MODIFIED SURFACE TREATMENTS

Charles Payne
Transportation Technical Program Supervisor

A Talk presented at the

Quality Assurance Workshop

in

Charleston, WV
February 20, 1991

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

Charlottesville, Virginia
VTRC 91-TAR3

MODIFIED SURFACE TREATMENTS

Charles Payne
Transportation Technical Program Supervisor

INTRODUCTION

Even though Virginia has been placing surface treatments for a number of years, we are still plagued with problems. The Research Council has been involved with surface treatment work since the early 1960s, and during that time, several studies have been completed, and the following recommendations have been made:

- Design methods should be used to determine quantities of aggregate and emulsion.
- State specifications should require that surface treatment aggregate is clean.
- Surface treatments should not be placed when the surface temperature is lower than 70°F.
- A pilot vehicle should be used during the placement of a surface treatment on roads carrying more than 400 VPD.
- More emphasis should be placed on inspection and workmanship.

Since the completion of these studies, some of the recommendations have been implemented, however, we have still been experiencing problems.

In 1983, the Research Council began a study in the Fredericksburg District to improve the quality of river gravel surface treatments. For two reasons, the problems with river gravel surface treatments are more complex than those experienced with crushed granites and limestones:

- River gravels do not have the porosity that crushed aggregates possess. Because the crushed aggregates have more pores than river gravels, they absorb the water out of the emulsion thus allowing a quicker set. This does not occur with river gravels; therefore, the water has to evaporate before a good set is achieved.
- Aggregates that are cubical in shape perform better than the rounded river gravels. When they are released to traffic, often much of the aggregate is whipped off before it bonds to the asphalt emulsion and ends up on the shoulders (see Figures 1 and 2).

240

Figure 1. Surface treatment that used river gravel.

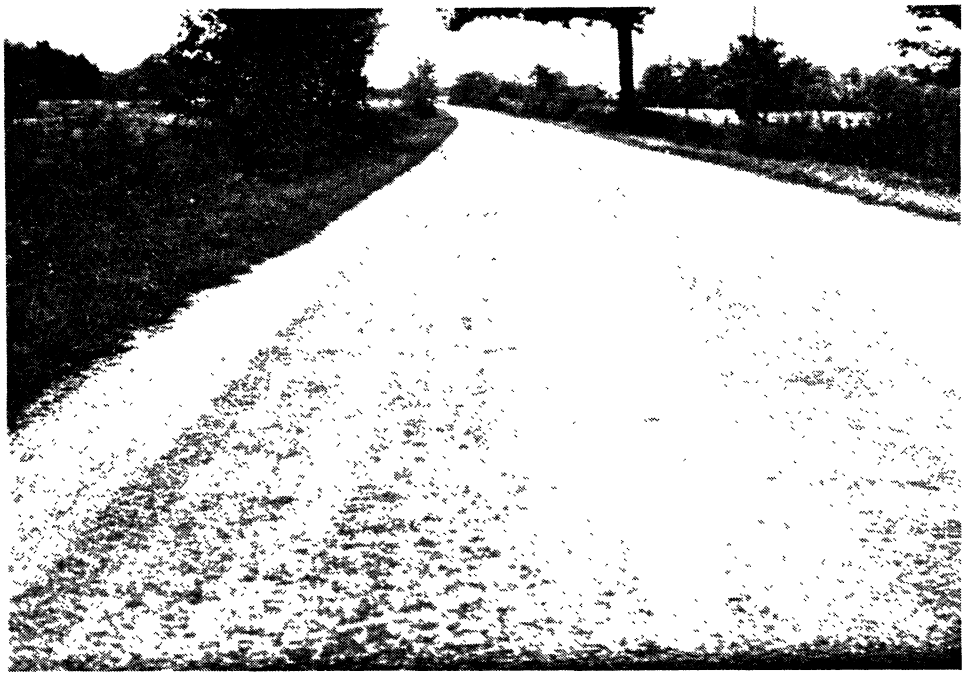

Figure 2. Loose river gravel on the shoulders.

By 1984, it was apparent that all areas of the state needed to be included in the study since all districts were experiencing problems. Therefore, the study was expanded to include the entire state and all types of aggregates.

