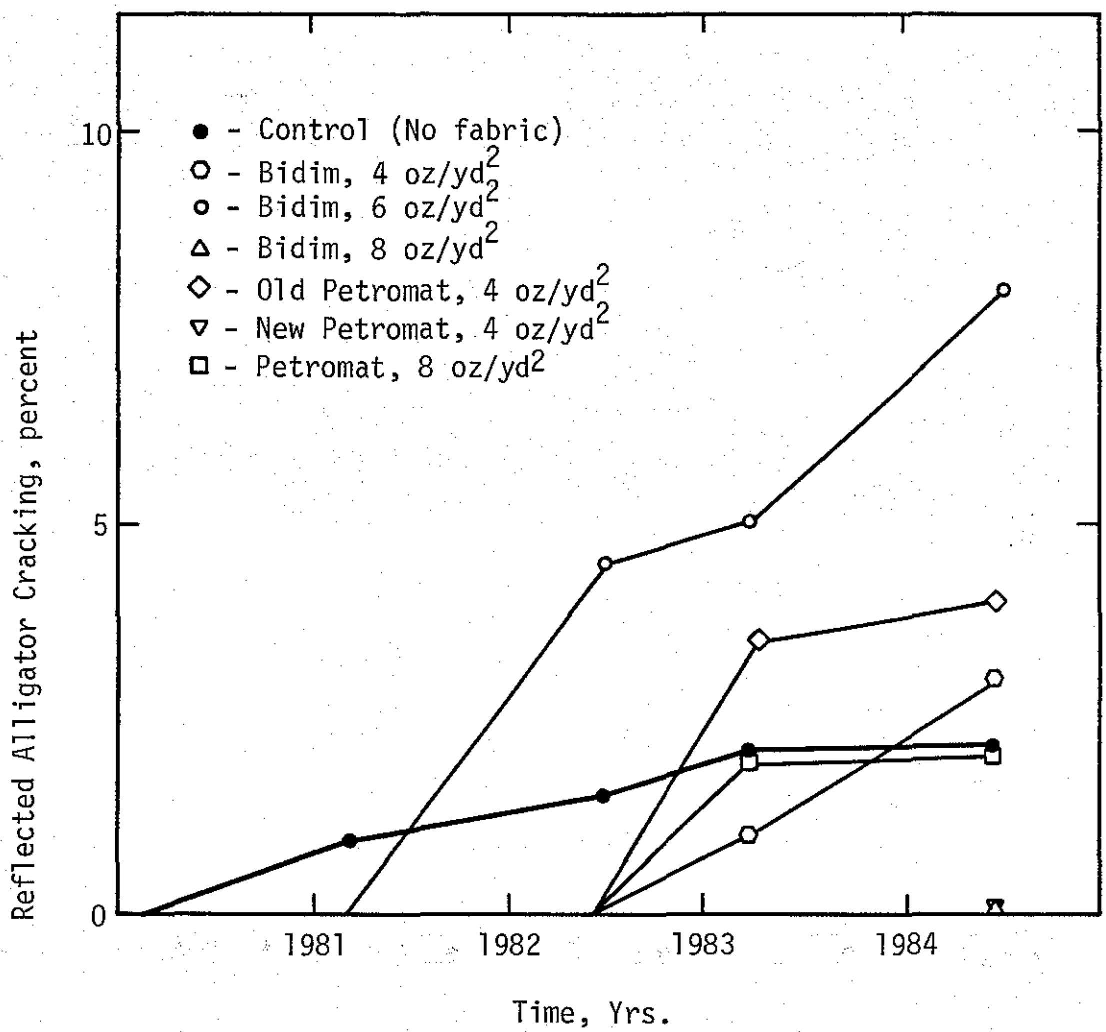

Figure 16. Length of Reflected Alligator Cracking in a Wheelpath as a Function of Time for Pavements in Edinburg, Texas.

