Sealing Cracks in Bituminous Overlays of Rigid Bases

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ABSTRACT

The objective of this project was to evaluate the effectiveness of seven polymer, rubber, or fiber-modified asphalt sealants and two asphalt emulsion sealants in sealing cracks in a bituminous concrete overlay on a rigid base. These nine sealants were compared with a filled asphalt cement, Pennsylvania Department of Transportation Class J-1. The sealants were observed to determine the effects of crack preparation, application methods, weather, and traffic on their performance. Inspections were conducted during different seasons to determine the condition of the sealants under weather extremes. The results of these inspections indicated that three sealants--Prismoseal A-2, AC-20 with Fibre-Pave, and AC-20 with rubber--performed significantly better than the remaining seven sealants and will be adopted for use in Pennsylvania. In addition, Superseal IIIA and Sof-Seal LM were recommended for further evaluation in sawn joints. H-1 with rubber, E-3, and CRF were not recommended for use because their performance, although satisfactory, was not outstanding.

The objective of this project was to evaluate the effectiveness of seven polymer, rubber, or fiber-modified asphalt sealants and two asphalt emulsion sealants in sealing cracks in a bituminous concrete overlay on a rigid base. These nine products were evaluated in comparison with a mineral-filled asphalt cement sealer, Pennsylvania Department of Transportation (PennDOT) Class J-1, which is a high-flow material, is tracked away from the crack by traffic, and is brittle in cold weather.

The experimental products were to be observed for a period of 36 months in an effort to do the following:

1. Compare the performance of the nine sealants with that of Class J-1 sealer;
2. Compare the performance of field blends of granulated rubber with AC-20 and H-1 and the prepackaged rubber or asphalt sealants;
3. Compare the effects of temperature extremes on the performance of the various products;
4. Determine whether the hot compressed air (HCA) lance improves the sealant bond;
5. Determine whether it is necessary to rout the cracks before the sealants are placed;
6. Determine whether the use of the squeegee improves the sealant performance;
7. Determine whether these materials are extruded by pavement movement;
8. Determine whether the materials are displaced by traffic;
9. Evaluate the overband method of crack sealing, as demonstrated by Prismo Universal Corporation;
10. Compare the performance of Class E-3 (CRS-2) asphalt emulsion with that of a proprietary emulsion formulated specifically as a crack sealant; and
11. Compare material and application costs.

PROJECT LOCATION

The project was located on Trunk Route 415 between Dallas and Harvey's Lake, Luzerne County, Pennsylvania (Figure 1). Sealing operations were performed between Station 1245 in Harvey's Lake and Station 1349 approximately 1 mi north of Dallas. Sealants were applied in the transverse cracks of the two outer lanes of the three-lane pavement (Figure 2). The longitudinal joints between the outside lanes and the center passing lane were also sealed. Seven of the sealants were applied in April 1981 and the remaining three sealants were placed in October 1981.

PREPARATION OF CRACKS

In the past, when cracks were filled with Class J-1 material, no crack preparation was performed by PennDOT. All materials used on this project except the Class E-3 and CRF emulsions, which can be applied to damp surfaces, require the cracks to be clean and dry.

Except for a short portion of Section 5, all cracks were routed by using a Crafco router to create a reservoir for the sealant at the top of the crack. This allowed more sealant material to be placed in the crack and to spread over a thicker cross section (1). The cracks were then brushed with a Crafco power brush and blown clean with a low-pressure backpack air blower. The surface of the routed area remained granular and dusty after the low-pressure air was used.

Prismo Universal Corporation introduced a material from England, Prismoseal A-2, that did not require routing. The crack was heated and blown clean with hot compressed air (HCA) at 3000°F and 3,000 fps. This procedure heated the bituminous concrete and flushed a small quantity of free asphalt to the surface along the crack. A clean, tacked surface was provided for the crack sealant material, which was placed by overseal banding, or using a metal box with a cutout to spread the approximate width and depth of 2 x 1/8 in.

