Form R-396 (1/1/87)

Standard Title Page -- Report on State Project

1755

Report No.	Report Date	No. Pages	Type Report: Addendum to Final Report	Project No. :
VTRC 90-R17	March 1990	13	Period Covered: March 1989 through May 1990	Contract No.:

Title and Subtitle

Addendum to Final Report - The Use of Hydrated Lime as an Antistripping Additive

Author(s)

G. W. Maupin, Jr.

Performing Organization Name and Address

Virginia Transportation Research Council
Box 3817, University Station
Charlottesville, Virginia 22903-0817

Sponsoring Agencies' Names and Addresses

Va. Dept. of Transportation
1221 E. Broad Street
Richmond, Virginia 23219

University of Virginia
Charlottesville
Virginia 22903

Key Words

Hydrated lime
Stripping
Test sections
Performance
Asphalt hardening

Supplementary Notes

Abstract

The subject report describes a follow-up evaluation of test sections that were installed in 1982 and 1983 and reported on in 1987. Each test section contained three asphalt concretes: (1) with no additive, (2) with hydrated lime, and (3) with one or more chemical additives. The hydrated lime continues to deter stripping as well or better than the chemical additives that were being used when the sections were installed.

1756

ADDENDUM TO FINAL REPORT

THE USE OF HYDRATED LIME AS AN ANTISTRIPPING ADDITIVE

G. W. Maupin, Jr.
Research Scientist

Virginia Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Transportation and the University of Virginia)

Charlottesville, Virginia

April 1990

VTRC 90-R17

1758

BITUMINOUS RESEARCH ADVISORY COMMITTEE

W. L. HAYDEN, Chairman, Assistant District Engineer - Construction, Virginia Department of Transportation

C. S. HUGHES, Executive Secretary, Senior Research Scientist, Virginia Transportation Research Council

J. D. BARKLEY, II, Resident Engineer, Virginia Department of Transportation

A. D. BARNHART, District Materials Engineer, Virginia Department of Transportation

M. K. BRITTLE, Resident Engineer, Virginia Department of Transportation

W. B. COBURN, Assistant District Engineer, Construction, Virginia Department of Transportation

G. W. F. CURTIS, District Materials Engineer, Virginia Department of Transportation

W. R. DAVIDSON, District Administrator, Virginia Department of Transportation

B. J. DAVIS, Area Engineer - Culpeper, Federal Highway Administration

C. E. ECHOLS, Assistant Professor, Department of Civil Engineering, University of Virginia

R. L. FINK, Assistant Maintenance Engineer, Virginia Department of Transportation

R. D. HORAN, Assistant Materials Engineer, Materials Division, Virginia Department of Transportation

J. T. LOVE, Transportation Engineering Program Supervisor, Materials Division, Virginia Department of Transportation

J. G. G. MCGEE, Assistant Construction Engineer, Virginia Department of Transportation

D. E. OGLE, Assistant District Engineer, Contruction, Virginia Department of Transportation

R. D. WALKER, Department of Civil Engineering, VPI & SU

ADDENDUM TO FINAL REPORT

THE USE OF HYDRATED LIME AS AN ANTISTRIPPING ADDITIVE

G. W. Maupin, Jr.

INTRODUCTION AND PURPOSE

Stripping of asphalt concrete has been recognized as one of the causes of reduced pavement service life nationwide, as well as within the state of Virginia. Chemical additives have been used in an attempt to enhance the bond between the asphalt cement and aggregate particles, but opinions concerning the effectiveness of chemical additives in the field vary. Hydrated lime is another type of additive that has been used with apparent success in some states.

The purpose of the original investigation, which was financed with HPR funds, was to evaluate the performance of six test sections of asphalt concrete that were installed in 1982 and 1983. Each test section contained three asphalt concretes: (1) with no additive, (2) with hydrated lime, and (3) with one or more chemical additives. The last performance evaluation was performed in 1986 and reported in the final report (1). This addendum reports a follow-up evaluation of the test sections, which was performed in May 1989, 6 to 7 years after placement.

