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January 30, 2003

RESEARCH UPDATE U 2003-2

FIELD EVALUATION OF DROP-ON-LINE® THERMOPLASTIC PAVEMENT MARKING MATERIAL
(Final Report)

REFERENCES

Work Plan 2002-R-4 (Product Evaluation)

INTRODUCTION

In the Agency's effort to incorporate the best technologies in highway construction that are both performance and cost effective, it researches and evaluates the performance of various materials, techniques, and practices. In response to an increased public concern about the visibility of pavement markings, the Vermont Agency of Transportation is actively pursuing the evaluation of new technologies in this field. These evaluations not only look at new materials but also new application methods. This study looks at the performance and durability of a new thermoplastic marking material that is applied using a new technique not tried before in the state.

PRODUCT DESCRIPTION

Drop-On-Line® profiled thermoplastic marking system, manufactured by Brite-Line® Technologies Inc., of Canton, Massachusetts, is a pavement marking system designed to enhance wet night reflectivity and durability. The thermoplastic material is applied using a specially designed closed extrusion die with a synchronized rotor applicator. The resulting line is a profiled pattern consisting of a series of individual, round to oval shaped elements measuring 2-5 cm in diameter and 2-6 mm high. The pattern permits water to drain around the reflective elements to produce a product that obtains higher retroreflectivity values in wet conditions. At high speeds, the geometric configuration of the line appears as a solid continuous line.

The thermoplastic material is composed of a synthetic hydrocarbon binder containing pigment, beads, and fillers. A minimum of 40% of the material's composition is glass spheres with additional drop-on glass spheres added to the molten material. In addition, the material is marketed as being a more flexible product than traditionally used thermoplastic, hence, making it less prone to shattering under conditions such as snow plow activities.

COST

At the time of installation, the material cost for the Drop-On-Line® thermoplastic was $2000 per ton. The amount of material supplied for this demonstration project – a 6" wide line, 0.60-miles long – was 1200 pounds, for a total cost of $1200. For the purposes of this study, the material and installation was provided at no cost to the Agency.

PROJECT DESCRIPTION

The site chosen for the evaluation of the Drop-On-Line® thermoplastic pavement marking system was on the Fairfax-St Albans IM 089-3(27) project on Interstate I-89. A 0.60-mile segment of the product was proposed for a portion of the delineation of the northbound white edge line between mile markers 112.00 and 113.00 in the towns of Fairfield and St. Albans. This location was selected because of its restricted access to vehicular traffic only, new construction, and snowplowing maintenance routine.

INSTALLATION

On September 24, 2002, Brite-Line® Drop-On-Line® profiled thermoplastic marking material was placed as part of the northbound edge line on Interstate I-89 beginning at mile marker 112.00. The application began at 12:40 pm with an average ambient air temperature of 68°F. The weather was clear and dry during the application. Present during the application were individuals from the Agency's Materials and Research Section and Construction Section, and the manufacturer's technical and regional sales representatives.

During the installation there was an immediate problem with the application of the material. As the pavement marking vehicle moved along, at an approximate speed of 5-7 miles per hour, the configuration of the line was inconsistent, producing a product with irregularities ranging from a thick, solid line to a line with an irregular patterning of the drop-on elements (Figures 1 &2). As a result of the poor quality line produced, operations were halted after the first 0.10-mile in order to inspect the material and equipment for deficiencies (Figure 3).

It appeared as if the material was clogging the applicator so the shoe was cleaned and the equipment checked to ensure it was adjusted and set properly. The application was resumed but inconsistencies in the line's appearance continued. The equipment was again stopped, checked over, and the melting box was checked for temperature – with an infrared gun – as well as any signs of a material problem. The temperature was within the specified range for thermoplastic pavement markings and no obvious problems were present. Again, the application resumed, this time the line produced resembled what it was designed to look like, a series of "oval drops" about 2cm by 4cm in diameter.

Figure 1. Initial installation – poor quality.

Figure 2. Initial installation – poor quality.

Figure 3. Equipment problems – operations halted.

As the application continued, the equipment was stopped again due to the redevelopment of irregularities in the line configuration after approximately 0.45-miles of material was placed. Because of the complications encountered and the quality of the line, the operation was halted. It was agreed upon that only 0.10-miles of the line would be retained for evaluation purposes and the remaining material would be ground out and replaced with standard thermoplastic at no additional cost to the Agency. The area retained for monitoring was between MM 112.35 and MM 112.45 (Figure 4).

