EXPERIMENTAL BRIDGE DECK MEMBRANE USED ON

Milton BMA 6216

POLYASTIC'S CONCRETE POXY MEMBRANE SEALER

Report 72-8

September 1972

VERMONT DEPARTMENT OF HIGHWAYS

J. T. Gray, Commissioner

R. H. Arnold, Chief Engineer

A. W. Lane, Materials Engineer

Report Prepared By

R. I. Frascoia
Research Specialist

INITIAL REPORT

PROJECT

Milton BMA 6216

PROJECT LOCATION

In the Village of Milton, Vermont, beginning at a point approximately 85 feet northerly from the intersection of U.S. Route 7 and State Aid Route 2 and extending north 415 feet along U.S. Route 7.

CONTROL SECTION

None

BRIDGE CONSTRUCTION DATA

Type of Construction - Complete removal and replacement of concrete deck, sidewalk and curbs.

Span Lengths - 50' + 260'

Overall Length - 310'

Horizontal Curvature - On 17^{o} curve for 45' with remainder on tangent

Grade - 1.42%

Superelevation - Varies from 5/8"/ft. to a 2" parabolic

DECK CONSTRUCTION DATA

Date Poured - June 2, 1972 (southbound lane)
July 26, 1972 (northbound lane)

Weather - Rainy June 2, 1972
Cloudy July 26, 1972

Deck Thickness - 8 inches

Concrete over Reinforcing Steel - 2" to 2½"

Concrete - Class AA

Cement - Type I 6½ bags per cubic yard

Aggregate Size - 3/4" maximum

Air Entrainment - Darex 9 oz per cubic yard

Retarder - None

DECK CONSTRUCTION DATA - cont'd

Pour Sequence - North to south

Finishing Method - Mechanical vibrating screed and bullfloat

Surface Texture - Burlap drag

Curing - Polyethelene

Sidewalk - Dow Corning 777-B Silicone Admixture used in the concrete

DECK CONDITION

The general surface condition of the finished concrete was as follows:

Northerly half of the northbound lane - many small depressions caused by rainfall during the finishing operation.

Southerly half of the northbound lane - relatively smooth.

Southerly half of the southbound lane - washboard effect.

Southerly approach span - relatively smooth.

Cracks - four transverse cracks passed through the northbound lane and extending up to three feet into the southbound lane.

There were notable exceptions as follows:

Laitance - At the base of the westerly curb and out approximately 12 inches - the laitance averaged 1/8" in thickness.

Adjacent to the easterly curb on the southerly approach span and along the beginning of the main span - the laitance ranged up to ¼ inch in thickness.

Adjacent to drain scuppers along the easterly side of the deck.

Other areas of the deck were generally satisfactory possibly due in part to acid etching done by the contractor several weeks prior to the membrane application.

(Acid etching cannot be expected to remove areas of heavy laitance)

Miscellaneous - A bituminous mix had been placed around drain scuppers along the westerly side of the deck to prevent damage to tires. Although the material had been removed, a light deposit remained on the concrete.

PROTECTIVE TREATMENT

Product - Polyastic's Concrete Poxy Membrane Sealer.

A two component, solvent cut, epoxy-polyamide manufactured by the Polyastics Corporation, 203-205 State Road, Croydon, Pennsylvania - 19020.

Preliminary Test Results - None. Samples not available.

RECOMMENDED APPLICATION PROCEDURE

Applied in two coats by airless spray or squeegee

COST

Total cost unknown. Material costs reported to be $18.50 per gallon

OBSERVATIONS MADE DURING MEMBRANE APPLICATION

Time	Temp	
8/29/72		Clear, winds light. Air temperatures recorded in shade.
7:30	60°	Sweeping and washing down northbound lane. One-way traffic being maintained on southbound lane. Factory representative on project.
8:30	67°	Twenty gallon batch of epoxy mixed for 4 minutes. Batch No. 3657-1.
9:05		Began epoxy application with squeegee on northerly end of deck. The sides and top of the curb were coated with epoxy utilizing a 6 inch wallpaper brush. Initial application was made on concrete with surface moisture which varied from dry in some areas to quite wet along the curb and in scattered depressions on the deck.
9:15		Began sprinkling water on dry areas of the deck prior to the epoxy application.
9:30	69°	Application complete on 110 lineal feet of deck. Sixteen gallons of material used on 1394 s.f. for an application rate of approximately 87 s.f./gal.
10:45		First coat complete. Thirty-nine gallons applied on 3920 s.f. for an overall application rate of approximately 100 s.f./gal.
11:30	74°	85° in sun. Small individual air bubbles and clusters of air bubbles can be seen scattered throughout the treated area.
1:15	76°	Began applying the second coat on both deck and curbing. The first coat, although surface dry to the touch is tacky under foot traffic. Most of the air bubbles and bubble clusters in the first coat are being broken by the squeegee during the application of the second coat.
1:45	78°	Approximately 10 gallons of material applied on 130 lineal feet of deck for an application rate of 165 s.f./gal.
2:30		Application complete. Twenty-nine gallons applied for a rate of 135 s.f./gal. on the second coat.