PROCEDURES

To evaluate the test sections, the pavement surface of each section was examined for any distress, which was recorded. Then, four 4 in x 4 in samples were sawed from each pavement section, placed in plastic bags, and transported to the laboratory. The samples were broken immediately to prevent healing of the asphalt and aggregate, and the broken surfaces were examined visually. The stripping was rated on a scale of 0 to 5 (0 = no stripping and 5 = severe stripping).

RESULTS

Pavement Condition

Route 58

Considerable block and transverse cracks were present in all sections; however, the cracks appeared to be slightly wider in the hydrated lime section. It is surmised that the cracks reflected from cracks in the underlying surface.

Route 600

There were numerous narrow cracks in the section with no additive, some longitudinal cracking in the section with chemical additive, and only minor cracking in the section with lime. There were black maplike streaks on the surface of the section with lime, which were unexplainable. This phenomenon is sometimes associated with stripping, but no stripping was observed in the samples that were removed from this section.

Route 10

Some minor cracks were visible in all of the sections upon close examination. All of the mixes appeared quite dense, although there was no concentration of the asphalt cement at the surface.

Route 250

All of the test sections were in good condition with no cracking; however, the surface appeared very dense. An adjacent lane containing chemical additive, which was not monitored as part of the original investigation, had severe raveling and cracking.

Route 360 (M)

There were spots where asphalt cement had migrated to the surface and maplike black streaks on the surface of the section with lime, which were similar to those observed on Route 600. The sections with additive and with no additive had been surfaced with a slurry seal in 1987 because of a slippery surface. As noted in the final report in 1986 (1), there was permanent deformation at an area where asphalt had migrated to the surface of the mix with no additive. The apparent development of an asphalt-rich slick surface could have been caused by excessive asphalt, excessive tack coat, or stripping. Extraction tests of the mixes sampled during the construction did not indicate that the mixes that became slick contained excessive asphalt. One small area received a heavy tack coat; however, it is unlikely that heavy tack was applied through the entire resurfaced sections. It is possible that the migration of stripped asphalt to the pavement surface exacerbated the problem.

Route 360 (B)

There was no noticeable distress present in any of the sections, although there was considerable stripping in the pavement samples, as discussed subsequently.

Examination of Pavement Samples

Table 1 lists the stripping observed in samples taken in 1986 and May 1989. Figures 1-6 display stripping in the samples that were removed at each location.

None of the mixes on Route 10 exhibited stripping although the aggregates used have been susceptible to stripping in the past. It was stated in the final report (1) that these mixes appeared impermeable; therefore, moisture was not present to cause stripping. In four of the five remaining installations, the mixes with lime had slight to no stripping, whereas the mixes with chemical additive had slight-moderate stripping to moderate-severe stripping. None of the additives, including lime and a supposedly improved additive, was particularly effective in the mixes on Route 360 (B).

On the whole, stripping has increased in most sections since the last evaluation in 1986; however, the increase is much less in the lime sections than in the chemical additive sections.

DISCUSSION

Generally, the samples from sections with hydrated lime exhibited much less stripping than the samples with chemical additives. The only exceptions were Route 10 where none of the mixes stripped and Route 360 (B) where all of the mixes displayed considerable stripping. These exceptions may be related to the permeability of these mixes. The mixes on Route 10 were relatively impermeable, and the mixes on Route 360 (B) appeared to be very permeable.

