EXPERIMENTAL APPLICATION OF AN EPOXY COATING BY AIRLESS SPRAY

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VERMONT DEPARTMENT OF HIGHWAYS

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POLYASTICS EPOXY

PROJECT

Dummerston S0119(2)

PROJECT LOCATION

In the town of Dummerston; on Vermont Route 30; beginning approximately 1.493 miles northwesterly of the Brattleboro-Dummerston town line and extending northwesterly 3.641 miles.

WORK LOCATION

Vermont Route 30 bridge over Rock River

BRIDGE CONSTRUCTION DATA

Type of Structure - Single Span

Span Lengths - 150'

Overall Length - 152.07'

Curb to Curb Width - 38' 8"

Skew - 10°

Horizontal Curvature - 5°

Grade - + 1.695%

Superelevation - 3/4"/ft

DECK CONSTRUCTION

Date Poured - 11/10/72

Weather Conditions - Cool and calm

Temperature - 65°F

Deck Thickness - 8"

Concrete Cover over Reinforcing Steel - 1 7/8" - 2 1/2" 2.23" average

Concrete - Class A

Cement - Atlas

Aggregate Size - 3/4" maximum

DECK CONSTRUCTION DATA - cont'd

Air Entrainment - Darex 8 oz - 12 oz/c.y.

Retarder - Daratard

Pour Sequence - South to north

Finishing Method - Gomaco Finishing Machine

Surface Texture - Smooth and clean

Curing - Polyethelene, hay and water

Concrete Test Results:

Air Entrainment - Low 4 3/4% - High 7 1/4% 5.64% on 21 tests

Slump - Low 1 3/4" - High 3 3/4" 2.59" average

Modulus of Rupture - 713 psi average @ 28 days

DECK CONDITION

Surface Texture - Very smooth

Cracks - No cracks visible

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 - The epoxy displayed good flexibility characteristics. Moisture absorption was low at 0.91 percent after 165 days immersion in water. Previous applications of the epoxy by squeegee on two bridges resulted in bubbles and pinholes averaging 90 per square foot. Because of the product's tendency to pinhole, a recommendation was made to discontinue its use until long term evaluation could be obtained on the two bridges treated earlier.

RECOMMENDED APPLICATION PROCEDURE

Applied in two coats by airless spray or squeegee.

COST OF PROTECTIVE MEMBRANE

120 gallons @ $50.00/gal = $6,000.00

OBSERVATIONS MADE DURING MEMBRANE APPLICATION

Time	Temp	6/19/73
8:15 am	65°	Partly cloudy Wind 0-10 MPH Deck very clean
10:05 am		Began applying the epoxy by airless spray, trial batches applied with and without solvent, settled on epoxy without solvent.
11:30 am		Trial area bubbling and pinholing.
12:05 pm		Epoxy spray appears to be working satisfactorily. Applying a light spray application of water on the concrete, just prior to the epoxy application.
12:30 pm		Approximately 1/10 of first coat complete. Spray working satisfactorily but slower than squeegee process. Difficult keeping ahead of epoxy application with light spray application of water.
1:10	75°	225 s.y. of first coat complete for 50.6 s.f./gal rate of application. Complete to sta 108 of 160 for application rate of 93.6 s.f./gal.
2:30 pm	78°	Southerly approach nearly tack free.
2:45 pm		Applied epoxy without pre-wetting at sta 126-130, curb out 2'. Visual inspection several hours later disclosed no noticeable difference in the size or number of air bubbles in the coat.
3:15 pm	80°	First coat complete. 60 gals applied on 6240 s.f. for application rate of 104 s.f./gal.
4:05 pm		Broke bubbles before applying second coat. Slight flow of epoxy towards low side of deck on both coats.
5:35 pm		Completed southerly 1/2 of deck with application rate of 125 s.f./gal.
6:55 pm	70°	Complete to sta 99, sun behind hill. Fewer bubbles and pinholes have appeared in 2nd coat. Rate to this point 97.5 s.f./gal.
8:20 pm		Epoxy applied by squeegee at sta 146-155. Spray not working properly.
8:25 pm		Deck complete. 120 gals on 6130 s.f. for rate of 51.1 s.f./gal or 102 s.f./gal/coat.

DISCUSSION

The deck surface was sandblasted prior to the membrane application.

The polyamide epoxy application was made with an airless spray apparatus. Skies were partly cloudy in the morning and clear in the afternoon.

A light spray of water was applied on the concrete immediately prior to the epoxy application. The water is intended to act much as a wetting agent aiding the epoxy to penetrate into the concrete. Although the water is also supposed to reduce bubbling, the elimination of its application at one location did not reveal any difference in the number of bubbles.

Air bubbles and air bubble clusters were noted in the epoxy shortly after application. The number of bubbles varied widely at different locations with fewer detected in the second coat. Almost all of the bubbles were less than 1/4 inch in diameter with many areas containing only very small bubbles and pinholes. Inspection of a sample, cut from the deck and examined under a microscope revealed 320 bubbles and pinholes in a 1/4 inch square area. Testing with hydrochloric acid did not disclose that any of the larger pinholes were open to the concrete but did reveal that holidays were present in the coating in a few areas where the deck had a pitted surface texture.

The application rate averaged 104 s.f./gal on the first coat and 102 s.f./gal on the second coat for an overall wet film thickness of 34 mils.

Electrical resistance readings taken the day after the system was applied averaged 163,000 ohms while readings taken a week later before the paving application averaged 80,100 ohms per square foot. The decrease in resistance as the system cures is believed due to shrinkage of the epoxy with a subsequent enlargement of the individual pinholes. This condition has also been noted while monitoring samples of the product under a microscope in the laboratory. Resistance readings under 500,000 ohms per square foot indicate that the system is not waterproof.

No difficulties were encountered with the pavement application.

CONCLUSION

An excessive number of air bubbles and pinholes were detected in the completed membrane system. Although most were 1/32 inch or less in diameter, low electrical resistance readings indicated that some holes were open to the concrete. Similar conditions were found on earlier applications when the material was applied with squeegees.

Field and laboratory applications of the epoxy have been made on 18 inch square concrete test slabs for visual observation and electrical resistance testing. Although the epoxy coating has remained flexible to the touch, cohesive cracks have developed in the samples over a 3 to 15 month period.

Polyastic's Concrete Poxy Membrane Sealer is not recommended for further use as a bridge deck membrane.