MetroMark Copolymer Traffic Paint
Vermont Route 14

Initial Report 97-1
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Reporting on Work Plan 96-R-7

State of Vermont
Agency of Transportation
Materials and Research

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16. Abstract

The Vermont Agency of Transportation (VAOT) is investigating the performance of non-solvent based traffic markings in anticipation of EPA regulations regarding volatile organic compounds (VOC's). Metropolymer Labs, Inc. sent a paint vehicle and crew to apply their product to a section of Vermont Route 14 as a demonstration of their copolymer material.

The striping operation was compromised by repeated equipment problems which resulted in the product having uneven application thickness. Nonetheless, tests were conducted for retroreflectivity, skid resistance, application thickness, and bead coverage.

In addition to testing the copolymer traffic paint, three different types of beads were evaluated. The durability of the product will be evaluated through yearly updates.

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INTRODUCTION:

This report is part of an ongoing effort by the Vermont Agency of Transportation (VAOT) to determine the performance characteristics of non-solvent based traffic paints. Forthcoming EPA regulations restricting the use of volatile organic compounds (VOC's) will prohibit many traffic marking products currently in use. In anticipation of these regulations, the VAOT is evaluating the performance characteristics of conforming, non-solvent based traffic markings.

PRODUCT DESCRIPTION:

MetroMark copolymer traffic paint is a low VOC, two component system which uses a medium of polyester, epoxy, and thermoplastic catalyzed in a 2% solution of methyl-ethyl ketone peroxide (MEKP). The manufacturer claims that a 200 μ thickness of MetroMark has been shown to last two years; and because of its low profile, it will hold up better to snow plowing than thermoplastic. MetroMark can be applied to existing markings, making it suitable for maintenance operations, as well as for new construction.

PROJECT DESCRIPTION:

At the request of Metropolymer Labs, Inc., manufacturer of MetroMark copolymer, VAOT agreed to apply the product on a 15 mile section of Vermont Route 14 between the towns of East Montpelier and Hardwick (see Location Map, page 7). The product was applied by a MetroMark paint crew using their own vehicle, and was put down at a thickness of 380 μ with a variety of glass beads. For comparison, different sections received Vermont coated beads, AASHTO Type I beads, and Metropolymer beads.

The striping operation started on October 24, 1996 at the intersection of Route 14 and Route 2 in the Town of East Montpelier and proceeded northerly, applying the white edge line. The temperature was 14^{0}C with overcast skies and a slight breeze.

White edge line was placed on the first afternoon. The double yellow center line was applied the next day, at which time one of the two paint guns failed. The MetroMark crew continued nonetheless, putting down one of the center lines. This gun also malfunctioned and began laying down an unacceptably thin (less than 380 μ) line. The heat exchanger was found to be defective. The operation was halted and the paint rig was taken back to the VAOT Central Garage for repairs. The following day the project was completed without further incidence.

Throughout the operation, VAOT Research and Development personnel observed the process and made periodic checks of the material.

All units in metric except mile markers/mileage references for project location and supplier's costs.

EVALUATION:

The material was tested for retroreflectivity and skid resistance, and was sampled for application thickness and bead coverage. Using test strips of duct tape placed at intervals throughout the project, measurements were made with a micrometer for thickness of application and the material applied to the duct tape was visually inspected for bead coverage. Retroreflectivity of the lines in the roadway was measured with a Miro-lux 12 portable retroreflectometer. Skid resistance was measured with a British Pendulum Skid Tester.

Thickness and Bead Coverage

Several duct tape strips were placed in front of the paint vehicle, three in the white edge line and three in the yellow center line. The MetroMark crew applied the product at a thickness of 380 μ (15 mils) and 100 mm in width, matching the existing markings. Bead application was visually inspected for coverage and adherence.

Test Site	Thickness	Width	Bead Coverage
White Edge Line			
1	711 μ (28 mils)	140 mm (5 1/2")	Good
2	457 μ (18 mils)	125 mm (5")	Sparse
3	584 μ (23 mils)	140 mm (5 1/2")	Good
Yellow Center Line			
4	305 μ (12 mils)	115 mm (4 1/2")	Fair
5	508 μ (20 mils)	115 mm (4 1/2")	Good
6	762 μ (30 mils)	115 mm (4 1/2")	Good

The test tapes showed that the thickness of the material varied considerably throughout much of the project and at least two factors contributed to this variability.