Moisture was a problem on this project because of frequent rain showers. Application of the sealants was delayed until the pavement had lost some of its moisture, but the pavement was deemed not sufficiently dry when portions of Sections 2 and 3 were placed. A torch was then used on Section 3 to further dry the cracks. A leaking sewer line permitted water to flow up through the pavement in portions of

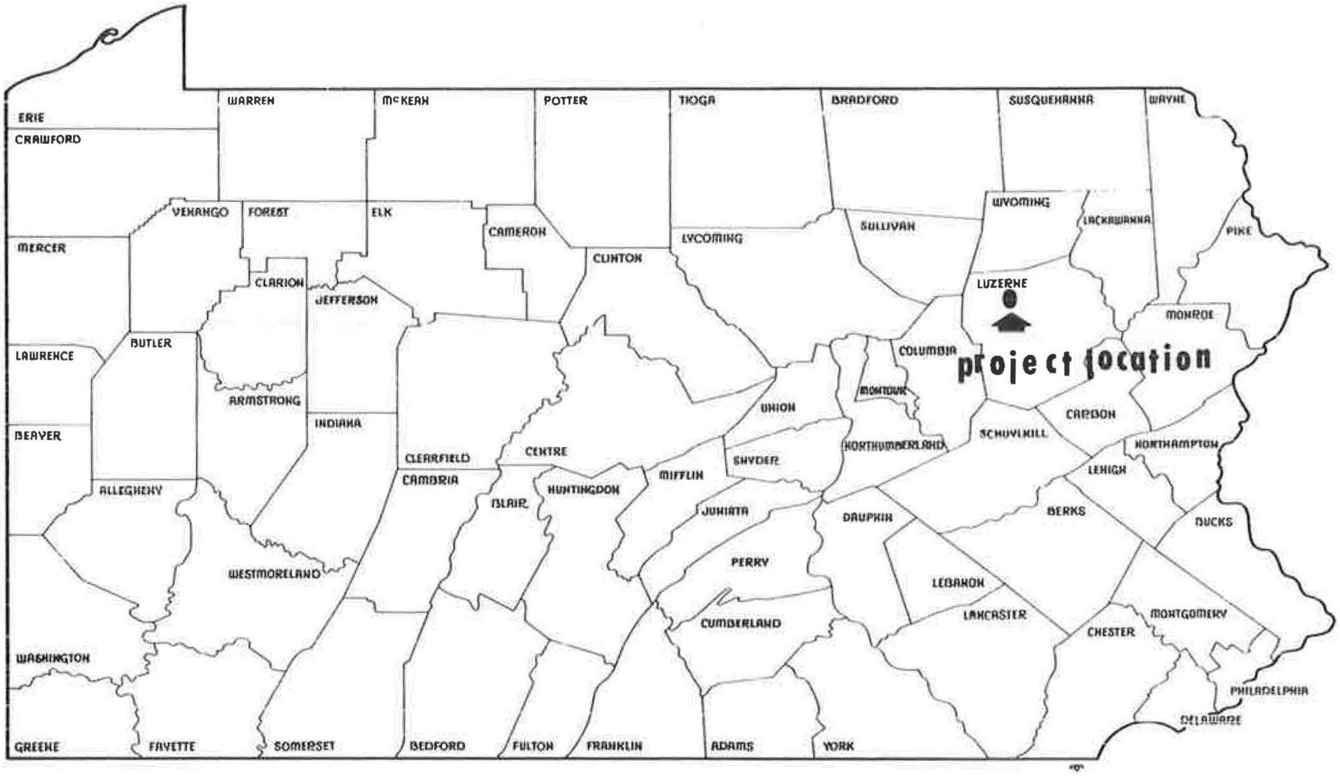

FIGURE 1 Location map.

Sections 3 and 5. These portions were sealed but were excluded from the area to be evaluated.

APPLICATION AND MATERIAL DESCRIPTION

Hot-poured sealants were applied from double boiler heating kettles and were pumped through an application wand directly into the crack and then smoothed with a squeegee. A small portion of Section 4 was placed without the squeegee operation to determine whether this procedure was necessary when Sof-Seal LM crack sealer was applied. The squeegee promoted the bond between the sealer and pavement and lowered the surface of the sealant below the pavement level, thus preventing the sealer from being affected by tires and snowplow blades. Prismoseal A-2 and AC-20 with Fibre-Pave were placed with special applicators and did not require squeegeeing.

