

# MATERIALS & RESEARCH DIVISION

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## RESEARCH UPDATE

### GLASPHALT PAVEMENT CONSTRUCTION ON VT ROUTE 12

REFERENCES: Work Plan 92-R-20

PURPOSE:

This research update documents the use of waste crushed glass as a portion of the coarse aggregate in a bituminous concrete pavement surface course placed on Route 12 in Hartland, Vermont.

BACKGROUND:

Past use of crushed glass in pavements by the State of Vermont was limited to a 0.42 mile long project on VT Route 116 in the city of South Burlington in 1972. The treatment was considered successful, but post construction monitoring was limited due to the placement of a bituminous surface course shortly thereafter. Limited supplies of waste glass discouraged further use at that time.

The recent development of regional solid waste recycling programs has resulted in the collection of significant stockpiles of glass which are now available for a variety of uses. The crushed glass for the Route 12 project was obtained from the Hartford Community Center for Recycling & Solid Waste Management (phone (802) 295-5740) which is located on VT Route 5, approximately four miles south of the I89 and I91 interstate interchange in Hartford. The facility is the largest recycling center in the Vermont Greater Upper Valley Solid Waste District and includes the collection of materials from five area towns. The Hartford Center accumulates about 500 tons of glass per year consisting of 75% clear and 25% green or brown glass. A desire to utilize the waste glass in the local area resulted in a decision to purchase and install a CB-5000-10 CLEANGLOSS<sup>tm</sup> SYSTEM crusher manufactured by J.R. Engineering Corp., P. O. Box 560, West Swanzey, New Hampshire 03469 (phone 1-800-732-0123 or (603) 357-3139). The unit is capable of crushing 10 tons of glass per hour. Market prices paid for the glass vary, but are currently in the range of \$22 a ton for clear, \$15 a ton for brown and \$8 a ton for green glass crushed and stockpiled. The Hartford facility has not found it economically feasible to separate the green and brown glass due to a limited quantity of the latter.

**PROJECT LOCATION AND CONDITIONS:**

The Hartland STP 9328(1)S project was selected for the glasphalt application. The project began on VT Route 12, at the intersection with US 5, at mile marker 0.000 and extended northerly to mile marker 0.600. The existing pavement on the 12 foot wide lanes consisted of approximately 2 inches of bituminous materials over a surface-treated gravel. The last treatment (5/8" bituminous concrete pavement) was placed in 1982. Surface conditions on the test section averaged 6/16" of wheel path rutting and cracking averaged 292 linear feet per 100 linear feet of roadway. Roughness measurements ranged from 182 to 296 inches per mile with an average value of 243 inches. Traffic volume in the project area averages approximately 3000 vehicles per day and the area is posted for a speed of 40 mph.

The new overlay design specified a 400 ton per mile leveling course of VT Type IV mix (3/8" minus) and a 1 3/4" surface course of VT Type III mix (1/2" minus).

**MIX DESIGN, TESTING AND PRODUCTION:**

Pike Industries, Inc. developed a glasphalt mix design in compliance with the Vermont Agency of Transportation requirements using the Marshall test procedures. The coarse aggregate portion of the mix included 31% 1/2" stone, 9% 3/8" stone and 10% crushed glass. The fine aggregate portion included 38% washed stone screenings and 12% washed sand. The gradation of the crushed glass consisted of 100% passing the 1/2", 92% passing the 3/8", and 24% passing the #8 sieve. Because quartzite materials are susceptible to asphalt stripping, an anti-strip additive was added to the AC20 asphalt at a rate of 0.5%. The effectiveness of the anti-strip product, PAVE BOND Lite by Morton International, was checked using Vermont test procedure VT-AOT-MRD 10-81 for both initial and 96 hour performance. The boiling test revealed 10 to 15 percent asphalt stripping from the glass aggregate, a level exceeding the 5 percent allowed, but not considered serious enough to cancel the glasphalt production and placement.

The standard and glasphalt mixes were produced at Pike's West Lebanon, New Hampshire batch plant located on Route 12A, approximately one mile south of the I89 interchange and six miles east of the Hartford glass source. The crushed glass, which had been stockpiled at the plant yard, was introduced in the same manner as the crushed stone and fine aggregate via the cold feed bins, drier drum and hot elevator. Production from the three ton standard batch plant was accomplished without any notable problems.

