Interim Report

THE EVALUATION OF EPOXY THERMOPLASTIC PAVEMENT MARKING MATERIAL IN VIRGINIA

--The Application--

by

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ABSTRACT

Epoxy Thermoplastic (ETP) is a recently developed epoxy-resin-based thermoplastic pavement marking material being promoted by the Federal Highway Administration as a possible substitute for conventional traffic paints and thermoplastics. Its reported advantages are excellent durability and adhesion, quick drying time, good visibility, lack of pollutants, and low cost. As part of its demonstration projects program, the FHWA is field testing ETP in several states, including Virginia, in an effort to evaluate the performance of the material. The Virginia evaluation will compare the performance of a 5.8-mile section of ETP lane markings on Interstate 95 to that of a corresponding section of traffic paint on the same highway. The initial installation of the material in Virginia had several equipment and operational problems which resulted in varying thicknesses and distributions of beads along the ETP stripes. These problems and the resulting inconsistencies, as well as the properties of the ETP material and the layout of the Virginia installation, are discussed in this report.

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INTRODUCTION

As part of its demonstration projects program, the Federal Highway Administration has chosen the Commonwealth of Virginia as one of the states in which it will conduct field evaluations of epoxy thermoplastic (ETP) pavement marking material. As indicated in the working plan entitled "Epoxy Thermoplastic Pavement (ETP) Material - Demonstration Project No. 60," the Virginia Department of Highways and Transportation is responsible for evaluating the performance of the material. The purpose of this evaluation is to compare the material to the conventional traffic paint used by the Department by field testing both materials and assessing their appearance, night visibility, and durability.

This report briefly describes the composition of ETP , its advantages and disadvantages, and the method of application. Additionally, it discusses and assesses the trial application of the material on a section of Interstate 95 in Northern Virginia. Once the test material has failed and the periodic follow-up evaluations are complete, a final report will be prepared to summarize the results and present recommendations.

EPOXY THERMOPLASTIC PAVEMENT MARKING MATERIAL

Composition and Application

Composition

The material being evaluated is an epoxy-resin-based thermoplastic material developed by the Southwest Research Institute for the Federal Highway Administration. Its main components are two epoxy resins, pigment, filler, and glass beads combined in the following proportions:

Solid resin--30 parts by weight solid epoxy resin
Liquid resin--20 parts by weight liquid epoxy resin
Pigment--10 parts by weight titanium dioxide (white formulation)
or 9.26 parts by weight silica encapsulated lead chromate, medium yellow pigment (yellow formulation)
Filler--10 parts by weight calcium carbonate
Beads--14 parts by weight standard pre-mixed beads

ETP has a density of 13.1 lb./gal.

Application

ETP can be applied to both concrete and asphalt road surfaces in much the same manner as other thermoplastic pavement markings are applied. To be effective, it must be applied as a hot spray at a temperature between 450° and 460° F. The equipment used is a truck whose basic components are a melter and a spray pot. Generally, a conventional cold-paint striper or a thermoplastic truck is converted for use in making the application. A three-man crew is required to operate the truck.

ETP is shipped as a solid block and is cut into smaller blocks for melting. It is generally applied with a low pressure, airless spray system, although atomized air can be used if it is heated to at least 350° F. The recommended application rate is 15 to 20 mils, applied at a speed of between 5 and 8 mph.

Advantages and Disadvantages of ETP

Advantages

The advantages of ETP reported by the FHWA are excellent durability and adhesion, quick drying time, good visibility, lack of pollutants, and low cost. Each is briefly described below.

Durability: More durable than conventional traffic paint by a factor ranging from two to ten, depending upon traffic and weather conditions. In warm climates with no snowplowing and moderate traffic conditions, the service life of ETP is ten times that of traffic paint. Cold climates where snowplowing and the use of tire chains are prevalent and traffic is heavy reduce durability to twice that of conventional paint applied under the same conditions.

Adhesion: As good or better than that of other marking materials on both concrete and asphalt surfaces. No primer or special surface preparation is required.

Drying Time: Can be exposed to traffic in less than 5 sec. with no tracking.