During 1983 and 1984, numerous test sections were placed in several districts using river gravels and crushed aggregates. Also, samples of all aggregate sources were obtained and design quantities were determined for each. In addition to the numerous test sites, observations were made on chip-seal operations in every district. By the end of 1984, it was obvious that specification changes were needed to achieve better chip-seal treatments.

In 1986, the following recommendations were implemented in hopes of improving surface treatments:

- Aggregate and emulsion quantities should be determined by the U.S. Customary Design Tests to eliminate excess quantities being placed.
- CRS-2 emulsion should be sprayed at temperatures between 160°F and 175°F rather than between 140°F and 175°F. This change could significantly improve surface treatments placed during the colder months.
- Districts should use No. 8-P aggregate rather than No. 8. Tables 1 and 2 show the differences in gradation. The 8-P aggregate costs approximately $1.00 per ton more than the regular No. 8; however, performance is usually better because it is cleaner.
- Contractors should be paid for the aggregate by the square yard according to the design quantities. Prior to this change, they had been paid according to quantities placed and were not tightly controlled. Consequently, quantities ranged from 18 to 30 lb/yd^2, whereas now they range from 15 to 20 lb/yd^2. The design quantity on the roadway in Figure 3 was 18 lb/yd^2 but 25 lb/yd^2 were placed.

Table 1

GRADATION REQUIREMENTS FOR NO. 8 AGGREGATE

Sieve Size	% Passing	Range
1/2	Min. 100	—
3/8	92 + or – 8	84–100
No. 4	25 + or – 15	10–40
No. 8	Max. 8	—
No. 16	Max. 6	—

Table 2

NO. 8 P GRADATIONS

Sieve Size	Percent Passing
1/2	100
3/8	84–100
No. 4	5–30
No. 8	Max 5

Although the new specifications improved surface treatments, problems continued to persist, especially with the river gravel chip-seal treatments and with the aggregates that contained excessive fines.

In 1986, literature was received from the North Carolina Department of Transportation regarding their successful use of blot seal treatments. During the 1986 paving season, representatives from the Maintenance Division and the Research Council visited North Carolina to observe the placement of modified surface treatments and also to observe a few modified surface treatments that were already in place. During this visit, it was learned that blot seals had been used successfully for as long as 10 to 12 years.

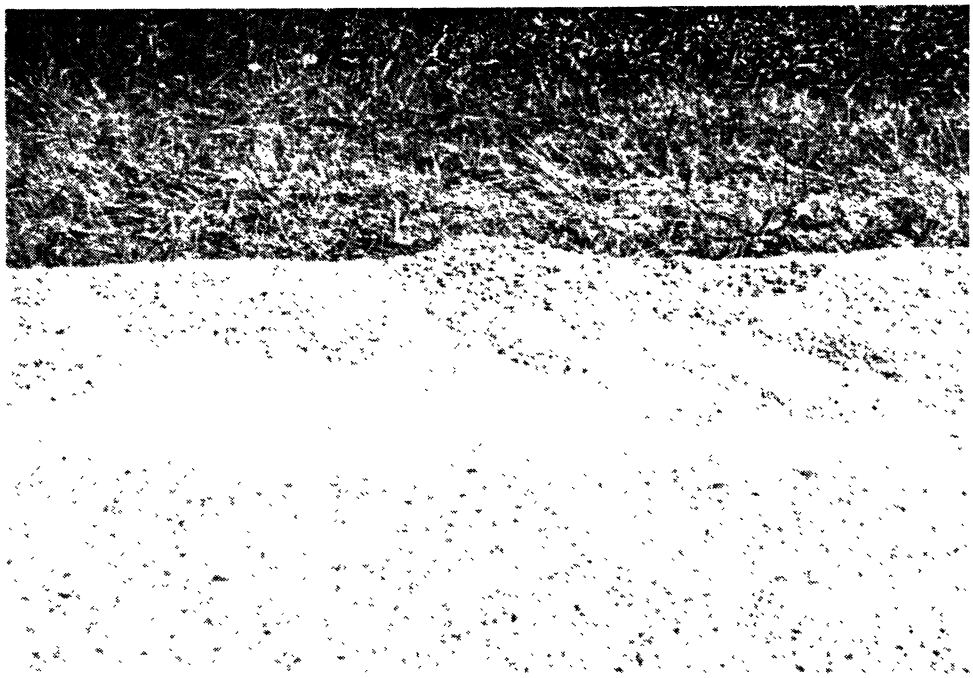

Figure 3. Excess material on the shoulder.