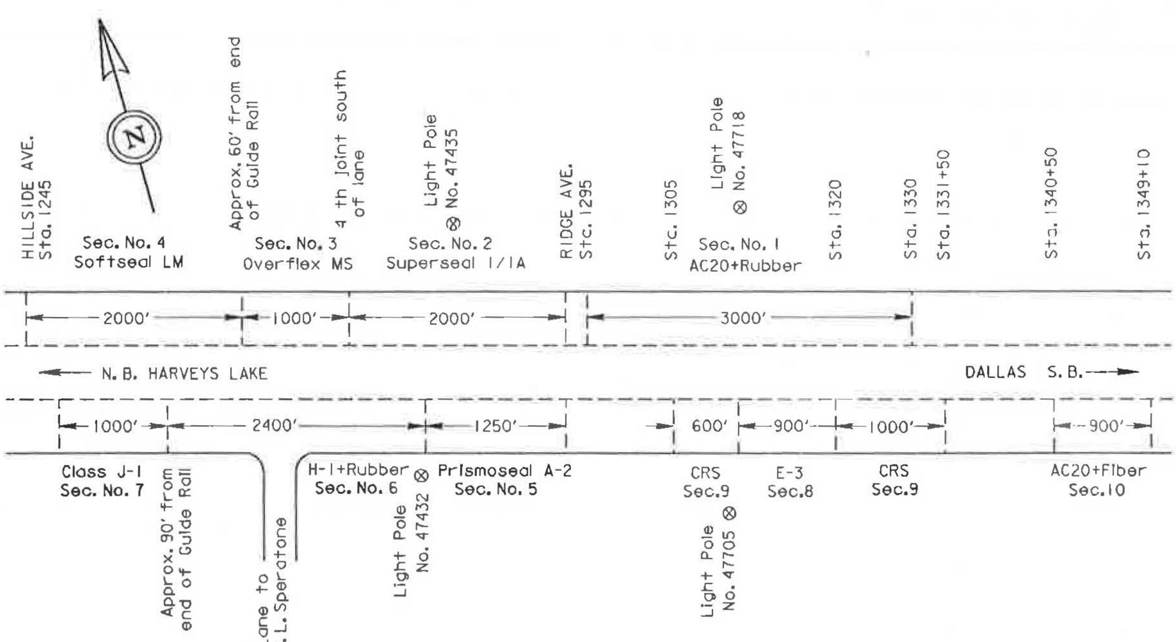

FIGURE 2 Crack Sealing Project LR 177, Luzerne County, Pennsylvania.

TABLE 1 Application Data

Section	Material	Producer	Application Temperature (F°)	Quantity Used (gal)	Cracks Filled (linear ft)	Coverage (ft/gal)
1	AC-20 with rubber		350	160	8,634	58
2	Superseal IIIA	Superior Products Company, Inc.	390-400	50	3,000	60
3	Overflex MS	Crafco, Inc.	375-385	25	1,500	60
4	Sof-Seal LM	W.R. Meadows, Inc.	375	42	2,500	70
5	Prismoseal A-2	Prismo Universal Corporation	350	60	1,250	20
6	H-1 with rubber	–	350	25	2,900	96
7	Class J-1	–	285	25	1,800	80
8	Class E-3	–	180	25	1,300	52
9	CRF emulsion	Witco Chemical Corporation	Ambient[a]	30[b]	1,600	53
10	AC-20 with fiber[c]	Hercules	285	70	1,350	19

[a]40°F. [b]Estimated gallons. [c]Fibre-Pave 5010.

Ten materials were placed on this project (Table 1), including Class J-1, which was placed in Section 7 as the control. Details of the application of these products follow.

Section 1: AC-20 (75 Percent) with Powdered Devulcanized Rubber (25 Percent)

The material in Section 1 was blended in the field by adding prepackaged granulated rubber to the circulating hot asphalt cement in the double boiler. Final mix temperature was 350°F. The addition of the rubber improved the resistance to flow over the plain asphalt cement and decreased the susceptibility to low-temperature cracking. When hot, this material flowed slightly from the cracks, but it adhered well as it cooled with no pick-up by vehicle tires.

Problems associated with the field mixing of this material were as follows:

1. The requirement that either a source of hot asphalt be reasonably close to the sealing project or a distributor be on the project to refill the heating kettle was cumbersome. Neither alternative was desirable because of the time lost in sending the heating kettle to the asphalt source and the cost associated with maintaining a distributor and operator for the small daily quantities of asphalt required on sealing projects. According to PennDOT policy, maintenance forces did not use a distributor for supplying asphalt. The heating kettle was filled at the nearest bituminous concrete plant.