Visibility: Through the use of both drop-on and pre-mixed glass beads, good night visibility is maintained throughout the service life.

Pollution: Virtually smokeless on application and with 100% solid composition (eliminating any volatile components), an application of ETP does not pollute the air.

Cost: In-place cost is approximately 10¢ to 15¢/lin. ft., although costs have ranged as high as 18¢/lin. ft. in some test evaluations. When the expected service life is reduced to that of conventional traffic paint, ETP is 1.65 times as expensive. However, since ETP has displayed a service life of at least twice that of traffic paint, a relative cost of no more than 82% is a more realistic estimate. If service life is four times that of conventional paint, cost drops to 41% that of traffic paint.

Disadvantages

The major disadvantages reported with the use of ETP are the high application temperature and the difficulty in keeping the equipment clean and obstruction free. Because of the time required to heat the material to 450° F (4 to 5 hours minimum), the difficulty in keeping it at that temperature until it reaches the surface of the road, and the safety risks inherent in the use of such a high temperature material, there has been some reluctance to adopt ETP.

Since ETP is a thermoplastic, the equipment must be cleaned while it is hot, and conventional solvents cannot be used. For thorough purging, the liquid resin component of the material must be used under heated conditions. Special attention must also be paid to the removal of stray pre-mixed beads, which have a tendency to clog the spray pot.

An additional disadvantage is the necessity and cost of equipment modification. Unless extensive, long-term use is planned, this may offset any cost advantage over the use of traffic paint.

EVALUATION SITE

Location of Site

The evaluation of ETP in Virginia is being conducted on a 5.8-mile segment of Interstate 95 which begins north of the Fairfax-Prince William County line and extends to the Dale City automobile rest areas. This location was chosen for three reasons:

- It includes a transition from concrete to asphalt pavement on I-95 south of the county line and thereby provides an opportunity to evaluate ETP on both types of road surfaces.
- It carries a heavy average daily traffic volume of 57,000 vehicles.
- It includes a newly paved 1.3-mile unmarked segment of asphalt highway in the southbound lanes.

Layout of Site

White ETP was placed on the right edge line and outside skip lines of the southbound lanes of I-95 and on the inside skip lines of the northbound lanes. Because of the limited supply of ETP available, only the first 1.5 miles of the southbound outside skip lines were sprayed. All remaining markings on the test section of pavement were marked with traffic paint (the left edge line with yellow paint).

The applications of ETP in the southbound lane begin one skip line north of the old Rte. 123 overpass and extend 5.8 miles to the entrance ramp from the Dale City automobile rest area. The details are given in Table 1.

The applications in the northbound lanes begin just north of the Neabsco Creek Bridge and extend 5.5 miles to the Fairfax-Prince William County line at the southern end of the Occoquan River bridge.

Table 1

Description of Applications

Southbound

Mileposts	Surface Type	Existing Markings
0.00-0.45 mi.	concrete	paint recently placed over thermoplastic
0.45-3.65 mi.	asphalt	traffic paint
3.65-4.50 mi.	newer asphalt	traffic paint
4.50-5.80 mi.	newly paved asphalt	none

Northbound

0.00-1.55 mi.	fairly new asphalt	2-month old traffic paint
1.55-3.60 mi.	older asphalt	traffic paint
3.60-4.50 mi.	very old asphalt	traffic paint
4.50-5.50 mi.	newer asphalt	traffic paint

ASSESSMENT OF THE APPLICATION PROCESS

The applications were made on September 27 and 28, 1983, under clear skies and with 70° F temperatures. An FHWA crew operated the ETP truck and a paint crew from the Culpeper District of the Virginia Department of Highways and Transportation was responsible for traffic control and the application of the conventional traffic paint.

For the Virginia installation, the FHWA leased an ETP truck from the Redland Prismo Corporation. From the beginning of the applications, the truck had operational problems. Before driving it to the evaluation site, the three-man FHWA crew spent nearly two hours trying to correct a malfunctioning bead gun. Once marking of the edge line and skip line in the southbound lanes was begun, problems were encountered with the distribution of the beads and material. On the concrete pavement and on the first several hundred yards of the asphalt pavement, the ETP was applied very thinly and unevenly. A sample of the skip line material revealed an application rate of 14 mils in the center of the line and 10 mils on the edge. Additionally, few beads were distributed by the bead gun along this portion of the line, and those that were applied were dispersed sporadically throughout the stripe.

