EXPERIMENTAL FEATURES REPORT

Interim Report 7-27-09 Region 2 Traffic Joe DeHeart

Project : IM-0252-382
Project Subaccount Number: 15517
Region : 2
Milepost : I25 MP 133
(1000 ft south)

7-27-09 Report Changes

The only changes to this 7-27-09 report as compared to the previous 2-3-09 report are the addition of readings taken 7-22-09. Changes are indicated in the margin.

TITLE

Epoplex Glowmarc 90 Polyeurea Pavement Marking

INTRODUCTION

1. Description of Experimental Feature:

a. This pavement marking was a proprietary product at the time of installation. Since its installation the product has been added to CDOT'S Approved Products List.

b. The Polyeurea pavement marking is a polymer based 2 part compound "LS90" much like the typical epoxy pavement material. The beads applied to the liquid substrate are the "Clusterbeads" and "Visibead Plus II". This combination of all three products constitutes the Glomarc90 product. The advantage of the polymer product is its UV resistance and it resistance to yellowing over time. The advantage of the beads used is the special construction and configuration of the beads and the significantly better reflectivity performance over normal glass beads. The Polyeurea marking provides wet night reflectivity where the other materials on the roadway offer none.

c. The extent of the test section is both the north and south bound lanes of I 25 from mp133 south 1000 feet. Polyeurea was placed in an inlaid groove (100 mil) on both the interior and exterior shoulder lines at a 25 mil thickness and preformed plastic markings was placed in an inlaid groove (90 mils) on the skip lines at a 65 mil thickness. The south 250 feet of the test section has the Polyeurea marking for the shoulders and skip lines. The roadway leading into and away from the test section has surface applied epoxy markings for the shoulder lines and inlaid preformed plastic markings for the skip lines. The Polyeurea, preformed plastic, and epoxy markings were placed on 11/5/2006.

2. Function/Purpose:

a. This pavement marking works the same as other pavement markings utilized by the State to delineate or to convey information. The intended purpose of the test section

was to evaluate the short and long term performance and initial cost of the polyeurea markings against the preformed plastic markings used.

b. Federal Hazard Elimination and Safety (HES) funds were used for the cost of this experimental feature. Crash history and pattern analysis indicated a correlation with night time accidents. Originally the proposed treatment was to add lighting along this section of roadway. Better delineation can be as effective as overhead lighting and can cost substantially less. This Polyeurea pavement marking was originally believed to have 2-3 times better night time reflectivity over epoxy pavement markings, thus making it a good solution for better delineation. Preformed plastic markings are believed to have the same reflectivity performance as the Polyeurea, but the Polyeurea bid price was about half of the preformed plastic unit price.

c. Attach plan sheet and typical section or working drawings if helpful in describing feature. See Appendix B

3. Background:

a. Has the experimental feature been used previously in Colorado or other states?

- List previous or current projects already testing this experimental feature.
  No projects prior to this one have used the product. After this project (2) CDOT projects will utilize this product in Region 2 and Region 6.
- List any known state-funded only projects (not listed above).
  Unknown
- List any known independent laboratory testing (if applicable).
  Unknown
- List any known installations by other agencies.
  Minnesota
  Nebraska
  North Carolina
  Georgia
  Virginia
  South Carolina
  Mississippi

b. Describe performance of projects listed above. Include successes and failures.

The product is performing as expected in all the locations listed above.

c. How is this particular experimental feature's use different from use on other similar projects?

The product is used the same as preformed plastic or epoxy pavement markings to delineate lane lines.

The product was installed in an inlaid groove at 100 mils and applied in the same manner as other CDOT utilized pavement markings. The application is

a spray truck that mixes the two components at the nozzle and has a double drop system for the two types of beads. Line marking was placed at 25 mils.

d. Description of any related approved or planned experimental feature projects and how their application fits the overall research effort for this feature.

The polymer based substrate is more durable over temperature ranges and is more UV resistant and will not yellow over time as much as epoxy paint. Polymer substrate could be an alternative for epoxy substrate as long as the standard beads are used for surface applications. Snow plow damage is the biggest factor in the performance of surface applied pavement markings. Even if the polymer substrate could last twice as long as epoxy, it might be scraped off by plows, thus negating its other benefits.

