Summary of Paper (3-22-04): Twenty Five Year Experience With Polymer Concrete Overlays on Bridge Decks

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ABSTRACT

The construction, performance and use of polymer concrete overlays on bridge decks over the past 25 years are summarized. Polymer concrete overlays that have an established history of use and acceptance include multiple-layer epoxy, multiple-layer epoxy urethane, methacrylate slurry and premixed polyester styrene. Evaluations indicate that these overlays can provide skid resistance and protection against intrusion by chloride ions for 25 years and are an economical technique for extending the life of hydraulic cement concrete decks. Polymer concrete overlays have recently been used as the wearing surface on fiber reinforced plastic bridge decks and performance similar to that on concrete decks is anticipated.

Key Words: polymer, overlays, bridge, deck, concrete, epoxy, epoxy urethane, methacrylate, polyester styrene, bond, skid resistance, permeability, corrosion.

PERFORMANCE OF OVERLAYS

Decks Evaluated

Decks evaluated to provide an indication of performance are located in California, Michigan, Ohio, Virginia and Washington [3]. Three overlays each constructed with multiple-layer epoxy (MLE), multiple-layer epoxy urethane (MLEU), premixed polyester (PP), and methacrylate slurry (MS), and two overlays constructed with multiple layer polyester (MLP) were evaluated. Evaluations were done at the time the overlays were constructed, in 1991 and in 1995 [3,4]. The oldest overlay, M44 over the Grand River in Michigan, was evaluated again in 2000 at an age of 24 years. The overlays ranged in age from 6 to 19 years and the average age for the overlay types evaluated ranged from 7 to 12 years when evaluated in 1995 [3].

Tensile Bond Strength

A plot of tensile bond strength (VTM-92) [2] vs age is shown in Figure 5. MLE, MLEU, and PP have not shown much change in bond strength over the life of the overlays. MLP overlays lose strength with time and should fail in approximately 10 years. There is insufficient data to evaluate the performance of MS overlays.

Permeability to Chloride Ion

A plot of permeability to chloride ion (AASHTO T 277) [5] vs age is shown in Figure 6. The results indicate that the best protection is provided by the MS and that MLE, MLEU, and PP overlays provide for negligible to very low permeability throughout their life. The protection provided at 25 years of age is ass good or better than that provided by hydraulic cement concrete overlays. MLP overlays show greater increases in permeability with age but provide good protection for 10 years.

Figure 5. Tensile rupture strength (VTM 92) vs age for polymer concrete overlays.