2. The proper proportions of asphalt and rubber were not always maintained. Proportioning was difficult, especially when a partially filled kettle was recharged.

Section 2: Superseal IIIA

Superseal IIIA was manufactured by Superior Products Company, Inc., and consisted of a mixture of materials compatible with asphalt-concrete pavements. The material, prepackaged in a ready-to-use form, was heated in a double boiler-type melter-applicator.

This material had poor adhesion, especially on moist or dusty surfaces. It was readily worked loose by using a finger.

Section 3: Overflex MS

Overflex MS was a premixed, prepackaged blend of 25 percent vulcanized rubber and 75 percent asphalt cement manufactured by Crafco, Inc. This product adhered very well and exhibited excellent resistance to flow and extrusion from the reservoir routed into the crack.

Section 4: Sof-Seal LM

Sof-Seal LM was a premixed, prepackaged combination of polymeric compounds manufactured by W.R. Meadows, Inc. It was susceptible to moist or dusty surfaces as shown by the ease with which the material was pulled loose from the pavement by using a finger. There was also slight flow when the material was placed in the crack.

Section 5: Prismoseal A-2

Prismoseal A-2 was a single-component, highly modified rubberized asphalt dispersion manufactured by Prismo Universal Corporation. Although this product was designed to be placed without routing, it was applied on only a small portion of this section in that manner; the remaining portion was prepared by routing. The crack was cleaned by being blown with hot compressed air. A band of material was then placed on top of the pavement surface. The material used on this project was supplied in paper bags, but in future it will be packaged in meltable plastic bags. The paper adhered to the sealant blocks and required considerable time to remove before the sealant could be placed in the heating kettle. This material adhered well and did not flow from the cracks. It was not extruded by traffic.

Section 6: H-1 (75 Percent) with Powdered Devulcanized Rubber (25 Percent)

The material in Section 6 was a field blend of granulated rubber as used for Section 1. The only difference between this blend and the AC-20 with rubber was the penetration of the base asphalt. The H-1 had 250 to 300 penetration versus 60 to 120 for the AC-20 asphalt.

The problems associated with this material were the same as those for AC-20 and rubber--the requirements for a source of hot asphalt and blend control. The higher-penetration base asphalt flowed more readily from the crack, especially on superelevated curves. This material also was extruded by traffic.

Section 7: Class J-1

Class J-1 was an asphalt cement blended with approximately 20 percent mineral filler. This material had been used extensively by PennDOT maintenance forces. It has high flow, is subject to low-temperature cracking, and is extruded by traffic. Past practice had been to pour the sealant on the road surface over the crack, thus subjecting the soft sealant to extrusion by traffic. On this project, the cracks were routed to form a reservoir below the surface of the pavement.

Section 8: Class E-3 Asphalt Emulsion

Class E-3 was an unmodified standard asphalt emulsion (AASHTO, CRS-2) that was used in comparison with the CRF emulsion. Application techniques were the same as those for the CRF sealant. Because E-3 will not withstand freeze-thaw cycling, it had to be stored in a heated storage tank or in drums that were protected from freezing.

Section 9: CRF Emulsion

CRF emulsion was a proprietary emulsified asphalt crack filler that was handled at ambient temperatures and formulated to withstand freeze-thaw cycling. This material was placed by using a pouring bucket. With this material, the crack did not have to be blown clean because the sealant was very fluid and wetted any particles in the reservoir. Sand was then spread over the sealed cracks and the sealant was permitted to cure approximately 1 hr before exposure to traffic. The advantages of this product were as follows:

1. It did not require a heating kettle, which saved the cost of heating the sealant and the wages of an operator;
2. It was available in 55-gal drums. These were easy to handle and store and were reclosed at the end of one work day and reused the next; and
3. It reportedly withstands freeze-thaw cycling. This permitted the unused portions to remain on the truck at the end of the work day and to be stored at a yard near the job site.

A disadvantage is its storage life of 6 months, as reported by the manufacturer, which is too short for normal PennDOT maintenance operations. Material not used in one sealing season is retained for use in the next season. The 6-month storage life would require all purchased CRF sealant to be used in one season.