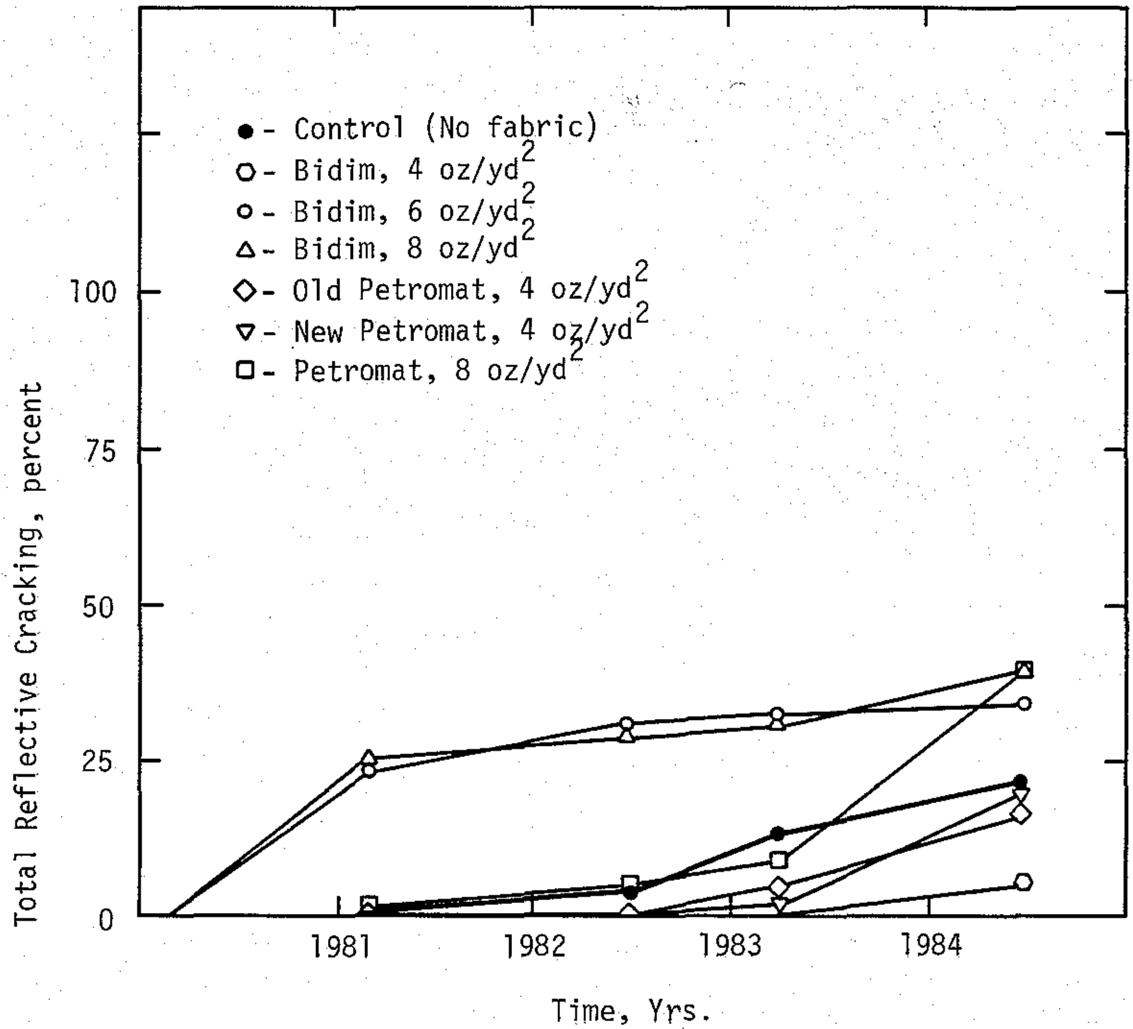

Figure 17. Total Reflected Cracking as a Function of Time for Pavement Test Sections in Edinburg, Texas.

transverse, alligator, and total cracking, respectively. These data indicate that, overall, Bidim C-22 (4 ounce per square yard) exhibited the best resistance to reflection cracking. In fact, all the 4-ounce fabrics outperformed the heavier fabrics. By comparison to the control section, the fabrics resisted transverse cracking better than they resisted longitudinal or alligator cracking. Fabrics, in general, did not consistently reduce or delay reflection cracking better than the control section which contained no interlayer.

Tyler Tests

This project consisted of the repair of continuously reinforced portland cement concrete (CRCP) and placement of a geotextile interlayer with two lifts of HMAC (2-inch Type D over 1½-inch Type B) on IH 20 near Tyler, Texas. Seven 0.25 mile geotextile test pavements were installed on a portion of this project in July, 1981.