A second trip was made to North Carolina to learn more about the blot seal treatments and to look at a number of treatments that had been in place for an extended period of time. Representatives from North Carolina showed us blot seal treatments that had been in service from 2 to 9 years. All of the treatments had been successful, and even the older treatments appeared to have life left in them.

Because of the success of blot seals in North Carolina and the fact that we saw in these seals a potential help with some of our chip-seal problems, we placed 30 test sections during the latter part of the 1986 paving season. These treatments were placed in the Fredericksburg and the Richmond Districts using river gravels and crushed granite and limestone, all of which had presented problems in the past.

Some of the test sections placed in 1986 were not successful because of faulty construction techniques and dirty aggregate. However, the Fredericksburg District felt that the treatments were successful enough to offer a potential solution to their river gravel problems. In 1987, all of the surface treatments placed in Fredericksburg were modified to be similar to the North Carolina blot seals. Also, two other districts used the modified treatments in several counties. By 1988, the Lynchburg District had converted completely to the modified surface treatments, and all districts were placing some of them.

TYPES OF SURFACE TREATMENTS

Single Seal Treatments

Single seal treatments are the usual type of treatment that Virginia places using CRS-2 emulsion and No. 8 or 8-P aggregate. The asphalt emulsion and aggregate quantities are predetermined by design methods tests and then adjusted according to road and traffic conditions. Depending on the aggregate used, the quantities usually range from 15 to 20 lb/yd^2 and emulsion quantities usually range from .22 gal/yd^2 to .32 gal/yd^2.

Modified Single Seal Treatments

The North Carolina blot seal treatments are called modified single or double seal treatments in Virginia. Modified single seal treatments involve spraying the CRS-2 emulsion at 0.17 gal/yd^2, followed immediately by the placement of 15 lb of No. 8 or 8-P aggregate. The treatment is then rolled with a steel wheel roller, immediately after which another application of 0.15 gal/yd^2 CRS-2 emulsion and a uniform application of 10 lb of choke or blot material meeting the gradations in Table 3 is placed.

Table 3

GRADATIONS OF BLOT MATERIAL FOR
MODIFIED SINGLE SEAL TREATMENTS

Sieve Size	Grade A	Grade B
3/8	Min. 100	Min. 100
No. 4	94 – 100	94 – 100
No. 8	80 – 100	
No. 16	49 – 85	
No. 30	25 – 59	
No. 50	8 – 26	
No. 100	Max. 10	Max. 10
No. 200	Max. 5	Max. 5

This fine graded aggregate can be either a natural or a manufactured sand; however, the VDOT does specify that the natural sand be used with river gravels and that manufactured sand should be used with crushed granites and limestones. This is done because of complaints received when using natural sand over roads with crushed aggregates.

After the choke or blot material is placed, it is then rolled a final time before allowing traffic on the treatment.

Modified Double Seal Treatments

This treatment consists of two applications of CRS-2 emulsion at the rate of 0.17 gal/yd^2 and the placement of 15 lb/yd^2 of No. 8 or 8-P aggregate. The treatment is then rolled and another layer of 0.15 gal/yd^2 and 10 lb choke or blot material are applied prior to the final rolling.

Problems With Modified Seal Treatments

Even though the success rate of the modified seal treatments in Virginia has been good, problems did occur in the beginning and, in fact, still do. Some of the problems that we have experienced are as follows.

Streaking

It was learned the first year that the nozzles in most of the distributors used in Virginia were the wrong size, and this caused streaking (see Figures 4 and 5).

Figure 4. A roadway that is streaked because nozzles of the wrong size were used.