Mechanical problems with the MetroMark paint rig was undoubtedly the biggest factor. The yellow cetner line from East Montpelier to North Montpelier was very thin and was caused by a failure in the heat exchanger. In this section the paint lines were too thin to measure.

A second factor related to traffic control that required the paint truck to stop periodically. When the paint gun was shut off and then restarted, the paint came out in a puddle and the line was thick for some distance afterwards. Test site 1 on the white edge line was located approximately 50 m from the beginning of the project in East Montpelier. As shown, the material was coming out nearly twice as thick as planned. At the next site, MM 3.1 in Calais, the paint rig had been going for approximately 10 km and the measured thickness had thinned out to 457 μ, closer to the 380 μ required. At white line test site 3, the paint rig had stopped for traffic and, as seen previously, the paint was applied too thick.

No-Track-Time

VAOT specifications require the product to reach a "no tracking" condition in 75 seconds at 24^{0}C. This is tested by driving over the line with an average sized vehicle at 50 to 65 km/h.

VAOT personnel conducted no-track-time tests on the easterly edge line during the first day of striping. Tested at 75 seconds, the paint tracked heavily (see Photo Addendum). The test was repeated at another location, this time at 120 seconds, and even though tracking was less than before, the paint was still in an unstable state and proceeded to break up and pull away from the pavement.

Retroreflectivity

As part of the evaluation, several different beads were placed independently throughout the project: AASHTO Type I, Vermont Coated Beads, and Metropolymer Beads. A total of 105 retroreflectivity readings were taken. Only areas where bead coverage was considered to be adequate were tested. The results shown below are average millicandelas (mcdl) for the various types of beads:

Beads	**Center Line**	**Edge line**
Metropolymer Beads	184 mcdl	155 mcdl
AASHTO Type I Beads	----	94 mcdl
VT Coated Beads	112 mcdl	---

Comparing the retroreflectivity of the various beads shows that the Metropolymer beads are currently giving the best results. Metropolymer beads are large gradation beads, similar to "Visi-beads", which present a greater reflective surface than either Vermont coated beads or AASHTO Type I beads. The larger size could be a mixed blessing as it has been speculated that they may get scraped off by snow plows. Test sites will be examined after each winter to verify the effectiveness of each bead type.

Skid Resistance (bpn)

Skid resistance was measured with a British Pendulum Skid Tester, expressed in British pendulum number (bpn). Tests were made at five sites, taking the average of three values at each location.

Test Site	Right Edge Line	Center line	Left Edge Line
MM 3.1 E. Montpelier	58	67	---
MM 5.4 E. Montpelier	60	---	46
MM 3.0 Calais	61	---	---
MM 5.2 Calais	65	65	72
MM 3.6 Woodbury	65	75	60

Skid resistance values are acceptable and appear consistent for both white and yellow lines and for the various beads used. Values for bare pavement have averaged 65 bpn in past studies. The average value from all sites is 63 bpn with a range of 46 to 75 bpn.

COST ANALYSIS:

MetroMark copolymer was placed at a cost of $0.12/lf . The material was applied at a thickness of 380 μ, and is marketed as having a three year life at that thickness. By comparison, waterborne traffic paint costs approximately $0.04/lf and has been shown to last one year. If proven correct, MetroMark's claim of three years of service makes the product comparable in price to waterborne paint.

SUMMARY:

MetroMark representatives had hoped that using their own paint vehicle and personnel would give the VAOT an exemplary sample of their product for evaluation. Unfortunately, several equipment failures caused an uneven application of the material. Also, the product had a no-track-time in excess of 2 minutes, greater than the state specified maximum of 75 seconds. Since the ambient air temperature was 14^0 C, lower than advisable, the product might have met the specifications under better conditions. MetroMark claims a 60 second dry time at 24^0 C, which would be acceptable.