Preconstruction. The original CRCP was constructed in 1965. Transverse cracks spaced, on the average, about 3.3 feet apart were prevalent throughout this project. In the most severely cracked areas, particularly those exhibiting substantial vertical movement upon loading, the concrete was completely removed and replaced with new reinforced concrete.

Construction. A specified quantity of asphalt tack (AC-20) was applied to the pavement surface. Fabrics were installed in the usual manner using a small tractor with special attachments. Both the traveled roadway and the shoulders were covered. Fabric construction joints were tacked at the overlap using hot AC-20. The fabrics were typically overlapped about 6 to 8 inches. Two passes of a pneumatic roller ensured good adhesion of the fabric to the pavement surface. The fabrics were not exposed to traffic.

Post Construction. Annual observations for 6 consecutive years revealed only a few isolated transverse reflection cracks (about 1 per 500 feet) dispersed uniformly throughout the test pavements without regard to the type or presence of fabric. The overlay system performed reasonably satisfactorily in arresting reflection cracking, but apparently the fabrics were unnecessary in this instance. In the summer of 1987, major maintenance activities to address rutting included milling from 0 to 1 inch off the pavement surface in the travel (outside) lane and overlaying with about 1 inch of HMAC. Annual evaluations were terminated at that time.

ECONOMIC OVERVIEW

Cost information supplied by district personnel and based on contractor bid prices is presented in Table 4. From these data (1), an overall average cost for furnishing and placing a 4 ounce per square yard fabric interlayer is about $1.10 per square yard including asphalt tack. At the writing of this report, the costs of fabric and asphalt cement are about the same as the 1980 values, but the cost of labor is considerably greater.

Based solely on the data obtained from the fabric test pavements evaluated herein, it appears that fabrics cannot be considered consistently cost-effective measures for reducing or delaying reflection cracking in asphalt concrete overlays. Unfavorable results have also been reported in Pennsylvania (9), Maryland (10), Minnesota (11), California (12), Vermont (13), Colorado (14), Arizona (15), Maine (16), North Carolina (17), Wyoming (18), North Dakota (19) and Louisiana (20). In all fairness to fabrics, it should be pointed out that favorable results have been reported in Georgia (21), California (22), Iowa (23), Texas (24), Colorado (25), Florida (26) and Virginia (27). Although results were considered favorable, few stated that fabrics were cost-effective in reducing or delaying reflective cracking.

Fabrics may have other advantages which were not evaluated in this study, such as service as a moisture barrier even after pavement cracking occurs. Evidence shortly after precipitation at Amarillo and Ozona indicated that the fabrics may reduce pumping. Unpublished data from test pavements near Brady, Texas, gave similar indications. These findings are supported by the literature (27, 28 and 29). For these test pavements, the difference in pumping between the sections with and those without fabric was not enough to consider the fabrics cost-effective for reducing pumping.

Table 4. Approximate Costs Associated with Fabric Interlayers and Comparative Costs of (1) Additional 1 inch Overlay and (2) Conventional Seal Coat (Based on 1980 contractor bid prices).

Item	Ozona	Amarillo	Edinburg	Tyler
Fabric & Placement	0.84	1.10	1.09	0.50
Tack Coat (@ 0.25 gal/yd^2)	0.19	0.24	0.19	0.25
Fabric Placement Only (Labor)	--	--	0.39	--
Total Fabric Installation	1.03	1.34	1.28	0.75
Additional 1 in. of Overlay	1.69	2.00	1.20	1.73
Conventional Seal Coat	0.77	0.65	0.39	0.85

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Based solely on the results of this study of the four field trials described herein, the following conclusions and recommendations are provided.

1. After up to ten years in service, no fabric type consistently showed significant improvements in resistance to reflective cracking over another fabric, a seal coat, or no fabric at all.

2. Generally, the application of a fabric does not appear to be cost-effective in reducing or delaying reflection cracking. Maintenance activities such as crack sealing, heater scarification, and/or overlaying to address surface cracks were required for fabric treated and untreated pavement sections after the same period of service.

3. Fabrics usually remain intact even after moderate cracking appears at the pavement surface. Therefore, an asphalt impregnated fabric may aid in reducing the flow of surface water into the base and thereby reduce "pumping." A comprehensive laboratory and field research effort should be initiated to evaluate the economic benefits of this attribute of fabrics when placed over pavements with pump-susceptible bases.

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