After the FHWA crew, with the assistance of two Prismo technicians, made some adjustments to the guns (including the use of a blow torch to heat the spray gun to the proper temperature), the distribution of the material and beads seemed to improve. However, only the edge line was sprayed for the remainder of the southbound application, apparently because of insufficient pressure within the system to operate the skip line and edge line guns simultaneously. Two samples of the edge line along the remaining southbound test area showed greater consistency in bead distribution, although the material tended to be rather thick in the center portion of the line. One sample had a thickness of 29 mils in the middle and 10 mils along the edges, while the other had a thickness of 30 mils in the middle and 12 mils along the edges.

After completing the southbound application, the crew moved the truck over to the northbound lanes, where the inside skip line was sprayed with ETP with no apparent problems. An analysis of a sample from the northbound skip line showed that the distribution of drop-on beads was consistent throughout the stripe. However, the line was applied quite heavily in the middle and very thinly along the edges, with a sample showing an application rate of 31 mils in the center and 6 mils along the edge. This may cause the stripe to appear somewhat narrow when viewed at night.

On the second day, the ETP truck performed much better as it marked the southbound skip line and restriped the portion of the southbound edge line which had been sprayed on the concrete surface the previous day. The drop-on beads were dispersed evenly along the stripes, and both spray guns performed well. Samples taken when both guns were operating revealed a skip line application rate of 19 mils in the center and 12 mils along the edges and an

edge line application rate of 27 mils in the center and 11 mils along the edges. A skip line sample taken later when only one gun was operating had an application rate of 31 mils in the center and 14 mils along the edges.

The second day's application had to be cut short, however, when the FHWA crew exhausted their supply of marking material after approximately 1.5 miles. The remaining unmarked portions of the skip line were then marked with traffic paint.

The analyses of the seven samples of ETP material and one sample of traffic paint taken during the application showed that the ETP varied in thickness from 14 to 31 mils in the center portions of the lines and from 6 to 14 mils along the edges of the lines, with an average application rate of 28 mils in the center and 11 mils on the edges. The traffic paint was applied at a rate of 8 mils (dry) in the center and 6 mils (dry) along the edges.

Despite the variety of difficulties encountered, the FHWA did manage to put down an ETP skip line and edge line which will be sufficient for the purposes of this evaluation. Since the Virginia Department of Highways and Transportation has long been looking for a pavement marking material that is both durable and cost effective and has a high retention of reflectivity, the Department is primarily concerned with the performance of the material. If, however, the equipment problems which plagued the application are indicative of those commonly found with ETP equipment, they must be seriously considered in any decision to adopt ETP as an agency standard.

PHOTOGRAPHS OF THE VIRGINIA APPLICATION

As part of the Department's evaluation of epoxy thermoplastic pavement marking material, a series of representative photographs are taken at each inspection. For the initial application, photographs of the ETP truck and of the pavement markings prior to the application are also included. Photographs of corresponding sections of the test area will be taken at future evaluations to provide a visual record of the performance of the material.