OBSERVATIONS MADE DURING MEMBRANE APPLICATION - cont'd

Time	Temp	
8/29/72		
2:30 cont'd		Very few air bubbles can be seen in the second coat with the exception of two 10 foot long areas near the southerly end of the main span.
8/30/72		
7:00		Began sweeping and washing down southbound lane. Traffic is being routed over the fresh epoxy coating on the northbound lane. The traffic and accompanying grit and stones do not appear to be damaging the epoxy although it is still quite soft to the touch in the areas with a thick coating of material.
10:30		Twenty gallons of epoxy mixed early to allow induction time as recommended by factory representative.
11:00	75°	Began application. All concrete surfaces are being given a light spray mist of water just prior to the epoxy application.
12:00	78°	Approximately 17 gallons of material applied on 145 lineal feet of deck for a rate of 94 s.f./gal.
1:25	79°	33 gallons applied on first coat for an overall application rate or 103 s.f./gal.
2:20	81°	Began applying second coat. Air bubble conditions appear similar to application made previous day.
3:35	79°	Application complete. Twenty-seven gallons applied for a rate of 126 s.f./gal. on the second coat. Overall application rate for the entire treatment area was 114.7 s.f./gal./coat.

DISCUSSION

The epoxy-polyamide material used was a new modification of an epoxy product which had been marketed for some time by the Polyastics Corporation. The carrying agent for the 2 component material consists of xylol which evaporated relatively slowly and Ketone solvents, MEK and MIBK, which evaporate quickly. The xylol accounts for the 10 hour pot life and a cure time of 24 to 48 hours.

The company representative on the project requested that a light application of water be placed on the concrete prior to the epoxy application. The purpose of the water was to lower the surface temperature of the concrete which in turn slows the solvent flash off and supposedly reduces the number of air bubbles which would otherwise occur in the epoxy.

Shortly after application of the first coat of liquid epoxy, individual air bubbles and air bubble clusters were noted. The bubble clusters generally consisted of one large bubble (1/8" to 1/4" in diameter) surrounded by 50 or more small bubbles. Most but not all of the bubbles were in areas where there was a build up of epoxy due to depressions in the deck or areas pock marked by rain during the concrete finishing operation. Visual inspection revealed that the individual air bubbles had at least a thin coating of epoxy on the concrete beneath the bubbles, although the original pinhole in the concrete which caused the air bubble might still not have been sealed. Most of the bubble clusters appeared to be floating on the epoxy. This gave the impression that they may have been caused by the presence of solvent or due to air entrapped in the material during mixing and or application.

The application of the second coat began four hours after the first coat was placed. The first coat, although tack free to the touch, was not sufficiently cured to prevent movement under foot traffic. The application of the second coat by squeegee broke most of the visible bubbles which had occurred in the first coat. Bubbles occurred in the second coat at the rate of approximately 10% of the number which had occurred in the first coat.

The Polyastic's representative on the project, Mr. Charles B. Gennaro, stated that 3 to 3½ mils of a 4 mil application (180 s.f./gal. produces a 4 mil thickness) should penetrate into the concrete. Inspection of the first coat revealed some dry looking areas which appeared to be due to penetration of the epoxy into the concrete. However, laboratory inspection of treated 6" by 6" by 1" thick concrete test slabs with a 30 power microscope did not reveal significant penetration of the material. The microscope did reveal many small air bubbles in the coating which could not be detected without magnification. Field inspection of areas with surface laitance (see deck condition on page 2) also disclosed that the epoxy was not able to penetrate through heavy laitance.

The northbound lane was opened for traffic approximately 17 hours after the second coat was applied. Although areas with a buildup of material were still quite soft to the touch, the traffic and accompanying grit and stones did not visually appear to damage the membrane.

The membrane application on the southbound lane resulted in air bubble conditions similar to the previous day.

The first coat application rate on both lanes averaged 101 square feet per gallon while the second coat averaged 130 square feet per gallon. The overall application rate for all treated areas was 114.7 square feet per gallon per coat.

Inspection of the deck on September 1, 1972, shortly before paving, disclosed no bubbles in the membrane system or signs of wear from traffic on the northbound lane. Electrical resistance readings were taken on the southbound lane of the bridge, 40 hours after the epoxy application had been completed. The readings ranged between a low of 45,000 ohms and a high of 440,000 ohms with an average of 218,000 ohms. This is superior to readings on other epoxy products applied at comparable rates (50 - 70 s.f./gal. total coverage) but not as high as the bridges treated with Duralkote 306 or Duralbond 102 (see Table I on page 8).

The bituminous pavement was applied with a steel track paver. Mix was spread by hand in front of the paver tracks to prevent damage to the membrane. Removal of the

mix from several areas for inspection disclosed that the coating was surface scratched but apparently unharmed. Little, if any bond was noted between the membrane and the first 1" course of pavement. Compaction along the curb areas resulted in damage to the epoxy coating on the concrete curbs in a number of areas.