Testing by Vermont Agency of Transportation inspectors included aggregate gradations, a 75 blow Marshall test series on the Type IV leveling mix, two Marshall series each on the Type III surface mix



and Type III glasphalt mix, plus a repeat of the stripping test on the glasphalt mix which again revealed a slight tendency towards stripping.

Two of the five test series revealed minor failures in the aggregate gradation percentages. Also, the glasphalt Marshall specimens were 0.6 and 1.2% low in the air voids and 0.6 and 1% low in VMA. Laboratory testing on samples of the Viking AC20 asphalt confirmed compliance with the specifications.

The leveling course for both lanes of the project and the top course on the northbound lane and the area of the Route 5 intersection consisted of standard mix, which was produced and placed on July 29 and 30, 1992.

The glasphalt production scheduled for the afternoon of July 30 was delayed due to an equipment breakdown at the plant. The work resumed on July 31 but rainshowers on the project resulted in cancellation of the paving after 198 tons of glasphalt mix were placed. The work was completed on the following Monday, August 3, 1992, with the production and placement of an additional 216 tons of glasphalt mix. A total of 19.6 tons of waste crushed glass was used in the production of the 414 tons of experimental bituminous mix.

There were no special problems noted by the plant engineer during the production of the glasphalt mix, nor by the paving crew during the placement of the mix.

#### COST:

The Bituminous Concrete Pavement, Item 406.25, was bid at \$27.85 per ton in place. There was no increase in the price paid for the 414 tons of experimental glasphalt mix.

It should be noted that the glasphalt mix was more expensive to produce due to the need for an anti-strip additive and the higher cost of the glass aggregate. The need for an anti-strip additive normally raises the bid price for bituminous mix by \$0.50 per ton. The standard aggregate used in the mix produced at the West Lebanon plant is crushed at the site by the Contractor. It is available for purchase at a cost of \$11.25 per ton. Assuming a 35% profit, the Contractor can produce aggregate for their own use at a cost of approximately \$7.50 per ton. The crushed glass was purchased at a cost of \$8.00 per ton and trucking costs were also incurred.



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HARTFORD VERMONT  
GLASS CRUSHING  
FACILITY



40 TONS OF GLASS  
WITH 90+% PASSING  
THE 3/8" SIEVE



STANDARD MIX IN  
FOREGROUND,  
GLASPHALT IN  
BACKGROUND





**FIELD PERFORMANCE AND TESTING:**

Four inch diameter field cores taken from the standard and glasphalt pavements revealed good bond to the leveling course. The cores ranged from 1 3/8" to 2" in thickness with an average of 1 3/4". The percentage of compaction was within the project specifications, averaging 93.1 on the standard mix and 94.4 on the glasphalt mix.

Locked wheel friction tests were taken on the standard and experimental pavements on September 22, 1992 after fifty days of service. Six tests were taken on each lane. The skid values averaged 48.2 on the glasphalt and 53.0 on the standard mix. Both averages were above the 45+ value normally obtained on new bituminous pavements.

Project inspections were made in late September and October 1992. Detailed observations revealed from 15 to 30 large particles of glass and 80 to 150 small particles of glass in the surface of each square foot of the experimental pavement. Sunlight reflecting off individual glass particles clearly distinguished the glasphalt mix from the standard pavement. Several of the large glass particles were cracked, but there was no loss of individual pieces noted. Some loss of the larger particles of glass is anticipated when cold weather arrives and the traffic includes snow plowing and sanding operations.

**SUMMARY:**

Approximately 0.48 miles of the southbound lane of VT Route 12 (mile marker 0.12 through mile marker 0.60) was paved with glasphalt on July 31 and August 3, 1992. There were no special problems noted during the production or placement of the experimental bituminous mix and inspections through 3 months of service indicate satisfactory field performance.

**FOLLOW UP:**

The project will be monitored annually for cracking, rutting, loss of matrix, roughness and friction values. Additional reports will be prepared as significant changes are noted.

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