

Experimental Pavement Marking Materials Final Status Report

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INTRODUCTION

This is the second and final report on the evaluation of the experimental pavement marking materials conducted by the Indiana Department of Highways (IDOH), Division of Traffic. Table 1 is a list of the materials that were installed under contract in 1983. For a detailed explanation

TABLE 1
EXPERIMENTAL PAVEMENT MARKING MATERIALS

Bisymmetric Pavement Marking Tape by the 3M Company
Epoflex Epoxy Thermoplastic
High Solids Rubber-Base Paint
Polyester
Solvent Epoxy
100% Solid Epoxy

of the materials and their installation criteria, refer to the first report entitled "Experimental Pavement Marking Materials Interim Status Report." It was published in the Engineering Bulletin, Proceedings of the 71st Annual Road School.

DESCRIPTION OF EVALUATION TECHNIQUE

The evaluation consisted of daytime and nighttime field reviews conducted at the district level and reflective performance testing by Central Office personnel. The materials were installed throughout the 1983 construction season, allowing systematic field review and testing to commence in the spring of 1984. A second round was done on some locations in the late summer and fall of 1984. The final round of review and testing was conducted in the spring of 1985. After completing reviews and testing, written approval was granted to repaint poor lines on a location by location basis.

The district review process revealed several factors that affected the performance of the materials. One problem discovered was failure of the material due to shortfalls in its composition or formulation. This type

of failure, as shown in Figure 1, occurred after the test site was subjected to harsh typical Indiana winter weather. The formulation problem occurred at both the manufacturing level and on site, where machine mixing was required. The second type of failure occurred when the material reacted with previously applied sealant materials. Figure 2 illustrates this



Figure 1.



Figure 2.



Figure 3.

problem. The third failure type resulted when the material was obliterated through sand sealing, as shown in Figure 3, or resurfacing. This type of failure, although not a material related, still results in repainting and thus is not cost effective.

Though the district reviewing process was crucial to the final recommendation, the remainder of this report will discuss the quantitative aspects of the reflective performance testing. Two Ecolux retroreflectometers were purchased by contract, to conduct reflective testing. Figure 4 is a photograph of one of the instruments. Refer to the interim status

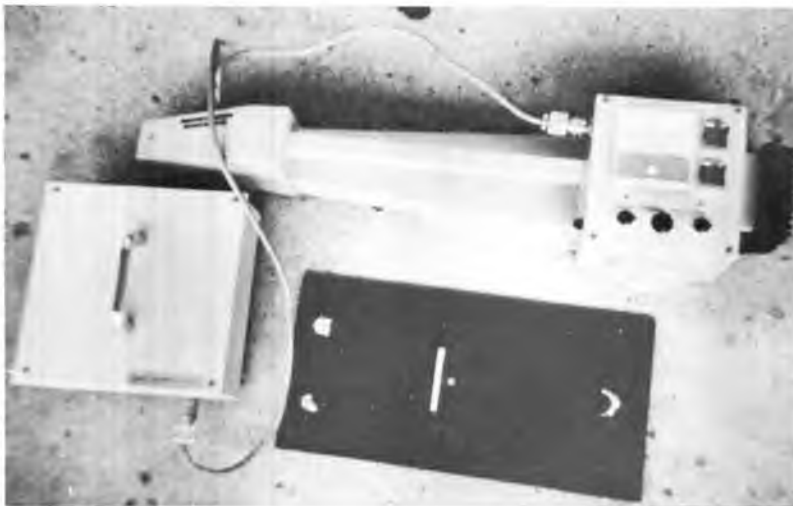


Figure 4.

report for a detailed explanation of the testing procedure. The testing operation involved a two-person team and a district flagging crew. They obtained over 1,800 material readings in the two years of testing. Figure 5 shows a typical operation used to obtain the readings.



Figure 5.

During the early stages of the analysis we discovered that the retroreflectance values for each instrument did not closely approximate each other. Each instrument is calibrated using its own specific calibration plate which is shown in Figure 4. However, this calibration does not insure that values obtained from one match those of the other. Test lines of both white and yellow were placed and comparison readings for both instruments were taken. Figure 6* is a graph of the retroreflectance values of the test lines. It demonstrates that readings from instrument 66 are higher than those from instrument 68 when tests were taken at identical locations. Furthermore, this difference is greater for white material than for yellow. This variance must be kept in mind when comparing the various materials.