When observed in its entirety, the striping on VT Route 14 looks reasonably good. The color is bright and the match-up of the new material with the existing striping was as accurate as could be expected, especially given the equipment trouble. Most of the problems with the painting were at the beginning of the project before adjustments had been made to the delivery systems. After the paint vehicle was operating properly and had been adjusted, the painted lines became more crisp and appeared to be more consistent in thickness. The repeated stopping to allow traffic to pass required shutting off the paint guns and subsequently caused some of the application problems.

Retroreflectivity and skid resistance appear good at this point. Metropolymer beads are presently giving the highest retroreflectometer readings of the three types of beads used.

FOLLOW UP:

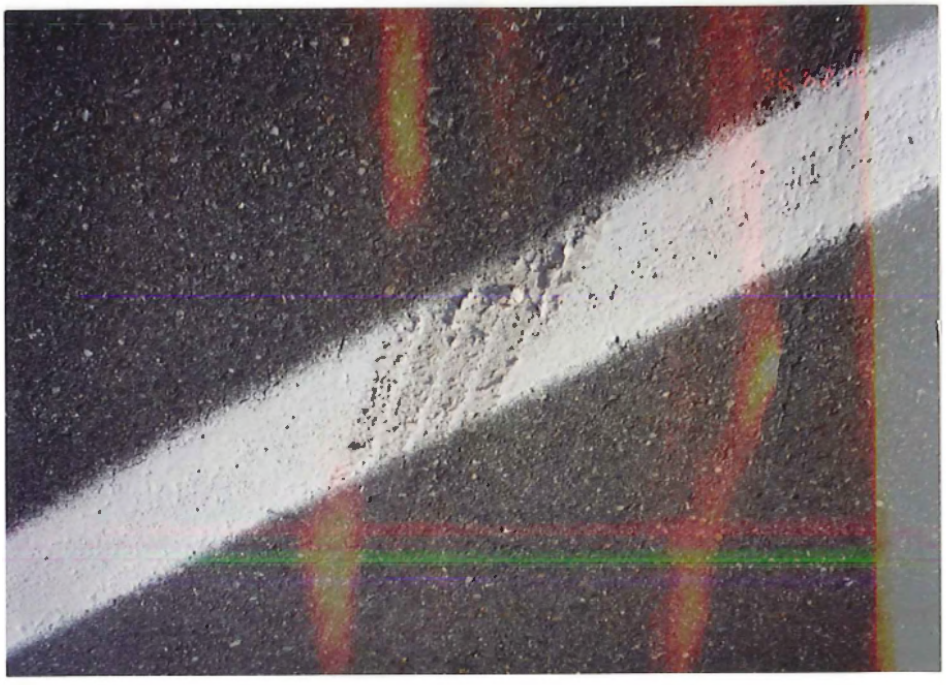
Yearly inspections of the project will be conducted to evaluate the performance and durability of the product. Retroreflectivity and skid resistance tests will be performed and an attempt will be made to determine if the Metropolymer beads are adhering to the paint or being dislodged by snow plowing. Particular interest will be given to the durability and service life of the product and its cost effectiveness relative to waterborne paints.

