Florida Department of Transportation
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AN INVESTIGATION INTO APPLICATION AND BONDING STRENGTHS OF THERMOPLASTIC PAVEMENT MARKINGS ON CONCRETE AND ASPHALTIC ROADWAY SURFACES

PROBLEM STATEMENT

Thermoplastic markings are known to have poor adhesion on concrete surfaces. They lose their bond with the concrete and tend to flake off. Failure has been observed within six to eight months. The markings appear to hold better on asphalt surfaces. The cause of the problem has not been identified yet.

The poor markings caused by the lack of proper adhesion to concrete surfaces have the potential to create several problems:

- Safety issues may arise as the motoring public travels on roadways with poorly defined center and edge lines.
- Cost issues arise because the highway maintenance crews must replace the markings with paint within a short period of time.
- Contractual disputes may arise.

OBJECTIVES

The primary objectives of this study were (1) to determine whether thermoplastics are suitable for concrete surfaces, that is, whether sufficient adhesion between them can be achieved, and (2) to determine which application procedures for surface preparation and application are most effective.

FINDINGS AND CONCLUSIONS

The adhesion between thermoplastic and asphalt was considerable, particularly as demonstrated by the high degree of failure that occurred in the epoxy glue and asphalt. Unanticipated failure in either indicates a strong bond. In the concrete-thermoplastic experiments, some instances of epoxy glue failure occurred, but the adhesion was significantly less than in the asphalt-thermoplastic experiments. Overall, thermoplastics performed better on asphalt than on concrete. Except for the control and sand-blasting sampling, asphalt values are higher than concrete values (see Tables 1 and 2, in which only the numbers in red, indicating failure of bonding between thermoplastic and either asphalt or concrete, are used to obtain averages).

The prime benefit of the study, however, was to be found in the investigation of surface preparation techniques. Surface treatment can improve adhesion with asphalt. The results with concrete, however, were not so promising.

Researchers concluded that, with regard to **asphaltic surfaces**:

- Grinding/scarifying produced the best results, followed by water-blasting and wire-brushing.
- Sandblasting produced the poorest results.
- Any surface treatment, regardless of type, was somewhat effective.

Table 1. Asphalt Pavement surface-adhesion stress in psi

Surface Treatment	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	AVG
Control- no treatment	150 thermoplastic failed	150 asphalt failed	150 epoxy glue failed	145 epoxy glue failed	100 epoxy glue failed	125 epoxy glue failed	**150**
Sand-blasting	150 thermoplastic failed	160 thermoplastic failed	170 thermoplastic failed	n/a asphalt failed	160 thermoplastic failed	n/a	**160**
Wire-brushing	180 thermoplastic failed	200 thermoplastic failed	140 asphalt failed	185 asphalt failed	140 thermoplastic failed	180 thermoplastic failed	**175**
Grinding/ scarifying	210 thermoplastic failed	220 thermoplastic failed	295 thermoplastic failed	120 asphalt failed	140 asphalt failed	160 asphalt failed	**242**
Water-blasting	300 thermoplastic failed	200 thermoplastic failed	200 thermoplastic failed	160 thermoplastic failed	190 thermoplastic failed	170 thermoplastic failed	**203**
Existing thermoplas-tic stripes	110 new thermo-plastic failed	110 new thermo-plastic failed	140 new thermo-plastic failed	95 old coating failed	110 old coating failed	n/a	**120**

Table 2. Concrete pavement surface-adhesion stress in psi

Surface Treatment	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	AVG
Control- no treatment	180 thermoplastic failed	200 thermoplastic failed	200 thermoplastic failed	150 thermoplastic failed	220 thermoplastic failed	250 thermoplastic failed	**200**
Sand-blasting	170 thermoplastic failed	185 thermoplastic failed	240 thermoplastic failed	210 epoxy glue failed	260 epoxy glue failed	220 epoxy glue failed	**198**
Wire-brushing	210 thermoplastic failed	160 thermoplastic failed	250 epoxy glue failed	140 thermoplastic failed	100 thermoplastic failed	195 thermoplastic failed	**161**
Grinding/ scarifying	230 thermoplastic failed	190 epoxy glue failed	250 thermoplastic failed	150 thermoplastic failed	270 thermoplastic failed	180 thermoplastic failed	**216**
Water-blasting	310 thermoplastic failed	200 thermoplastic failed	190 thermoplastic failed	185 thermoplastic failed	140 thermoplastic failed	100 thermoplastic failed	**188**

With regard to **concrete surfaces**,

- Grinding/scarifying produced the best results, followed by sandblasting and water-blasting.
- Wire-brushing produced the poorest results.
- Most treatments, except grinding/scarifying, were marginally effective or less effective than no-treatment.

Due to the length of the study, researchers do not suggest that thermoplastics no longer be used on concrete surfaces; further studies should be conducted to determine the long-term bonding characteristics between thermoplastics and concrete.

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