Figure 7* graphically illustrates the extent of degradation our regular white paint undergoes during one winter season. This graph is of a single location. The data was gathered from the time of installation to the approximate time of repainting. It is provided for comparison purposes and should not be construed as the expected performance of all of our highway paint.

Figures 8* through 15* are the graphical representation of the

* Figures 6-15 were not reproducible

retroreflectance performance of each experimental material. Each graph is a plot of the mean value for the district in which the material was installed. The season in which information would be obtained varied from district to district. The charts include all available information. It should be noted that readings were not attainable until the material had undergone one winter season due to the late delivery of test instruments. These graphs are to be used in conjunction with the following comments and recommendations.

COMMENTS AND RECOMMENDATIONS

3M Bisymmetric

Comments

1. Bisymmetric pavement marking material adheres better to new asphalt surface than it adheres to concrete surface or old asphalt surface.
2. The cost of bisymmetric tape is in excess of 20 times the cost of a painted line.
3. After three years, the bisymmetric tape does not maintain an adequate level of retroreflectance to be feasible for continuation of use.
4. Bisymmetric tape is more susceptible to deterioration with transverse vehicular movement over the material.

Recommendations

1. White bisymmetric tape may be used as a lane line, or Yellow bisymmetric tape may be used as the centerline markings on bridge overlay projects. The bisymmetric tape shall only be permitted as an acceptable alternate by contractor option, on those bridge overlay projects with special provisions permitting such. (This is current IDOH practice.)
2. Bisymmetric tape shall be used on 3-R and 4-R projects at the following locations:
 - a. Gore area markings (this does not include any cross-hatched markings in the gore area).
 - b. Edgeline of the ramp adjacent to the gore markings.
 - c. Parallel edgelines approaching narrow bridges (300 ft length). The above markings shall be placed on the surface course of 3-R (or 4-R) contracts in lieu of the temporary pavement markings for such locations, as the work progresses through these areas. (This is current IDOH practice.)
3. Bisymmetric tape should be rejected for use in all applications where there is high movement of traffic across the material.
4. Due to the initial cost, life expectancy of the material, and volume of traffic upon the state's highway system, bisymmetric pavement

marking tape should not be utilized on the state highway system at locations other than as denoted in recommendations #1 and #2.

Epoflex

Comments

1. Application temperature of the material is very critical.
2. After application, the material has a very fast dry time (five seconds).
3. The material exhibited characteristics of poor bonding to the pavement.
4. The effective usable life of these materials, placed on these projects, appears to be less than nine months.

Recommendations

It is recommended that Epoflex pavement marking materials be rejected for use upon the Indiana Department of Highways system of highways.

High Solids Paint

Comments

1. High solids rubber-based paint is basically a conventional hop line paint.
2. Current paint equipment could be used to apply this type of material.
3. The material is applied at the same thickness and bead application rate as our standard and fast dry traffic paints.
4. This material has a three minute dry time. In order to eliminate tracking of this material, it would be necessary to have a longer paint train or to place cones. An alternate to these solutions is to accept an increase in the tracking of this material.
5. High solids rubber-based paint may be more susceptible to bleeding of the crack sealer than our standard and fast dry paint. It was noted at some locations that the sealer had bled through the markings and the markings appeared black.

Recommendations

Due to cost and life expectancy of this material, it is recommended that the high solids rubber-based paint be a permitted alternative to our standard and fast dry traffic paint.

Polyester Paint

Comments

1. According to manufacturers bulletins and descriptions, polyester pavement markings should generally not be placed on concrete

because the material does not adhere well to concrete. This was verified by the placement of polyester material on I-70 on a concrete section. Transverse lines were placed and approximately three months later, the lines had chipped off the pavement and were unusable. Apparently the polyester had not bonded sufficiently to the concrete surface. The polyester material was compared to hot thermoplastic, performed pavement tape and temporary construction tape.