Chemical No. 2 on Route 360 (B), which was supposed to be an improved additive, did not reduce stripping more than the conventional chemical

Table 1

VISUAL STRIPPING EVALUATIONS OF PAVEMENT SAMPLES

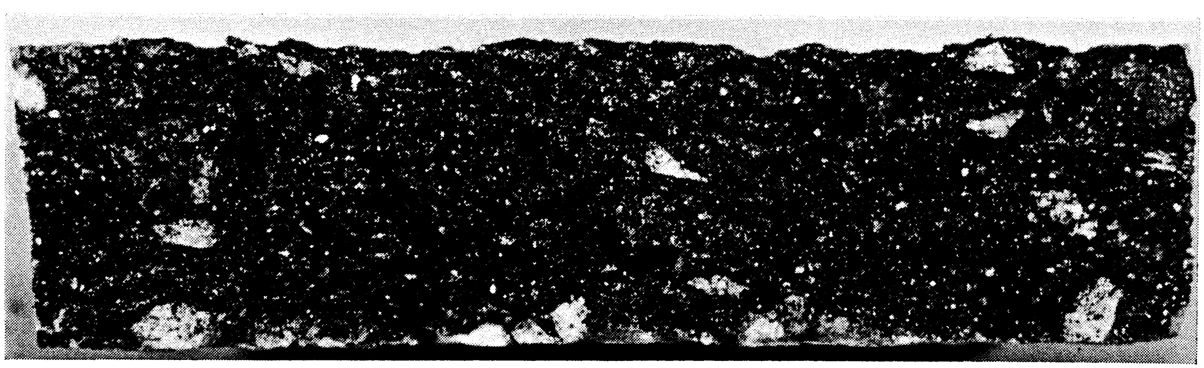
Route	Additive	Stripping 1986	Stripping 1989
58	None	Slight	Slight-moderate
	Chemical	Slight	Slight-moderate
	Lime	None	None
600	None	Moderate	Moderate
	Chemical	Slight	Moderate
	Lime	None	None
10	None	None	None
	Chemical	None	None
	Lime	None	None
250	None	Slight	Moderate-severe
	Chemical	Slight	Moderate-severe
	Lime	None	Slight
360 (M)	None	Moderate-severe	Moderate-severe
	Chemical	Moderate	Moderate-severe
	Lime	Very slight	Slight
360 (B)	None	Severe	Severe
	Chemical No. 1	Moderate	Moderate
	Chemical No. 2	Slight	Moderate
	Lime	Slight-moderate	Moderate

additive or lime. The lack of effectiveness of any additive suggests that the use of additives will not prevent damage to pavements that have an undesirable physical characteristic such as high permeability.

On one test section, the mixes without lime that exhibited considerable stripping have been resurfaced after only 4 years of service. It is believed that the mixes at the other locations that exhibit moderate to severe stripping will not reach the designed service life.

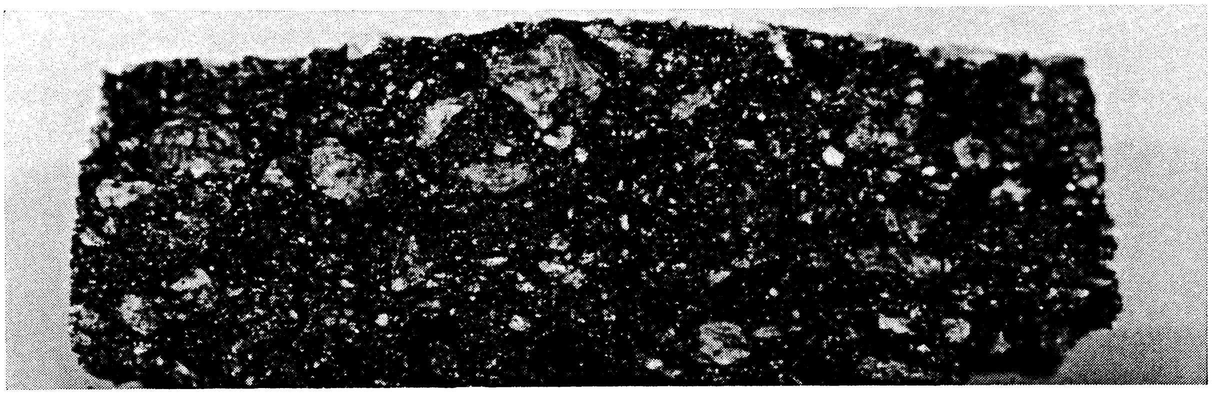
a. No additive.

b. Chemical additive.