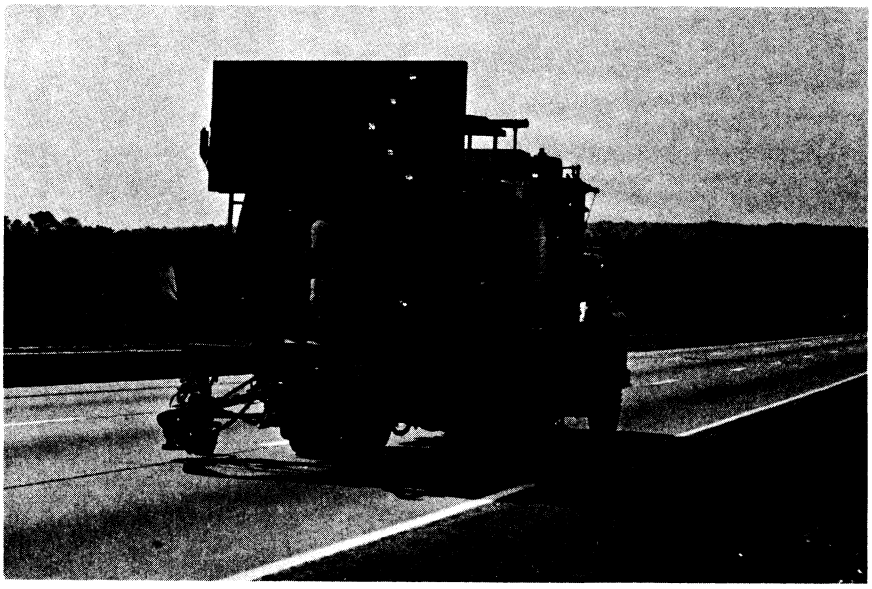

Figure 1. The ETP truck.

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Figure 2. Existing pavement markings on asphalt surface before ETP was applied.

Figure 3. Overview of the southbound lanes. Outside edge line and skip lines are marked with ETP; inside skip lines and edge line are marked with traffic paint.

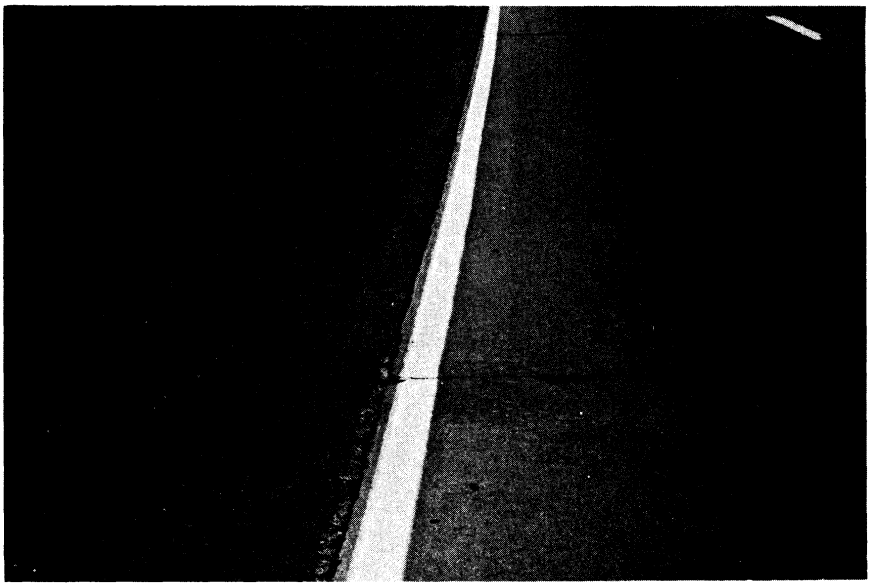

Figure 4. ETP edge line on concrete surface.

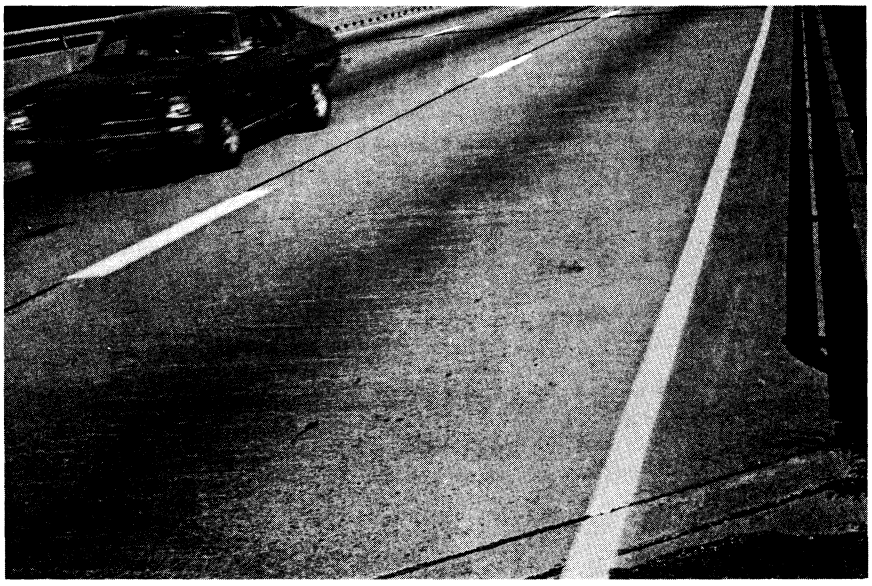

Figure 5. Traffic paint on concrete surface.