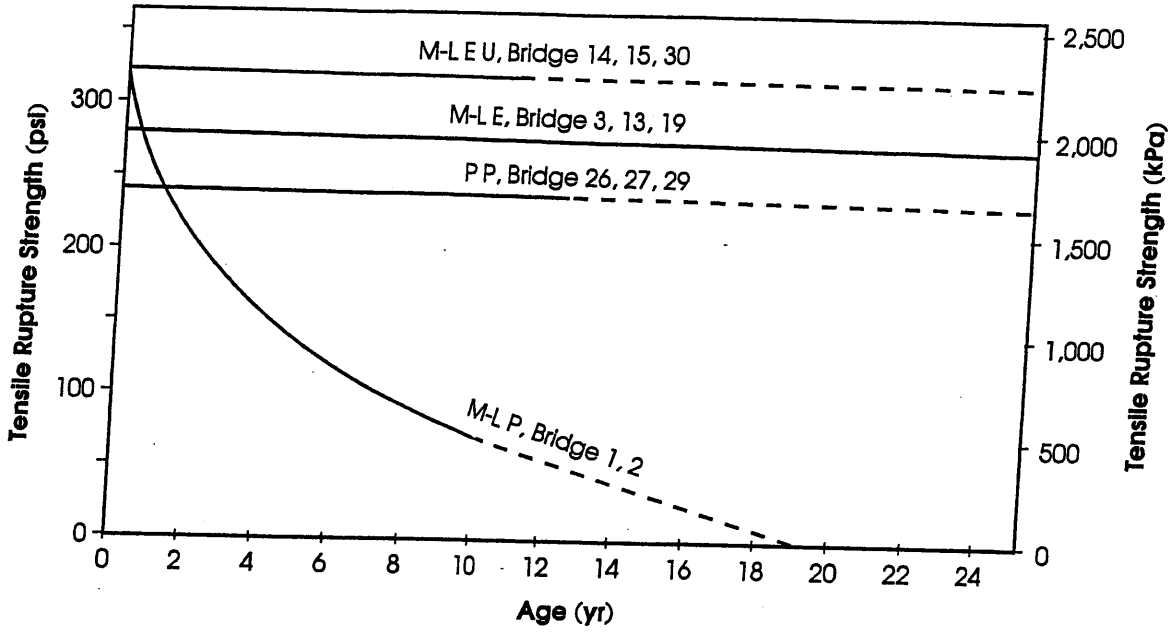
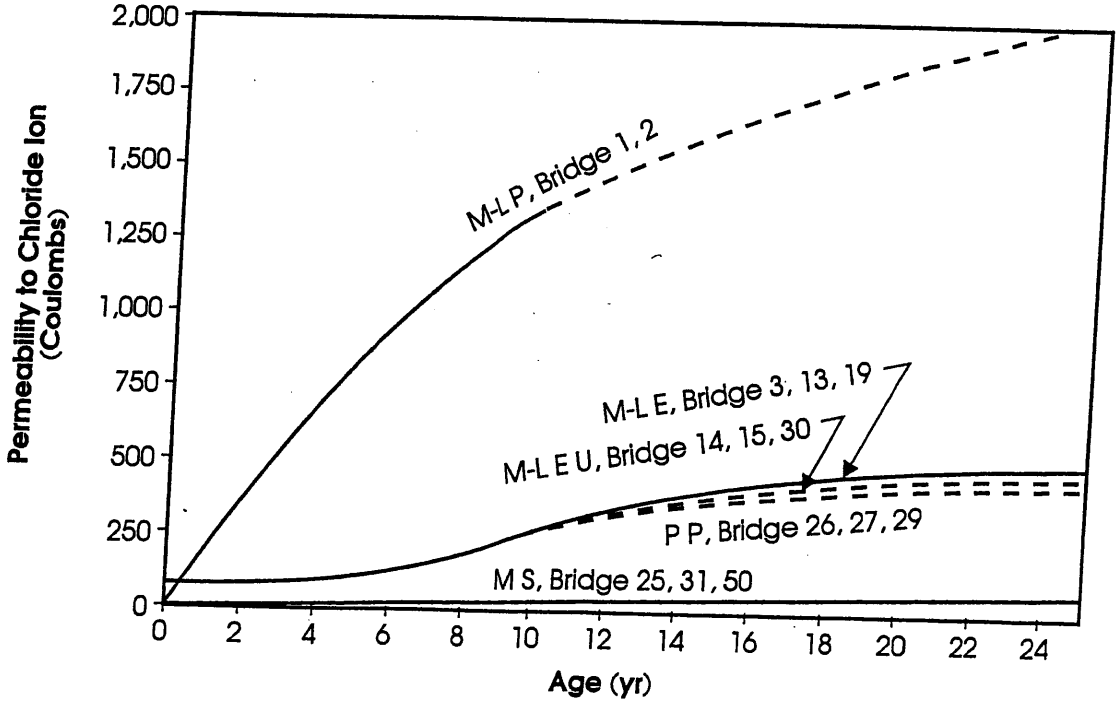