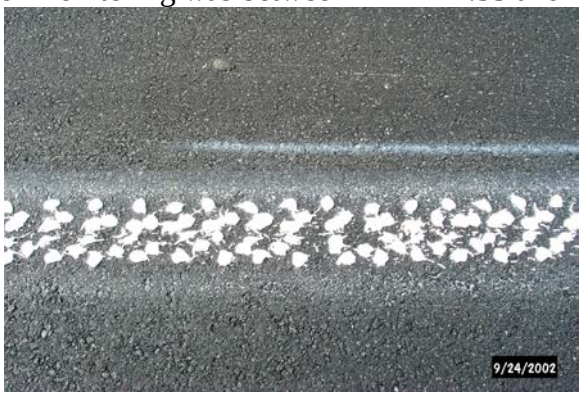

Figure 4. Detail of pavement marking material retained for evaluation.

MATERIAL TESTING

As a result of the blockage experienced during the application of the Drop-On-Line® product, the technical representative from Brite-Line Technologies, Inc., sent the material supplied to the Vermont demonstration to their laboratory for testing. According to the technical representative "the results of our trials confirmed that one of the components to our formulation did not meet the requirements established for our material. One of the polymers used in our binder system exceeded our temperature requirements when tested by our lab."

Although the polymer, supplied by a vendor, was certified as meeting their requirements, it failed to melt and blend with the other components of the product at the required temperatures. Brite-Line Technologies, Inc., attributes the "failure of the polymer to melt and blend into the material seriously compromised the entire material formula …[leaving] the entire formula deficient in binder." Hence, resulting in the blockage of the equipment during the application and the placement of a potentially poor performing material.

PERFORMANCE

The day following the installation the District Maintenance Supervisor drove the project area during an evening rainfall. He reported that the Drop-On-Line® product showed up really well and on October 8, 2002, two weeks after the installation, a site visit revealed material was well intact. At that time retroreflectivity data was collected using an LTL 2000 reflectometer. The values on the two-week old material are presented in Table 1.

Retroreflectivity Values (White Material) Brite-Line® Technologies Drop-On-Line® Thermoplastic						
Location	**Reading Number**					**Average Reading**
	1	**2**	**3**	**4**	**5**	
Test Site 1	145	233	188	131	146	**169**
Test Site 2	176	152	200	163	173	**173**
Test Site 3	179	230	117	63	82	**134**
Standard Thermoplastic (Control)						
Test Site 4	138	185	181	197	175	**175**
Test Site 5	133	180	182	173	174	**168**

Table 1. Retroreflectivity Values – White Material

A field inspection revealed that after 2 ½ months of service, the entire test section of the Drop-On-Line® product was gone. The northbound white edge line between MM 112.35 and MM 112.45 was completely delaminated while the standard (control) thermoplastic material remained well intact (Figure 5). The loss of the marking material was likely the effect of standard maintenance snowplow operations and was associated to the material's poor bond strength with the bituminous concrete pavement. It is inconclusive if the profile and geometry of the line was a contributing factor. As noted by the manufacturer's technical representative, the deficiency in the binder would most likely compromise the entire material formula and the overall product's performance.

Figure 5. Drop-On-Line® pavement marking system (foreground) after 2 ½ months of service vs. standard thermoplastic (background).

SUMMARY

Brite-Line® Technologies, Inc., Drop-On-Line® pavement marking system, a relatively new product to the pavement marking industry, has been placed in various states throughout the country. Prior to its experimental application in Vermont, it had been applied to highways in California, Oregon, Massachusetts, Maryland, North Carolina, and Texas, between the years 2001-2002. Massachusetts applied the product to a limited access highway in the Fall 2001. After one winter maintenance season, under an adopted "bare pavement" policy, they reported that the line remained well intact. They also commented that the material, placed at twice the thickness as standard thermoplastic markings, recovered better under wet conditions than the traditional thermoplastic line and it also provided a tactile effect.

The experimental application of the Drop-On-Line® system on Interstate I-89 in the towns of Fairfield and St. Albans, Vermont exhibited a very short life span. The premature failure of this product was likely due to a deficiency in the material's composition that caused a poor bond between the marking material and the pavement structure. This theory is supported by material tests done by Brite-Line Technologies' laboratory, on the product that was supplied to Vermont. As a result, the loss of the material was accelerated by snowplow abrasion from normal maintenance routines. Additionally, the retroreflectivity results on the product were lower than anticipated, based on data provided in the manufacturer's literature.

Based on the performance of the material in this experimental application it is not considered a suitable product for Vermont highways. A future evaluation on the product may be warranted based on data collected from other states, such as Massachusetts, that experience similar climatic events, after additional winter seasons. Additionally, it is recommended that certification and test results of the material be provided confirming the product being supplied is in conformance with the manufacturer's specifications.

DISCLAIMER

"The information contained in this report was complied for the use of the Vermont Agency of Transportation. Conclusions and recommendations contained herein are based upon the research data obtained and the expertise of the researchers, and are not necessarily to be construed as Agency policy. This report does not constitute a standard, specification, or regulation. The Vermont Agency of Transportation assumes no liability for its contents of the use thereof."