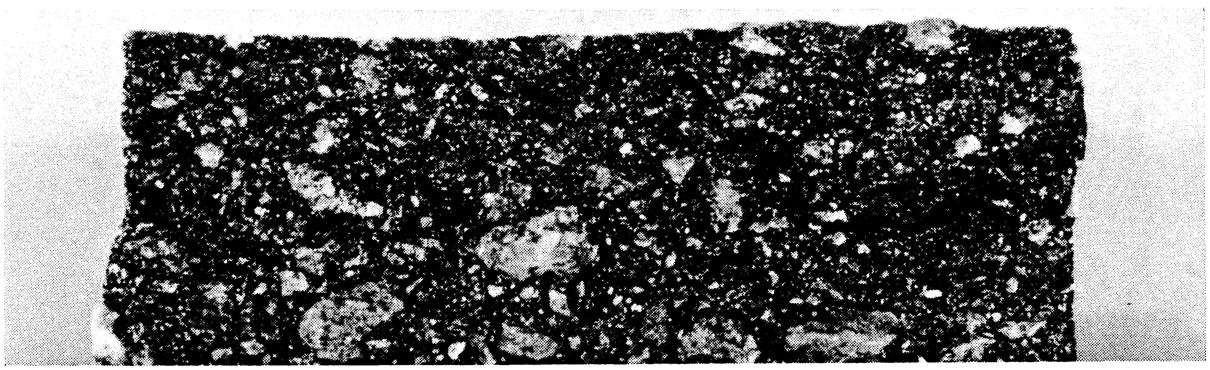


c. Hydrated lime.

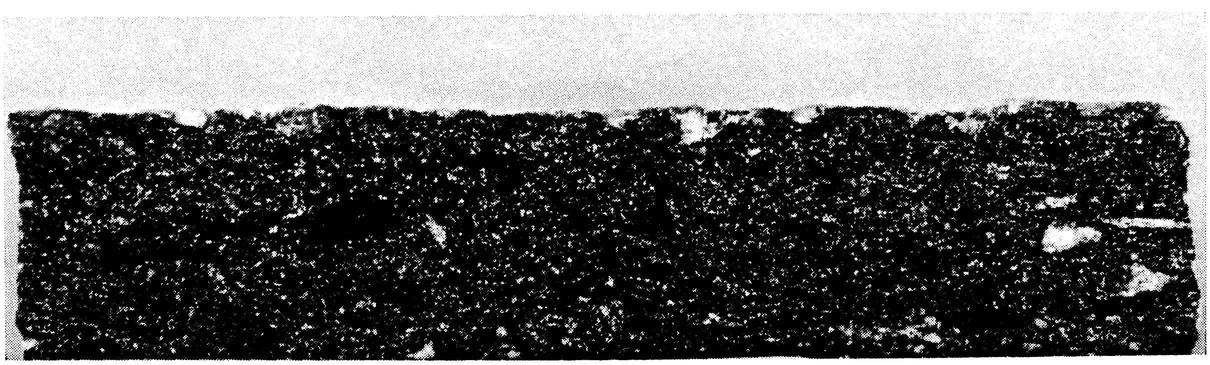
Figure 1. Pavement samples from Route 58 after 7 years.



a. No additive.