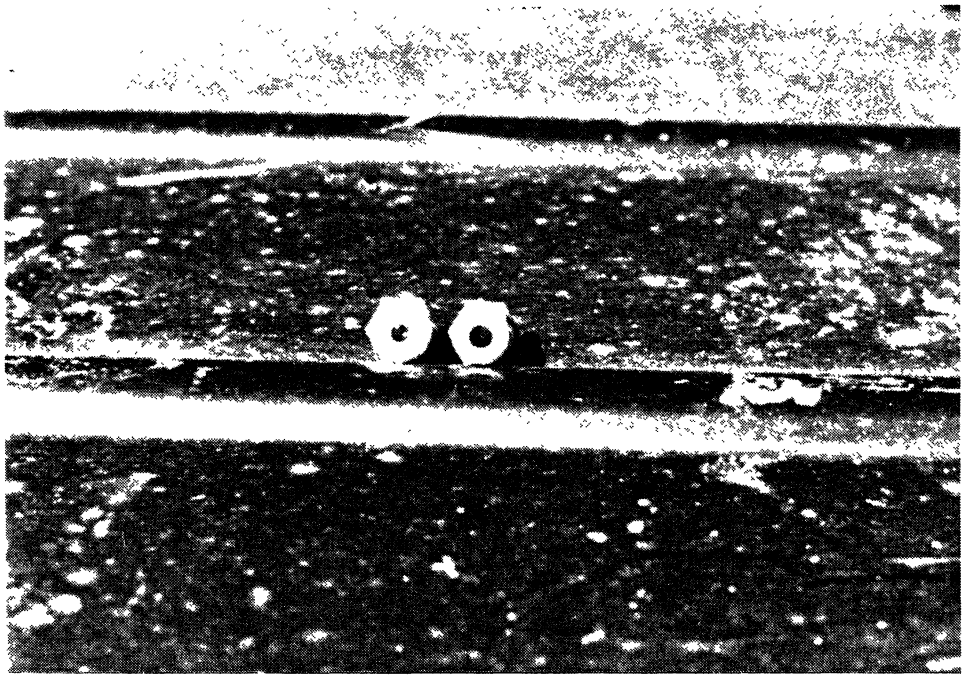

Figure 5. Two different size nozzles.

The nozzle that was furnished by the manufacturer works well when placing regular chip-seal treatments because the range of asphalt emulsion quantities were between 0.20–0.45 gal/yd^2. However, when placing the modified surface treatments in which the asphalt emulsion quantities are between 0.15–0.17 gal/yd^2, these nozzles would not apply the material uniformly.

After learning what was causing the streaking, we replaced the nozzles with ones that would dispense from 0.10–0.35 gal/yd^2 and the streaking problem was eliminated.

Nonuniform Coverage of the Choke Material

Another problem that was encountered in the beginning was nonuniform coverage of the choke material (see Figure 6). This nonuniformity is caused by the material being so damp that it would not flow from the chip spreader evenly. Contractors now try to ensure that the choke material is kept dry, and some have installed a vibratory system on the front of the spreader that keeps the material flowing evenly.

Dusty Choke Material

The second year that the modified surface treatments were placed, dusty choke material was a problem in at least one district (see Figure 7). Most contractors use the Grade B blot material on which the gradation was changed in 1989. Since that time, dust has not been a major problem.

Figure 6. Nonuniform coverage of choke material.

Figure 7. Dust from dusty choke material.

Aggregate Spillage

Aggregate spillage has also presented a problem. If the first layer of aggregate is more than one stone thick when the final layer of asphalt emulsion and choke are placed, spalled areas occur (see Figures 8 and 9). Contractors and inspectors are now aware of the cause of this problem and therefore try to ensure that these spills are cleaned up so that the problem won't occur.

Traffic on Unfinished Modified Seal Treatments

When we first started placing the modified seal treatments, a pilot truck was not always used, nor was good traffic control always maintained. Because of this, traffic often traversed the modified seal treatment prior to the choke layer being placed. This often caused movement of aggregate so that some areas would have aggregates more than one stone thick, which would result in spalled and flushed pavements. In 1990, Virginia's specifications were changed to ensure that traffic would not be permitted until after the final layer of blot material was placed. To accomplish this, a lane is completed before the adjacent lane is started (see Figure 10). Once the blot material has been placed and rolled, traffic can travel at high rates of speed without throwing stone.

Figure 8. Spalling as a result of aggregate spillage.

Figure 9. Spalling as a result of the excessive use of aggregate.