Placing the sand cover on the CRF sealant was the slowest part of the operation and two men were required to keep up with the pouring of the sealant. The excess sand was unsightly and was blown around by traffic immediately after the work area was opened.

Section 10: AC-20 with Hercules Fibre-Pave 5010

Section 10 sealant was a blend of AC-20 and 7 percent of fine-denier, short polypropylene fibers. It was mixed in the field by addition of the fiber to the hot asphalt cement. This required a source of hot asphalt cement, which presented the same problem as that with blends of rubber with AC-20 and H-1 discussed previously. The blended sealant was applied with a wand supplied by Hercules and was placed without using a squeegee. Application was very fast. The sealant had good adhesion and did not flow from the crack.

MATERIAL AND APPLICATION COSTS

A complete valid cost analysis of the methods used to prepare the cracks and to apply the sealants on this project was not possible because of the limited quantities placed and because of the experimental nature of these methods of preparation and application. A major portion of the placement of all 10 sealants used the same preparation and application techniques, permitting comparison by the same PennDOT maintenance standards for production rates and labor costs for all materials. These costs are as follows:

With routing:

One foreman at $8.51/hr + 55 percent overhead	= $13.19,
One equipment operator at $7.61/hr + 55 percent overhead	= 11.80,
Five maintenance workers at $6.51/hr + 55 percent overhead	= 50.45,
Equipment costs	= 40.56,
Total	= $116.00/hr.

Without routing:

One foreman at $8.51/hr + 55 percent overhead	= $13.19,
One equipment operator at $7.61/hr + 55 percent overhead	= 11.80,
Two maintenance workers at $6.51/hr + 55 percent overhead	= 20.18,
Equipment costs	= 20.00,
Total	= $65.17/hr.

The unit cost, cost per linear foot, and daily costs for application of the sealants based on the PennDOT maintenance standards are given in Table 2. Material costs for the premixed sealants were approximately twice as much as those for the field-mixed sealants. This extra material cost may be offset by the savings in labor from not having to obtain hot asphalt cement and by the assurance of having a higher-quality sealant blend. The lowest-cost product was the Class E-3 asphalt emulsion. The cost per gallon for E-3 shown in Table 2 was on the basis of a bulk bid and was lower than that for sealants for which smaller shipping units, such as drums, pails, or boxes, are used. If protected from freezing or used only during warmer weather, this emulsion could be an economical sealant material. Sof-Seal LM was the most expensive sealant and cost approximately twice as much as the other premixed sealants.

In reality, differences in productivity would exist because of varying material consistencies and application techniques. These actual rates could only be determined on a production job where the crew was familiar with the use of the particular sealant material. New standard rates could then be determined for each and the in-place unit costs adjusted accordingly.

INSPECTIONS

Three on-site inspections were performed: March 1982, July 1982, and March 1984. These months were chosen to evaluate the sealants after exposure to weather extremes. Temperatures before the March inspections were approximately 0 to 10 degrees above zero and before the July inspection it was over 90 degrees. Inspections were made by two representatives from the Bureau of Bridge and Roadway Technology and one from the Bureau of Maintenance and Operations. Each observer rated the performance of each sealant by using the following criteria:

1. Resistance to extrusion by traffic,
2. Resistance to oxidation or embrittlement,
3. Resistance to particle intrusion,
4. Resistance to flushing,
5. Effect of cold weather,

TABLE 2 Comparison of Application and Material Costs

Section	Material	Cost per Gallon ($)	Coverage (ft/gal)	Material Cost per Linear Foot ($)	Total Cost of Labor and Material per Linear Foot ($)	Cost per Day of Material at 160 gal/day ($)	Daily Labor Costs ($): With Routing	Daily Labor Costs ($): Without Routing	Total Cost per Day of Standard Application Amount[a] ($)	Total Cost per Day of Standard Application Amount[b] ($)
1	AC-20 with rubber	1.58	58	0.03	0.10	253	870	–	1,123	1,120
2	Superseal IIIA	3.25	60	0.05	0.12	520	870	–	1,390	1,344
3	Overflex MS	2.94	75	0.04	0.11	470	870	–	1,340	1,232
4	Sof-Seal LM	6.40	70	0.09	0.16	1,024	870	–	1,894	1,792
5	Prismoseal A-2	2.25-3.00	20	0.11	0.15	360-480		490	850-970	1,680[c]
6	H-1 with rubber	1.58	98	0.02	0.09	253	870	–	1,123	1,008
7	Class J-1	1.58	80	0.02	0.09	253	870	–	1,123	1,008
8	Class E-3	1.10	52	0.02	0.09	176	870[d]	–	1,046	1,008
9	CRF emulsion	2.85	53	0.05	0.12	456	870[d]	–	1,326	1,344
10	AC-20 with fiber									
	Field mixed	1.34	19	0.07	0.11	214		490	704[c]	1,232[c]
	Premixed	2.52	19	0.13	0.17	403		490	893[c]	1,904[c]