2. Upon initial application of the polyester material, the nighttime reflectivity is very good.
3. Upon initial application the white material had a gray tinge to it. This is explained by the abundance of beads.
4. At night the yellow material has a lighter color (i.e., lemon color).
5. When placed over a sealed joint or crack, the sealing material tended to bleed through the polyester material, leaving a black line. In one case, or area, the polyester material caused the seal material to soften and lose bond from the pavement. The polyester pulled loose from the pavement and was no longer usable.
6. The drying time of the polyester material is very slow and when used for lane lines or centerlines, it is necessary to cone the markings in order to reduce the tracking caused by vehicles traveling over the material.

Recommendation

Due to the poor adherence to concrete, the bleed through of seal material, and softening of the seal material to the point of the polyester not being retained on the pavement, it is recommended that this material be rejected for use upon Indiana Department of Highways system of highways.

Solvent Epoxy

Comments

Within nine months of the application of the solvent epoxy material:

1. On one of the projects, 92% of the pavement markings were redone. Some by the contractor and some by district forces. That redone by the contractor was noted prior to acceptance of the contract and it was too late in the season for him to reapply the pavement markings.
2. On one project there was total repainting of the solvent epoxy pavement marking material. These materials had been acceptable under the contract.
3. On another project the majority of the solvent epoxy material was repainted. During the inspection, it was noted in some locations

that the material was flaking off, as if it were powder based material.

4. On a fourth project, it was noted that the solvent epoxy, which was plated over the joints, caused the joint sealing material to bleed through the solvent epoxy and black out the line. This resulted in an unusable and unrecognizable marking.

Recommendations

Due to the performance life of the material being slightly better than paint and the cost in excess of twice the cost of fast dry paint, it is recommended that this material be rejected for use upon the Indiana Department of Highways system of highways.

100% Solid Epoxy

Comments

1. As denoted by one of the manufacturers, the mixing ratio of the two components is critical.
2. It was noted on one contract that when the material was applied, it looked good, however, in 24 hours it turned black and at a later date, these darkened spots failed and chipped away due to vehicular actions.
3. It was noted on some of the contracts that the material tended to clog the spray guns. Due to the extensive clogging of guns, the completion of what would normally be a two-week job, took seven to eight weeks.
4. The white line, when placed, had a good white color, however, after being in place a few days, it tended to darken (have a gray tinge).
5. The 100% solid epoxy pavement marking material did provide a better nighttime lane delineation, under rainy conditions, than did our standard fast dry paint markings.
6. After the material had been in place three to four months, it was noted that the epoxy material, on concrete pavement, tended to chip away, in the area of the joints.
7. In early spring, 1985, it was noted that the white material, on concrete pavement, when viewed in the day, exhibited a very poor white color, however, when viewed at night under headlights, the line appeared to be white and it did provide acceptable reflectance.
8. With few exceptions, after two years of the material being in place, it has been recommended that the locations be repainted due to wear, or lack of reflectivity of the epoxy pavement markings.

Recommendation

It is recommended that this material be permitted for use on those

locations where the ADT is in excess of 1,100 vehicles per lane and it can reasonably be expected that the location will provide a two-year time frame, after the material is installed, before resurfacing (i.e., the location is not proposed or scheduled for resurfacing within the next three years).

SUMMATION

Further graphical methods, such as plotting retroreflectance versus volume or versus time, provided unacceptable statistical correlations. Therefore, a material degradation curve could not be developed for any of the experimental materials. Further applications under stricter supervision and testing could result in an acceptable degradation curve.

In summary, the final status regarding general use of the experimental materials is shown in Table 2. The recommendations were based on the non-quantitative district review process and the retroreflectance testing of the materials.

**TABLE 2
FINAL STATUS REGARDING GENERAL USE**

| Material | Status |
|-----------------------------------|--------------------------|
| Bisymmetric Pavement Marking Tape | Conditional Use |
| Epoiflex Epoxy Thermoplastic | Not Suitable for Use |
| High Solids Rubber-Base Paint | Standard Paint Alternate |
| Polyester | Not Suitable for Use |
| Solvent Epoxy | Not Suitable for Use |
| 100% Solid Epoxy | Conditional use |