Figure 10. A modified seal treatment under construction (one side has been choked, one side has not).

Effects of Ambient Temperature on Surface Treatments

It was stated earlier that 10 lb/yd^2 of choke material should be used. However, during the cooler months, we found that sometimes 8 lb/yd^2 of choke material is enough to prevent aggregate whip-off. However, during the hot, humid months, it is sometimes necessary to place 12 lb/yd^2 to prevent whip-off. An easy way to determine whether enough choke is being placed is to let a vehicle travel on the new treatment at 45 MPH to determine whether aggregate will be whipped off.

Summary of Good Construction Practices

As with any type of seal treatments, good construction practices need to be adhered to in order to obtain the best possible job. In addition to the usual good construction practices, the following recommendations need to be followed:

- The correct nozzle needs to be used to eliminate streaking and to ensure uniformity.
- Natural sand should be used if river gravel is used, and manufactured sand should be used if crushed granite and limestone aggregates are used. Also, choke material should not be too damp.

- Dusty or dirty blot materials should not be used, especially on high trafficked roads with high traffic volumes.
- A steel wheel roller should be used.
- The pilot vehicle should be used, and traffic should not be permitted to travel on a modified surface treatment until the final application of choke material has been placed and rolled.

Figures 11 through 17 show some modified surface treatments.

Figure 11. Close-up of modified seal treatment using natural sand for the choke material.

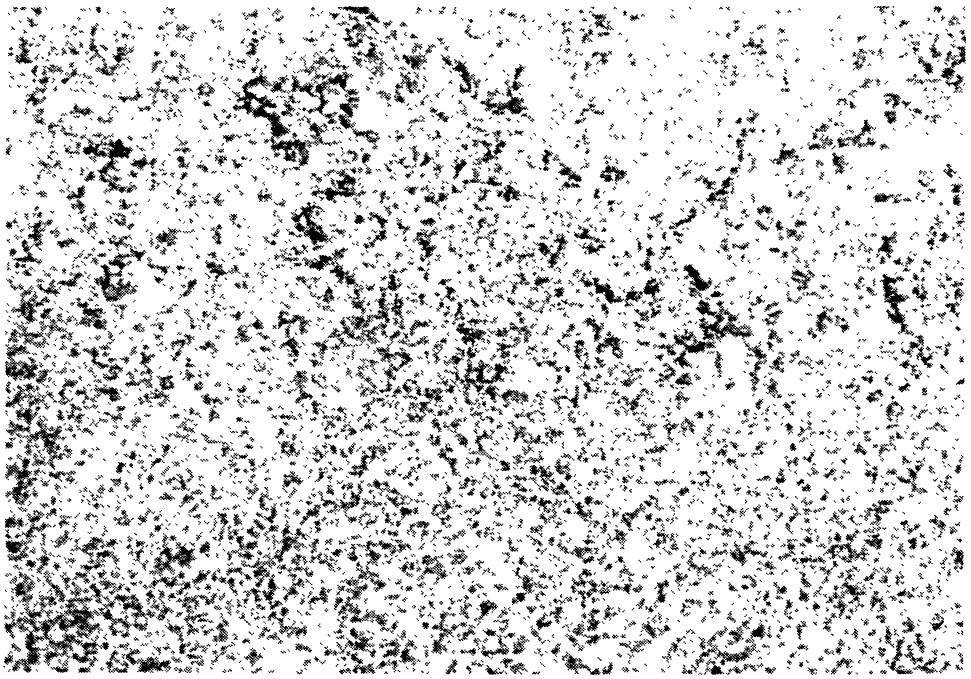

Figure 12. Close-up of modified seal treatment using manufactured sand as the choke material.