[a]Maintenance standard: 160 gal/day.
[b]Maintenance standard: 11,200 ft of cracks per day.
[c]Figures may be misleading for materials that do not require routing, because actual production would be greater than the standards. Because this was such a small application and start and stop times varied, valid application rates for the various materials could not be determined.
[d]Does not require heating kettle but does require dump truck for sand.

6. Ability to bond to pavement,
7. Abrasion resistance, and
8. Ability to rebond.

During the March 1982 inspection each of the sealants was rated poor, fair, or good on each of the foregoing rating criteria (Table 3). In July 1982 only an overall rating of poor, fair, or good was assigned to each sealant, as follows:

1. Good: AC-20 with Fibre-Pave, AC-20 with rubber, H-1 with rubber, and Prismoseal A-2.
2. Fair: E-3, CRF, Overflex MS, and Superseal IIIA.
3. Poor: Sof-Seal LM and J-1.

For the final inspection in March 1984, a numerical value was assigned to each rating: 0.5 for very poor to 4.0 for excellent. A value was assigned to each performance category by each evaluator, which permitted a score to be derived for each product and a numerical value to be determined for minimum performance. Twenty was chosen as the minimum acceptable performance score. No evaluation of the Class J-1 joint sealant was made during the March 1984 inspection because it was deemed to have failed in all categories. Results of this inspection are shown in Table 4.

INSPECTION RESULTS

AC-20 with Rubber

AC-20 with rubber showed no extrusion from the crack, was elastic and soft, did not track, and did not have an excessive amount of intrusions. During the March 1982 inspection, the sealant could be pulled loose from the road surface and moisture was present underneath; when the July inspection was conducted, the sealant had a tight bond to the pavement. The kneading action of the traffic was beneficial. The overall score for this sealant during the final inspection was 21.0. This product ranked third.

Superseal IIIA

The performance of Superseal IIIA was fair. No bleeding or tracking by traffic was evident, but

TABLE 3 Summary of Evaluations: March 1982

Characteristic	AC-20 with Rubber	Superseal IIIA	Overflex MS	Sof-Seal LM	Class J-1	H-1 with Rubber	Prismoseal A-2	CRF Emulsion	Class E-3	AC-20 with Fibre-Pave
Resistance to extrusion by traffic	Good	Good	Good	Good	Poor	Fair	Good	Poor	Poor	Very good
Resistance to oxidation or embrittlement	Fair	Good	Good	Good	Poor	Fair	Good	Fair	Fair	Good
Resistance to particle intrusion	Good	Very good	Good	Very good	Poor	Good	Good	Good	Good	Good
Resistance to flushing	Good	Very good	Good	Good	Poor	Fair	Good	Fair	Fair	Good
Effect of cold weather	None	None	None	None	Brittle	None	Can be gouged by snowplow blades	None	None	None
Ability to bond to pavement	Good	Poor	Fair	Poor	Good	Good	Good	Good	Good	Good
Abrasion resistance	Fair	Good	Poor	Good	Fair	Fair	Good	Fair	Fair	Good
Ability to rebond	Good	Poor	Poor	Poor	Good	Good	Good	Good	Good	Good

TABLE 4 Summary of Ratings: March 1984 Inspection.