Other manufactures provide specialized beads that are better at reflectivity than standard beads and are comparable to the “Clusterbeads" and "Visibead Plus II.” Since this test project, Epoplex has been developing second generation specialized beads with better reflectivity called the “Visimax" and "Visibead Plus II.” The use of these special beads is the critical factor in the brighter reflectivity performance of this product. A pavement marking with these specialty beads must be inlaid. If this material is surface applied, the snow plows will grind off the specialty beads leaving a marking line with worse reflectivity than epoxy.

e. What is the anticipated time frame for completion of the performance evaluation of all similar experimental features?

It has been assumed that the expected life of preformed plastic skip line pavement markings is about 5 years. The goal of the test section is to evaluate the reflectivity of the preformed plastic pavement markings and the Glowmarc 90 at the 5 year point which would be the end of the assumed life of the preformed plastic skip lines. If the inlaid Glowmarc 90 is still more reflective than the inlaid preformed plastic markings then CDOT will have an alternative for the preformed plastic markings that can be placed for approximately half the cost. A secondary result to this test section it that the effective life of the preformed plastic marking may only be 3-4 years instead of the assumed 5 years when measuring long term reflectivity performance.

4. Potential Benefits to the Department.

CDOT will have an alternative for the inlaid preformed plastic markings skip lines that can be placed for approximately half the cost.

On a multi lane highway, it has been R2’s practice to place inlaid preformed plastic pavement marking on the skip lines. With this more reflective material the delineation is improved over using epoxy marking material. Due to the

cost of the preformed plastic marking material, the region has only been able to afford placing it on the skip line, where the desire is to place it on the shoulder lines as well.

Many miles of skip lines on multi lane highways as well as all shoulder lines are epoxy markings because the MLOS funds used for striping maintenance have been insufficient to satisfy the overall LOS for the region and place more inlaid preformed plastic markings on skip lines. With this alternative product the region could place twice as many miles of improved reflectivity skip lines.

REPORTING

1. Construction Report –

- Ease of installation:

  The installation techniques utilized are already standard practice in the pavement marking arena. The two processed used were, grooving of the concrete or asphalt mat and spray truck application of the marking material. At the time of installation there was only one truck capable of holding and mixing the polymer (Polyeurea) substrate within the central United States. The subcontractor used to apply the Glowmarc 90 mobilized from Wisconsin. Since this project was completed there have been two Colorado contractors that have obtained the equipment to place the polymer substrate.

- Unforeseen difficulties, including the need of any Contract Modification Orders (CMO) associated with the experimental feature:

  The most time consuming aspect of the installation was the clean up of the water used during the pavement grooving operation. The grooving operation itself was not any different than used for inlaid preformed plastic pavement markings and achieved approximately the same rate of production. The application of the Glowmarc 90 was not any different than used for epoxy pavement marking and achieved approximately the same rate of production.

2. Performance Evaluation – Due annually on or before July 1st should, at minimum, include:

- Comparison

  Reflectivity readings are taken randomly within 300 feet north and south of the 133 mile marker sign on the north bound lanes of I25. To the south of the sign, the inlaid Glowmarc 90 was placed on the white and yellow shoulder lines along with inlaid preformed plastic skip lines. To the north of the sign, surface applied epoxy markings were placed on the white and yellow shoulder lines along with inlaid preformed plastic skip lines. Three to five readings are taken randomly along each pavement marking are taken and averaged.

Reflectivity readings are taken using a Delta LTL-X Retrometer and calibrated before each series of readings. The reflectometer will read accurate readings with the wheels on the back of the machine installed. If the wheels are not installed the reflectometer will read slightly higher readings. The first sets of readings were taken inadvertently with the wheels not installed. Subsequently, all readings performed after the initial have been with the wheels not installed in order to measure consistently through the test period.

• Before/After Study.

The first reflectivity readings were taken shortly after all the different kinds of markings were applied to the roadway. These initial readings were considered the benchmark or control readings with which all subsequent readings would be compared.

7-27-09 Report Changes

Material	11/21/06	12/5/06	7/17/07	7/1/08	7/22/09	2010	2011
Glowmarc 90 – white	1246	345	307	304	289		
Glowmarc 90 – yellow	334	102	130	106	119		
Epoxy – white	297	176	77	69	53		
Epoxy – yellow	156	26	41	32	33		
Preformed Plastic – white	787	217	149	83	104		
Glowmarc 90 vs Preformed Plastic	158%	159%	206%	366%	278%		

Notes:

1. Readings on 12/5/06 were after a snow event and there was mag chloride still visible on the surfaces of all the pavement markings.
2. Epoxy pavement markings in this test section were traced on 9/17/07. The epoxy pavement markings will be traced again in Sept-Oct 2009.