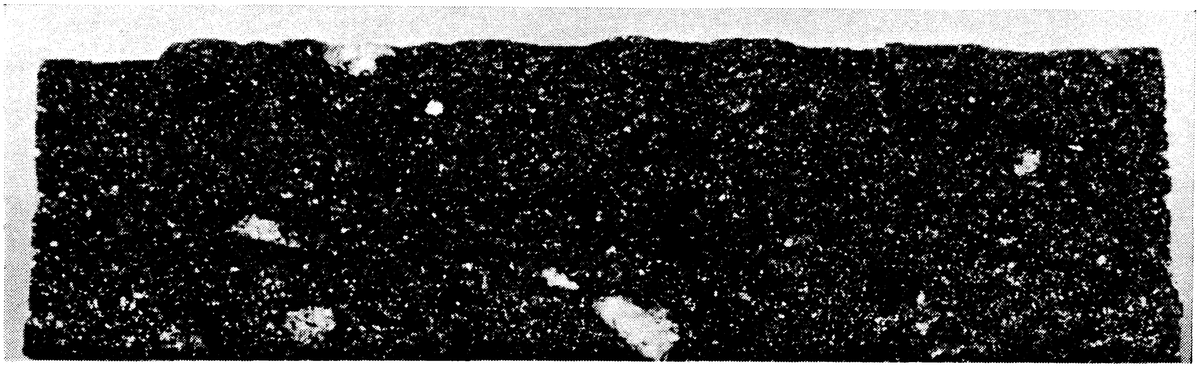


b. Chemical Additive.

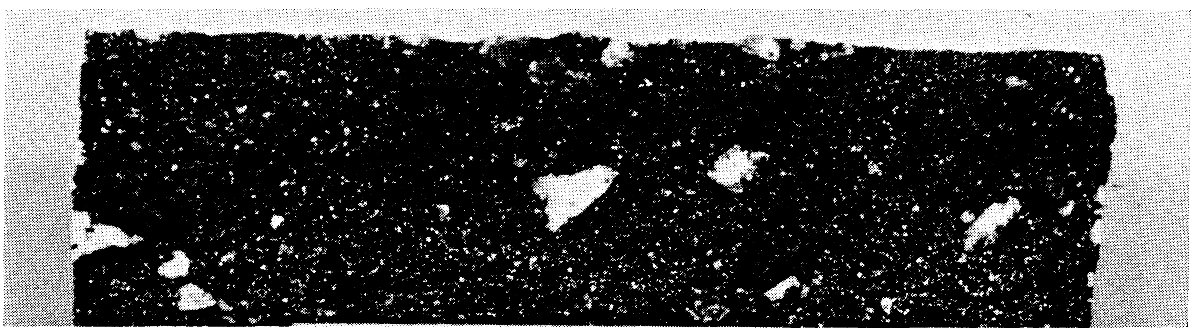


c. Hydrated lime.

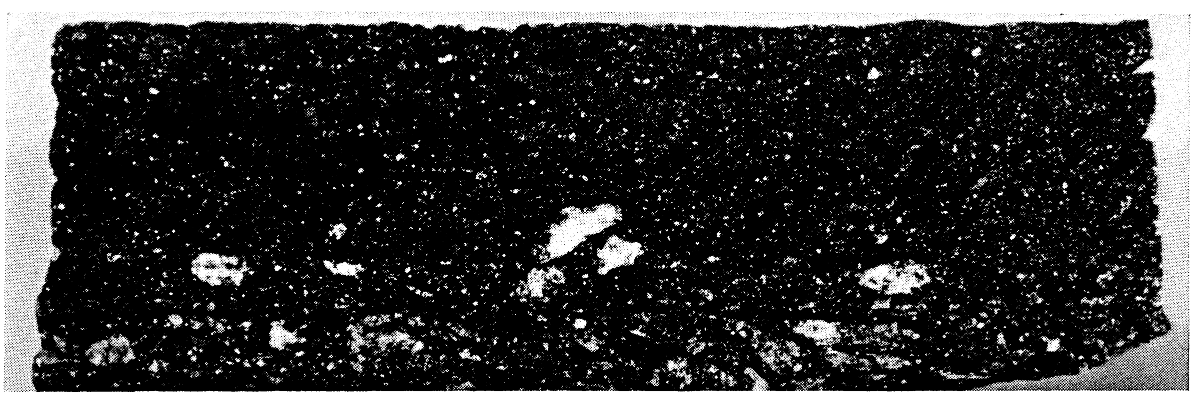
Figure 2. Pavement samples from Route 600 after 7 years.



a. No additive.