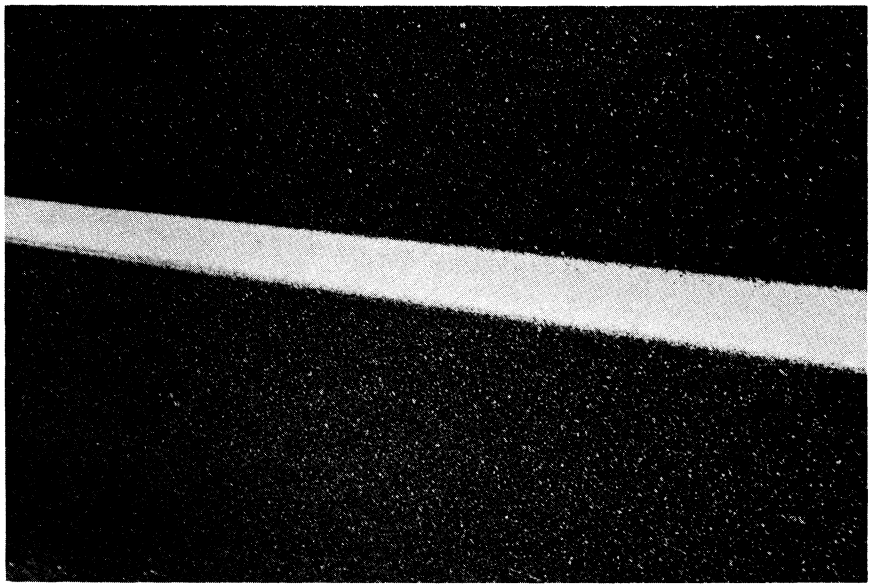

Figure 6. ETP edge line on asphalt surface. Line appears somewhat thicker in the middle.

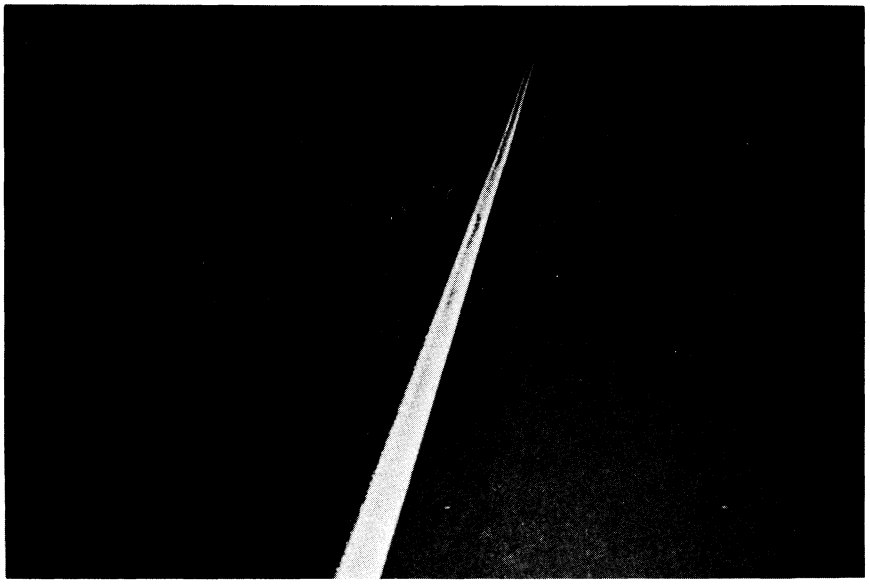

Figure 7. Night view of ETP edge line on asphalt surface. Line appears quite dark in middle.

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