• Laboratory Testing.

No laboratory testing has been performed related to this project.

• Horizontal/Vertical Surveys (if required).

No horizontal / vertical surveys performed related to this project.

• Visual Observations/Engineering Judgment.

See Appendix A - Interim Report Wednesday, November 28, 2007 for observations.

- Early termination may be requested if further evaluations would not provide additional beneficial information or if a statewide implementation policy can be recommended.

    The end of the testing was initially planned for 5 years from placement (11/2011) which corresponds to the assumed end life of the preformed plastic markings. The reflectivity readings of the Glowmarc 90 and preformed plastic markings will be compared. If the two materials reflectivity readings are similar then the test is considered a success in showing that the Glowmarc 90 performs similarly to preformed plastic pavement markings and can be installed for half or more of the square foot price. The test may be concluded earlier if the effective life of the preformed plastic marking is realized in 3-4 years instead of the assumed 5 years.

3. Final Report - At the conclusion of the reporting period, a Final Report is due and should include a summary of findings and recommendations on future use.

    Final Report will be submitted in early 2012. The final report may be submitted earlier if the effective life of the preformed plastic marking is realized in 3-4 years instead of the assumed 5 years.

RESPONSIBILITIES

The Principal Investigator is responsible for technical liaison efforts, performance evaluations and submittal of all evaluations/reports to the Research Branch. Should the Principal Investigator leave this area of functional responsibility, a replacement Principal Investigator must be identified and the Research Branch notified of the change.
It is imperative that the Principal Investigator apprise the regional maintenance superintendent of the location and status of the experiment, to preclude maintenance activities from invalidating the evaluation effort.

The Sponsor (either a Regional Transportation Director or Region Materials Engineer) is to be listed and will be accountable for ensuring that the evaluations and reports are completed in a timely manner and submitted to the Research Branch. Provide a statement that lists the Sponsor's commitment to review reports during this experiment as well as those of related projects to determine the potential statewide application/impact prior to CDOT making a request to FHWA for removal of the feature from experimental status.

The Research Branch will compile an annual report to the Chief Engineer documenting the completion rate of the evaluations and reports.

PROPOSED IMPLEMENTATION PLAN

Include the anticipated manual, policy, specification changes, etc., that would need to be updated should this experimental feature research conclude a positive impact or benefit to the CDOT.

APPENDIX A

Interim Report
Wednesday, November 28, 2007

Subject: Polyeurea Pavement Marking I25 MP 133

Gentlemen,

Early last year we discussed placing a pavement marking test section on I25 to evaluate the performance of Epoplex's Glowmarc90 Polyeurea pavement marking material. The intended purpose of the test section was to evaluate the performance and cost of the Polyeurea markings against the preformed plastic markings. I would like to take the opportunity to present you with the ongoing performance results of the pavement marking materials.

This test section was installed with the project IM 0252-382 / 15517. The extent of the test section is both the north and south bound lanes of I 25 from mp133 south 1000 feet. Polyeurea was placed in an inlaid groove (100 mil) on both the interior and exterior shoulder lines at a 25 mil thickness and preformed plastic markings was placed in an inlaid groove (90 mils) on the skip lines at a 65 mil thickness. The south 250 feet of the test section has the Polyeurea marking for the shoulders and skip lines. The roadway leading into and away from the test section has surface applied epoxy markings for the shoulder lines and inlaid preformed plastic markings for the skip lines. The Polyeurea was placed on 11/5/2006.

The Polyeurea pavement marking is a polymer based 2 part compound "LS90" much like the epoxy pavement material. The beads applied to the liquid substrate are the "Clusterbeads" and "Visibead Plus II". This combination of products constitutes the Glomarc90 product. The advantage of the polymer product is its UV resistance and it resistance to yellowing over time. The advantage of the beads used are the special construction and configuration of the beads and the significantly better reflectivity performance over normal glass beads. The Polyeurea marking provides wet night reflectivity where the other materials on the roadway offer none.