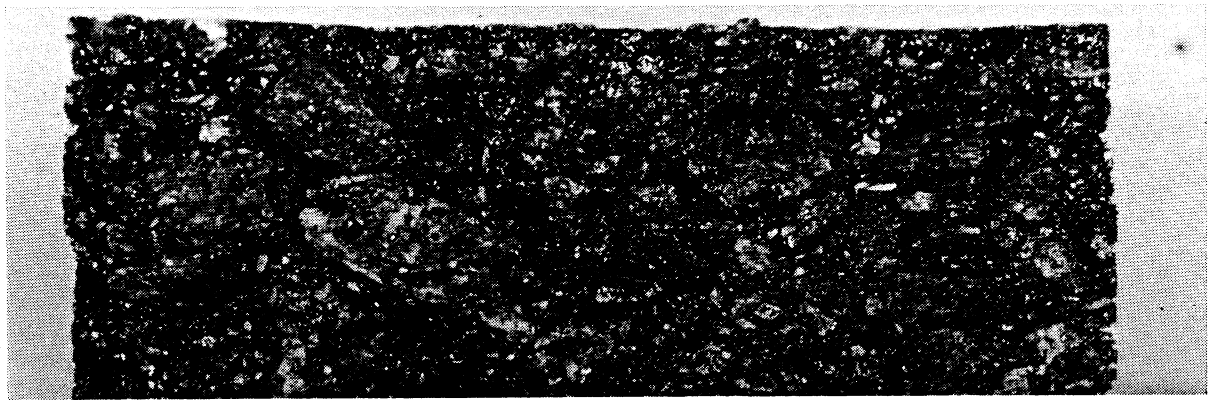


b. Chemical additive.



c. Hydrated lime.

Figure 3. Pavement samples from Route 10 after 6 years.

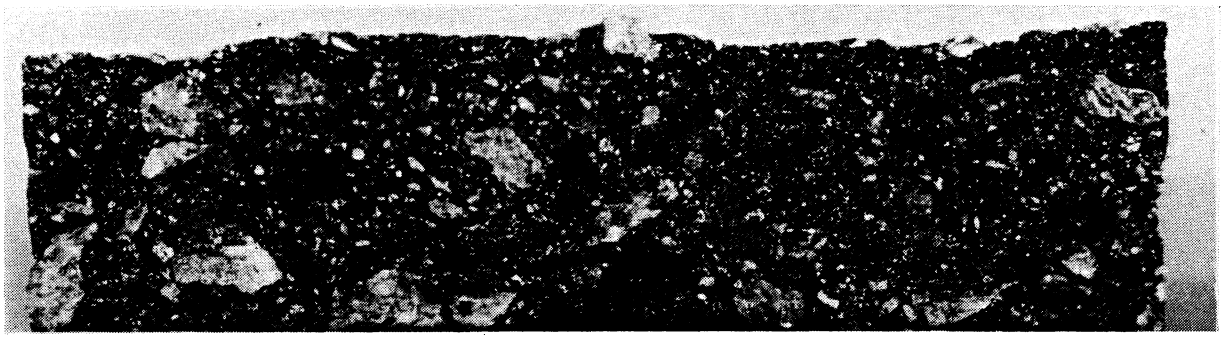


a. No additive.