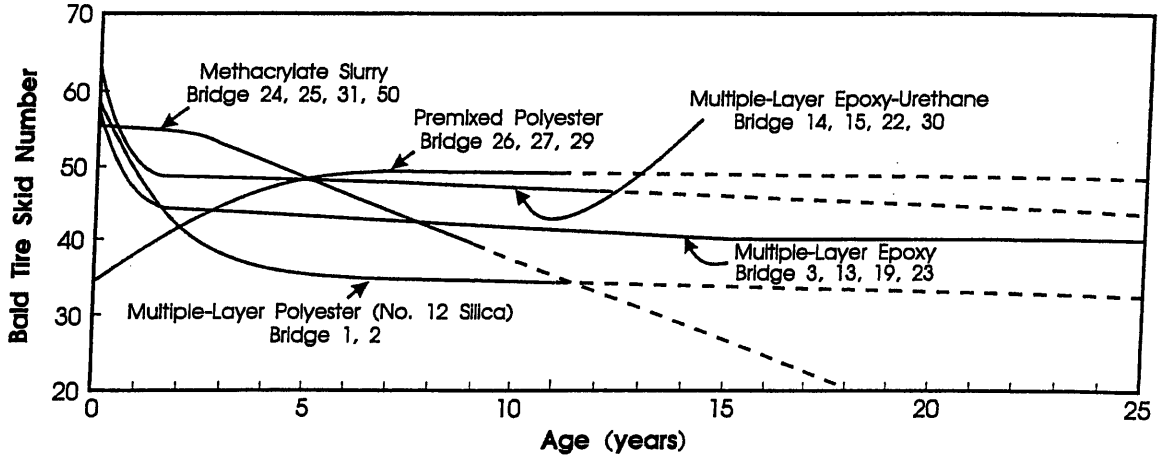
Figure 6. Permeability to chloride ion (AASHTO T 277) vs age for polymer concrete overlays.



Skid Resistance

A plot of skid number vs age is shown in Figure 7. New polymer concrete overlays typically have a bald tire (ASTM E 524) [6] skid number of 50 to 60. The skid number of polymer concrete is usually in the 30's or 40's after 15 to 20 years in service. With the exception of the MS, acceptable numbers are typically being maintained throughout the life of the overlays.

Figure 7. Bald tire skid number (ASTM E 524) vs age for polymer concrete overlays.



SUMMARY OF USE

Table 5 shows the number of polymer concrete bridge deck overlays constructed in the United States each year beginning in 1990 and the total constructed prior to 1990 based on data obtained from the seven major suppliers of materials. Use has increased during the 90's and as of 1999 a total of 555 bridges had been overlayed. Polymer concrete overlays constructed in accordance with AASHTO specifications [1] have become an accepted deck overlay system and use is expected to continue. Use of polymer

concrete overlays on fiber reinforced plastic bridge decks is expected to become an accepted practice because of the excellent performance on concrete decks.

TABLE 5. SUMMARY OF USE OF POLYMER CONCRETE OVERLAYS

Year	MLE1	MLE2	MLEU	MLE/ES	ES/MS	PP	MS	Total
90	0	3	3	4	2	3	1	16
91	19	15	4	6	0	6	8	58
92	6	5	6	4	4	6	4	35
93	9	17	7	0	1	9	3	46
94	10	9	8	4	0	22	7	60
95	12	12	5	1	3	7	4	44
96	1	1	6	3	3	17	1	32
97	13	4	14	2	4	17	0	54
98	8	1	7	1	5	10	0	32
99	-	-	9	-	6	24	0	39
Before 90	2	8	56	22	12	23	16	139
Since 90	78	67	69	25	28	121	28	416
Total	80	75	125	47	40	144	44	555

CONCLUSIONS

Multiple-layer epoxy, multiple-layer epoxy-urethane, and premixed polyester polymer concrete overlays constructed in accordance with AASHTO specifications can provide a skid resistant wearing and protective surface on concrete bridge decks for 25 years and are an economical alternative to hydraulic cement concrete overlays. Performance of similar polymer overlays on fiber reinforced plastic bridge decks is expected to be as good as on concrete decks.

RECOMMENDATION

Departments of transportation should use polymer overlays as described herein to provide bridge decks with skid resistance and protection against intrusion by chloride ions.

REFERENCES

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4. M. M. Sprinkel, *Nineteen Year Performance of Polymer Concrete Bridge Overlays*, American Concrete Institute, SP-169, Farmington Hills, MI, 1997.
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