	AC20+ RUBBER			SUPERSEAL 111A			OVERFLEX MS			SOF-SEAL LM			H-1 + RUBBER			PRISMO-SEAL A-2			CRF			E-3			AC20+ Fiber		
RATER	H	C	K	H	C	K	H	C	K	H	C	K	H	C	K	H	C	K	H	C	K	H	C	K	H	C	K
RESISTANCE TO EXTRUSION BY TRAFFIC	3	3	3	3	3	3	2	2	3	1	2	3	2.5	3	1	3	3 3	3.5	2	2	1	1.5	1	1	3	2	3.5
RESISTANCE TO OXIDATION OR EMBRITTLEMENT	2.5	3	3	1.5	1	2	2	3	2	2	3	3	2.5	3	1	3	3 3	3.5	2	2	3	1	1	1	3	2	3.5
RESISTANCE TO PARTICLE INTRUSION	2.5	2	3	3	3	3	2	2.5	3	1	1	1	2	2	1	3	3 3	3.5	1.5	2	3	1	1	3	3	2	3
RESISTANCE TO FLUSHING	2.5	2	3	3	3	3	3	2	3	1	3	3	2	2	1	3	3 3	3.5	2	3	1	1.5	2	1	2	2	3
EFFECT OF COLD WEATHER	2.5	2	2	1	1	1	1.5	2	2	2	3	3	1.5	3	2	3	3 2	3	2	2	2	1.5	1	1	3	3	3
ABILITY TO BOND TO PAVEMENT	2.5	3	3	1	1	1.5	1.5	1	1	1	1	1.5	1.5	1	1	3.5	3 1	2.5	2.5	1	3	1.5	1	3	3	4	3
ABRASION RESISTANCE	2.5	3	3	3	2	3	1	2	1.5	1	3	3	1.5	2	1	3	3 3	3	2	3	1	1.5	3	1	3	2	3
ABILITY TO REBOND	3	2	2	1	1	0.5	1.5	1	1	1	1	0.5	1.5	2	3	4	3 2	2	2	3	2	1.5	2	3	4	2	3
RATING, POINTS	21.0	20.0	22.0	16.5	15.0	17.0	14.5	15.5	15.5	10.0	17.0	17.0	15.0	18.0	11.0	25.5	24.0 20.0	24.5	17.0	17.0	17.0	11.0	12.0	14.0	24.0	19.0	25.0
RATING, RANK	3			9			5			6			7			1			4			8			2		
ACCEPTABLE	YES			NO			NO			NO			NO			YES			NO			NO			YES		

0.5 Very Poor
1.0 Poor
1.5 Poor/Medium
2.0 Medium
2.5 Medium/Good
3.0 Good
3.5 Very Good
4.0 Excellent

Note: Class J-1 was not evaluated.

almost all cracks had extensive areas of bond failure. Some areas of bond failure observed during the March 1982 inspection had rebonded when exposed to the higher summer temperatures. Loosening of the aggregate in the bituminous concrete pavement during preparation of the crack by routing may be partially responsible for the poor bond. This sealant had an average score of 16.0 during the March 1984 inspection; the moderately high score reflects the good properties of the sealant and indicates that it may perform satisfactorily when placed in a clean sawn joint of a bituminous overlay. This sealant ranked ninth.

Overflex MS

Overflex MS exhibited some loss of bond and was severely abraded by traffic. After exposure to higher summer temperatures, little healing of the edge cracks was evident. The average score was 15.5. This sealant ranked fifth.

Sof-Seal LM

Large areas of Sof-Seal LM were lost from the crack by traffic action; the remaining areas had poor bond and could be pulled from the crack by hand and when released would pull back like a rubber band. The sealant remained soft and had good weather resistance. This product may be suitable for sawn cracks and will be further evaluated under those conditions. The score for this sealant averaged 14.7 and it was ranked sixth.

Class J-1

The performance of Class J-1 sealant was unsatisfactory. It flowed out of the crack on superelevated curves and into the crack in other areas. Intrusions were common. This product was rated poor during the 1982 inspections and was not rated in 1984 because of its poor condition. This product was rated tenth.

H-1 with Rubber

H-1 with rubber was a field blend of H-1 (250-300 penetration) asphalt cement and granulated devulcanized rubber. It is the same as AC-20 with rubber except for the softer base asphalt cement. The performance was similar to that of the AC-20 with rubber, but the sealant flowed from the crack on superelevations and migrated into the crack. The score for this product averaged 14.7 and it was ranked seventh.