Plan quantities for the project were 6,134 SF for the preformed plastic pavement marking and 74 GAL for the Polyeurea marking. As you can see the quantities for the preformed plastic are not considered small and are typical for an overlay project. We expected to see normal competitive bid prices for the preformed plastic the contractor's bid price of reflects that. The quantity for the Polyeurea is very small and we did not expect a very competitive price especially when the only contractor able to apply this material had to mobilize from Wisconsin. The cost break down is below:

Preformed Plastic marking - bid price $14 / SF - (6134 SF)
Polyeurea marking - bid price $761 / Gal - (74 Gal) --> conversion of 0.01 Gal / SF --> 0.01 Gal/SF x $761/SF = $7.61/SF

Even with the higher than expected gallon price the Polyeurea is half the price of the preformed plastic.

The performance measure has two parts with one being the reflectometer readings of the various pavement marking materials and the other being the visual interpretation of the lines by the driver.

My visual interpretation as a driver at night was the ability to see the polyeurea line for approximately 5 delineator posts ahead of the vehicle for the shoulder lines in comparison with the epoxy markings being able to see approximately 3 delineator posts ahead of the vehicle. The Polyeurea skip lines

were visible approximately 5 skips ahead of the vehicle in comparison with the preformed plastic markings being able to see approximately 3-4 skips ahead of the vehicle. The most dramatic visual was the apparent disappearance of the shoulder line as the end the test section going from the polyeurea shoulder line to the epoxy shoulder line both white and yellow. I received two unsolicited emails from a CDOT employee who drives this stretch frequently and the project manager of the overlay project have included those below:

From Dole Grebenik

"This new paint met or exceeded my expectations. During the day, its brightness is comparable to the epoxy, but its real strength is at night. The total brightness is only marginally better than new epoxy but the big advantage is in the amount of stripe that shines. With the epoxy, let's say 150 feet of stripe lights up, with the polyeurea, the 3D texture glows for 2 to 3 times farther. The true test will be in 6 to 12 months. Unfortunately, it is not a fair test since the epoxy is not placed in a groove either."

From Mike Bass

"The high level of reflectivity comes from the cluster beads which required the inlaid process. The colors seem more vivid than the epoxy, which almost looks dull by comparison. I guess the real test will be whether the colors fade and dull over time. I doubt reflectivity will be much of an issue due to the cluster beads. I'm curious what the actual numbers are compared to the epoxy."

Driver interpretation is without a doubt subjective and difficult to quantify but the information does speak well for the performance of the polyeurea material.

Reflectometer readings were taken on the following dates:

Material	11/21/2006	12/5/2006	7/17/2006
Polyeurea - white	1246	345	307
Polyeurea - yellow	334	102	130
Epoxy - white	297	176	77
Epoxy - yellow	156	26	41
Preformed Plastic - white	787	217	149
Polyeurea vs Preformed Plastic	158%	159%	206%

Notes:

1. Readings taken on 12/5/06 were after a snow event and there was mag chloride still visible on the surfaces of all the pavement markings.

2. Multiple readings were taken for each material and color and the average of those readings are represented here.

3. A Delta LTL-X Retrometer was used for the reflectivity readings with the wheels off and was calibrated prior to each measurement event.

The reflectometer readings show that the polyeurea is significantly brighter than the preformed plastic pavement marking.

As a side note to the comparison of the Polyeurea to preformed plastic, Federal HES money was applied for and used in this project to improve roadside hazards. The original application indicated lighting to be installed to reduce night time accidents. It was requested that better delineation be applied instead of illumination. Polyeurea was chosen as a marking material that would provide better delineation of the shoulder lines satisfying the requirement. Delineators along this stretch of road were doubled to accomplish the same goal. The performance of the Polyeurea on the shoulders lines and the double delineators indicate better delineation was accomplished. Recent accident data has not been obtained to determine if these improvements actually reduced the number of night time accidents. That comparison will be conducted at a later time.

Conclusion is that the Polyeurea marking was placed at half the cost of the preformed plastic marking. The driver perspective indicates the polyeurea offers more delineation of the roadway than preformed plastic, translating to better site distance. Reflectometer readings show the Polyeurea is at least 50% brighter or more than the preformed plastic marking. The Polyeurea has demonstrated to be a better short and long term performing marking material over preformed plastic markings and can be installed at less than half the cost per square foot. As the product develops, local contractors are able to install, more projects, and projects with larger quantities we will surely see the price per square foot significantly reduce making the cost versus performance even more attractive.

If you have any questions or desire additional information, please don't hesitate to call.

APPENDIX B

CDOT Project 15517 – Specifications

Adobe Acrobat 7.0 Document

EPOPLEX – Specifications

Adobe Acrobat 7.0 Document