Resistance readings taken on the completed 2" thick pavement were all recorded as infinity. Such readings might be expected on a new pavement or may be due in part to the addition of asbestos fibers in the bottom course at the rate of 1½% by weight. Trial drops of the mix showed zero % air voids in the Marshall brickettes. Actual field compaction is unknown.

Laboratory samples of the epoxy ranging from several mils to 1/8" in thickness displayed excellent flexibility at room temperature and nearly as good flexibility at sub-zero temperatures.

A one coat application on an aluminum panel remained intact when the panel was bent nearly 180°. Excellent bond has been exhibited on all materials that the epoxy has been placed on.

Permeability tests now being conducted demonstrate that water has been able to penetrate the epoxy coating on a 6" x 6" x 1" concrete slab. Absorption amounting to 0.35% has been observed while an identical untreated sample absorbed 1.0% moisture by weight (see table II on page 8).

Follow up evaluations to determine the product's effectiveness shall include visual observations of the epoxy treatment on the concrete curbs. However, consideration should be given to the fact that the curbs were not acid etched or otherwise cleaned of laitance or road dust.

TABLE I

Electrical Resistance Readings on Epoxy Bridge Deck Membranes

Product	Type	Number of Coats	Total Coverage sf/gal	Average Resistance Reading-ohms
Polyastics	Epoxy Membrane Sealer	2	57.4	218,000
Rambond 223	Epoxy Membrane Sealer	1	19.7	5,100
Duralkote 306	Epoxy Membrane Sealer	2	24.2	30,000,000
Duralbond 102	Epoxy Bonding Compound	2	36.8	1,150,000
Duralkote 304	Epoxy Paint	2	67.4	30,000
Ramcoat Epoxy	Epoxy Paint	2	68.3	1,100
Ramcoat Epoxy over Rambond 223	Epoxy Paint Over Epoxy Membrane Sealer	2	17.4	45,000

TABLE II

Water Absorption Test Results

Days Immersed	Percent Increase by Weight	
	Polyastic's Coated Sample	Untreated Sample
2 days	0.2%	1.0%
7 days	0.3%	1.0%
13 days	0.35%	1.0%

CONCLUSIONS FOR POLYASTICS CONCRETE POXY MEMBRANE SEALER

Advantages

1.) excellent flexibility

2.) excellent bond

3.) better then average electrical resistance

4.) good workability

5.) easy to control application rate

6.) can be applied to moist concrete surface

Disavantages

1.) air bubbles

2.) high cost (cost per gallon is high but coverage per square yard of concrete may make it less expensive)

Polyastic's Concrete Poxy Membrane Sealer

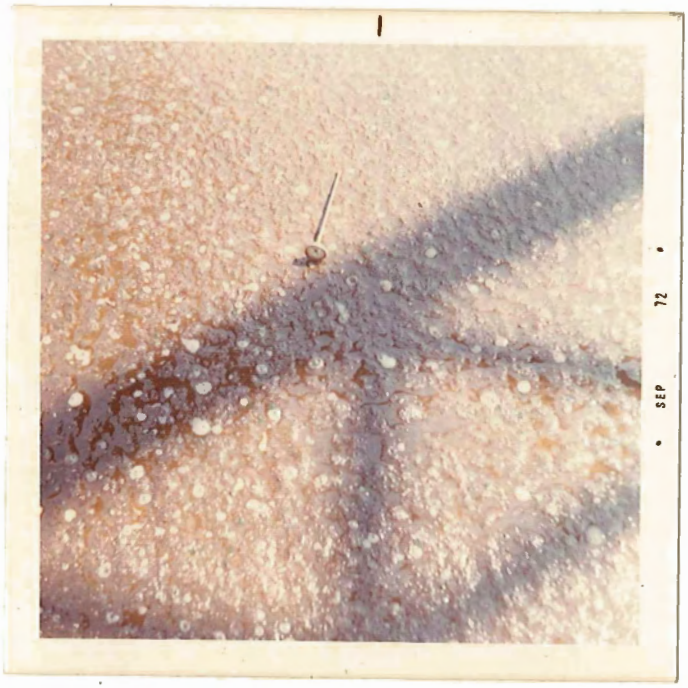
Milton BMA 6216

August 1972

Laitance along westerly curb

Applying first coat of the clear epoxy. Note the spray application of water

Inspection of first coat of epoxy revealed that the material had not penetrated into areas of heavy laitance



Air bubbles and bubble clusters in first coat shortly after application. Concrete surface texture due to rain during finishing operation

Polyastic's Concrete Poxy Membrane Sealer

Milton BMA 6216

August 1972

Air bubble clusters in first coat placed on concrete test slab

First coat complete on southbound lane

Applying second coat. Note dry looking areas where the first coat of epoxy appears to have penetrated into the concrete