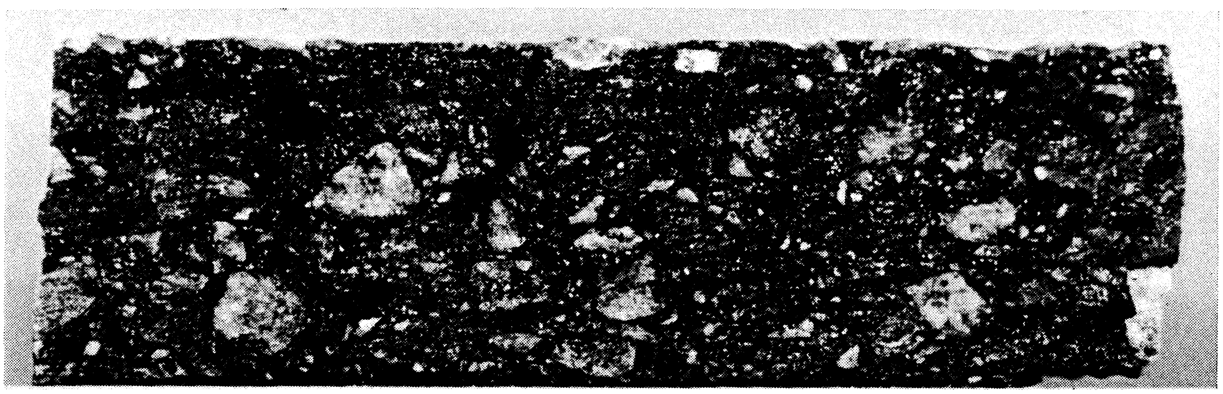
b. Chemical additive.

c. Hydrated lime.

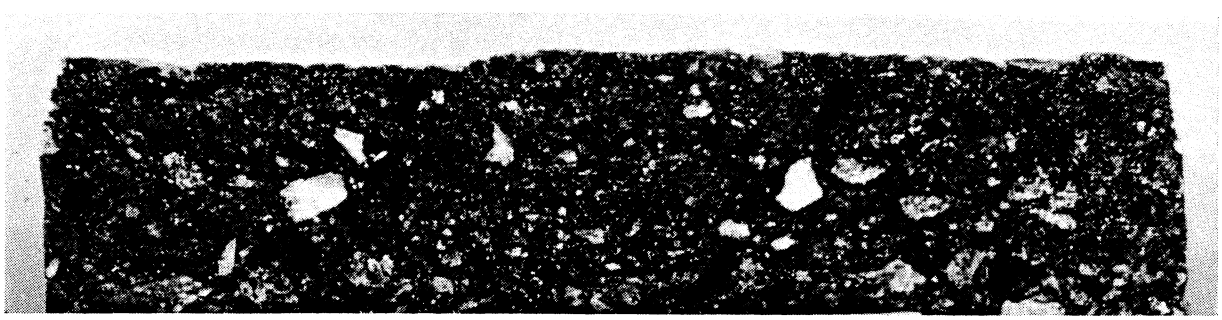
Figure 4. Pavement samples from Route 250 after 6 years.



a. No additive.



b. Chemical additive.



c. Hydrated lime.

Figure 5. Pavement samples from Route 360 (M) after 6 years.

a. No additive.

b. Chemical additive No. 1.

c. Chemical additive No. 2.

d. Hydrated lime.

Figure 6. Pavement samples from Route 360 (B) after 6 years.

CONCLUSIONS

1. Generally, there was less visible stripping in pavement samples containing hydrated lime than in pavement samples with no additive or with the chemical additives that were used routinely in 1982 and 1983.

2. The importance of mix properties was demonstrated on Route 360 (B) where high permeability possibly prevented any of the additives from being effective and on Route 10 where low permeability prevented stripping in any of the mixes.

3. Mixes without lime had a shortened service life at one location.

RECOMMENDATION

Based on the results of this follow-up evaluation, lime has performed as well or better than chemical additives that were being manufactured in 1982-83. This observation supports the current specification that requires that lime be used unless a chemical additive can be tested and proven to be equivalent to lime. It is recommended that the present specification be retained.

1770

REFERENCE

1. Maupin, G. W., Jr. 1987. Final report: The use of hydrated lime as an antistripping additive. VTRC Report No. 87-R16. Charlottesville, Va.: Virginia Transportation Research Council.