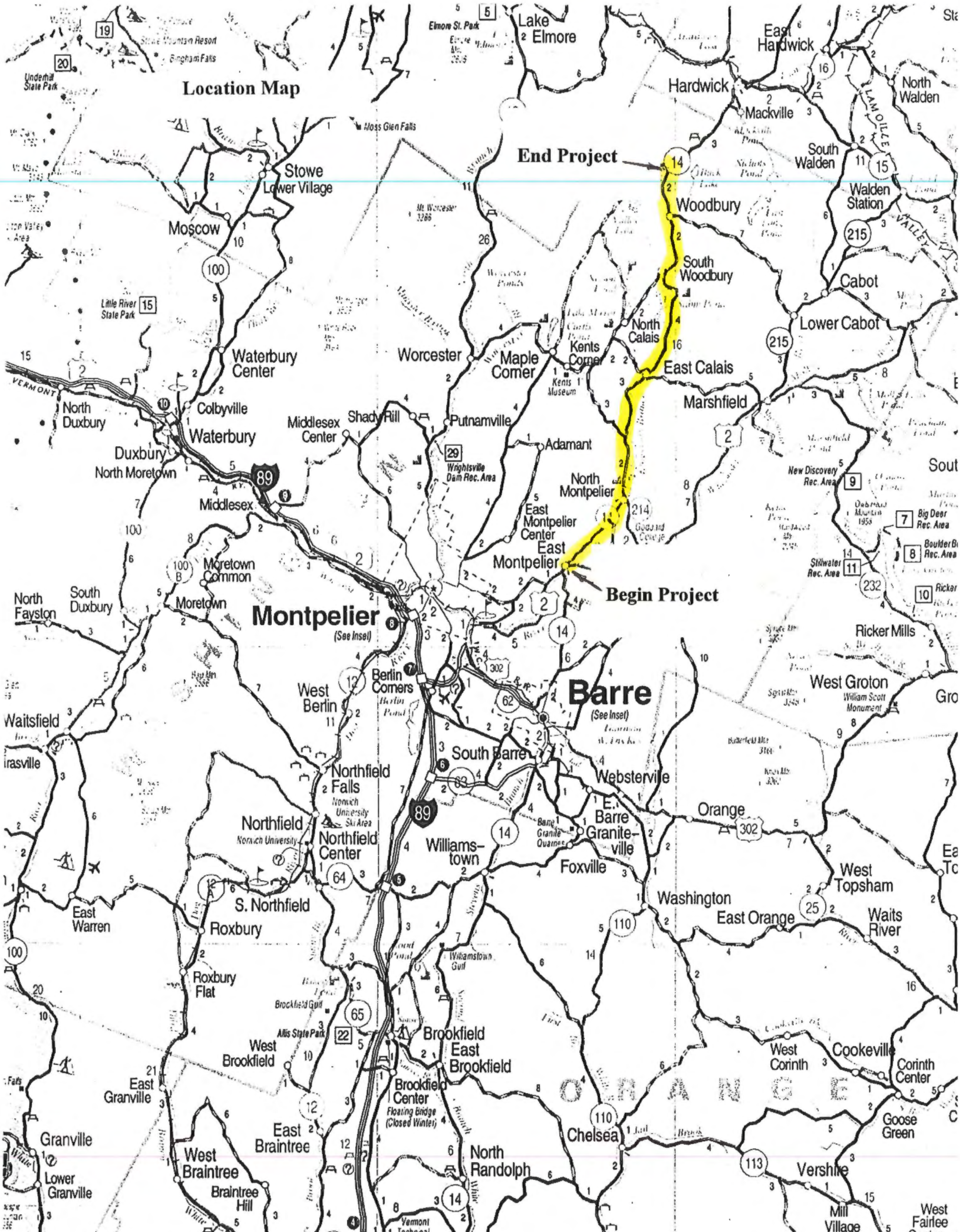
Photo Addendum

Application of
MetroMark copolymer traffic paint

No-Track-Time
Tested at 75 seconds

No-Track-Time
Tested at 120 seconds




Location Map
End Project
Begin Project
Montpelier
(See Inset)
Barre
(See Inset)
Lake Elmore
Elmore
Stowe
Lower Village
Moscow
Waterbury Center
Waterbury
Colbyville
Duxbury
North Duxbury
North Moretown
Middlesex
Middlesex Center
Shady Rill
Putnamville
Worcester
Maple Corner
Kents Corner
Kents Museum
Adamant
North Calais
East Calais
Marshfield
Woodbury
South Woodbury
Hardwick
East Hardwick
Mackville
North Walden
South Walden
Walden Station
Cabot
Lower Cabot
North Montpelier
East Montpelier Center
East Montpelier
Moretown Common
Moretown
North Fayston
South Duxbury
Waitsfield
West Berlin
Berlin Corners
South Barre
Websterville
E. Barre
Graniteville
Orange
Northfield Falls
Northfield
Northfield Center
Williamstown
Foxville
Washington
West Topsham
East Orange
Waits River
S. Northfield
Roxbury
Roxbury Flat
East Warren
West Groton
Ricker Mills
Brookfield
East Brookfield
West Brookfield
Brookfield Center
East Granville
Granville
Lower Granville
East Braintree
West Braintree
Braintree Hill
North Randolph
Chelsea
West Corinth
Cookeville
Corinth Center
Goose Green
Vershire
Mill Village
West Fairlee Center
ORANGE