Prismoseal A-2

The performance of Prismoseal A-2 was good. Some loss was evident on high portions of the lane where snowplow blades scalped the surface, but the sealant was resistant to extrusion and particle intrusion. The portion placed over the cracks prepared by the hot lance adhered better and retained more sealant. The average score for this sealant was 24.5 and it was ranked first. The portion that was prepared by routing and without the hot lance was scored 20.0 by one observer.

CRF Emulsion

CRF emulsion was one of the two cold-applied sealants. It was poured into the routed crack and then covered with sand aggregate. There was no control over the ratio of aggregate to emulsion; therefore, some areas of the crack appear to be low in sealant content and some rich in sealant. Where exposed to traffic, the asphalt worked to the surface and was extruded onto the adjacent pavement surface, forming a seal around the crack. Where the sealant was not exposed to traffic, some erosion of the sealant was evident. CRF performance varied from good to poor and appeared dependent on the ratio of sand to emulsion and to exposure to traffic. The average score was 17.0 with a ranking of fourth.

E-3 Emulsion

E-3 emulsion was cold applied with a cover of sand. In areas where it was not kneaded by traffic, the sealant was brittle and eroded by water. There was considerable variance in the performance of this sealant from one crack to another and in different portions of the same crack, which may be due to the varying ratios of emulsion to sand. The average score was 13.3 with a rank of eighth.

AC-20 with Fibre-Pave

The performance of AC-20 with Fibre-Pave was ranked medium to excellent on all evaluation criteria. When inspected in March 1982 after one winter of exposure, the sealant had a fuzzy, matted appearance, with fibers extending up from the surface of the asphalt. The overband could be pulled loose by hand and considerable moisture had accumulated under the sealant, but when inspected in July 1982 the sealant had a smooth surface and was tightly bonded to the roadway. The performance of this product over the areas of multiple cracks indicates that it may be useful as a wider seal-coat type of application on multiple cracks or alligatored areas. This sealant has good resistance to extrusion by traffic. The average score was 22.7 with a ranking of second.

CONCLUSIONS AND RECOMMENDATIONS

1. The performance of the sealants used on this project indicates that a crack sealant, under normal field conditions, must be able to coat and bond to surfaces that may be damp or dusty or both. The sealants that have high cohesive strengths and thus high resistance to intrusion of incompressibles generally require cleaner and drier pavement surfaces for satisfactory bond. Sealants that are a blend of straight asphalt cement and a modifier, such as rubber or fiber, bond well to dusty or damp surfaces. Emulsion-based sealants are unaffected by damp surfaces.
2. All products, with the exception of the Class J-1 sealant, would perform well as sealants for cracks. The roadway conditions on this project were severe; free water was flowing under and through the overlay during much of the test period. However, three of the products tested, AC-20 with rubber, AC-20 with Fibre-Pave, and Prismoseal A-2, scored significantly higher than the other products and therefore it was decided that only these three be considered for recommendation as approved department sealants.
3. The AC-20 with Fibre-Pave 5010 is a blend of polypropylene and AC-20. The blend must not exceed a temperature of 300°F; therefore, a precautionary note should accompany any instructions for its use.
4. The application of Prismoseal A-2 would require different pumps on the heating kettles because of the silica filler used in the sealant. It is anticipated that a change in the type of filler will be made, which would permit the application through existing equipment.
5. It is recommended that the department continue to use AC-20 with devulcanized rubber.
6. The use of H-1 with devulcanized rubber as a replacement for AC-20 with rubber is not recommended because the base asphalt cement is inherently too soft.
7. Superseal IIIA and Sof-Seal LM are recommended for additional evaluation for use in sealing joints sawn in bituminous concrete overlays.
8. The use of Class J-1 crack sealant should be discontinued; its service life is very short, less than 1 year.
9. The use of cold asphalt emulsions for crack sealing, although suitable, is not recommended because the other acceptable products have a longer estimated service life with little, if any, additional cost.
10. It is further recommended that the AC-20 with rubber, AC-20 with Fibre-Pave 5010, and Prismoseal A-2 be placed by overbanding with an approved applicator.
11. It is recommended that the hot-lance method of surface preparation be further evaluated for efficiency and cost-effectiveness.

REFERENCE

1. M.C. Belangie and D. Anderson. Evaluation of Flexible Pavement Crack Sealing Methods in Utah. Report FHWA/UT-81/1. Utah Department of Transportation, Salt Lake City, Jan. 1981.

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