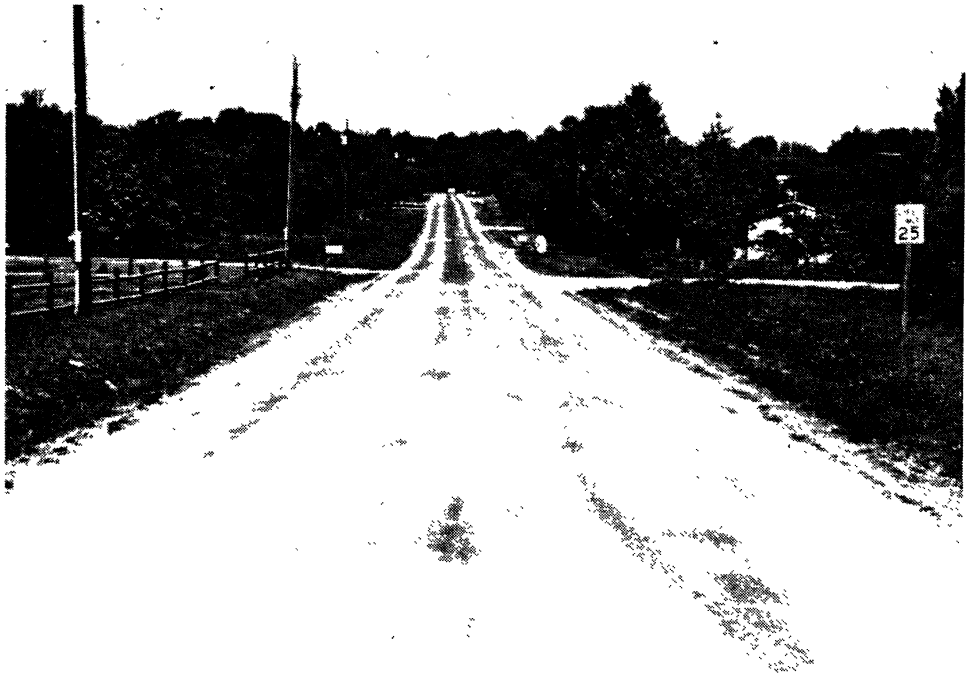

Figure 13. Two-day-old modified surface treatment (some of the blot material has been blown off by traffic).

Figure 14. One-month-old modified surface treatment (sand on sides of the road).

Figure 15. One-year-old modified surface treatment (same road and treatment as in Figure 14).

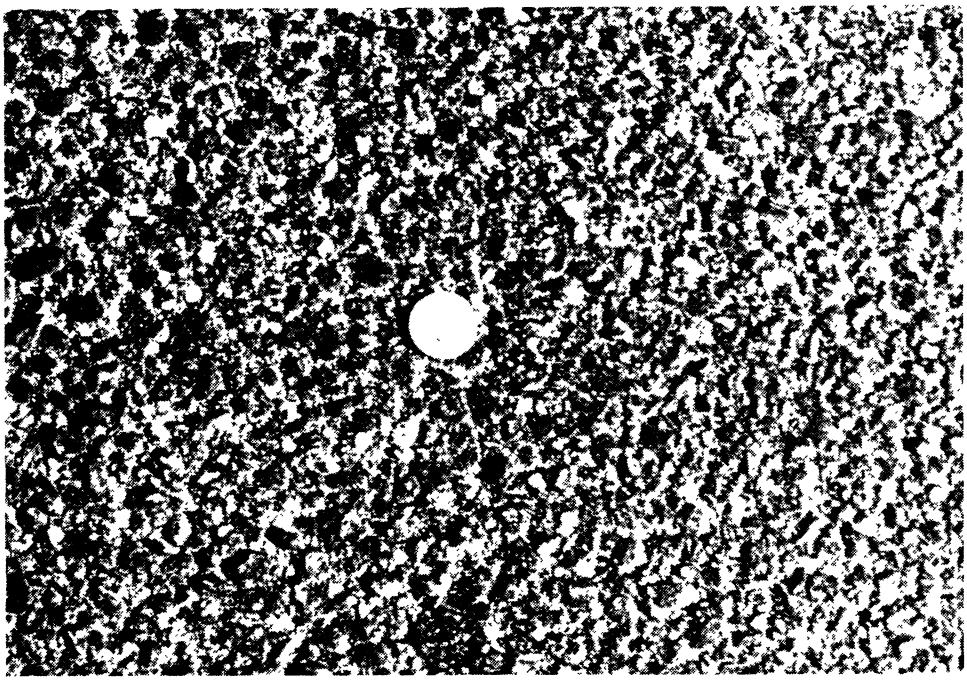

Figure 16. Close-up of two-year-old modified treatment using Aylett S and G material (problem river gravel).

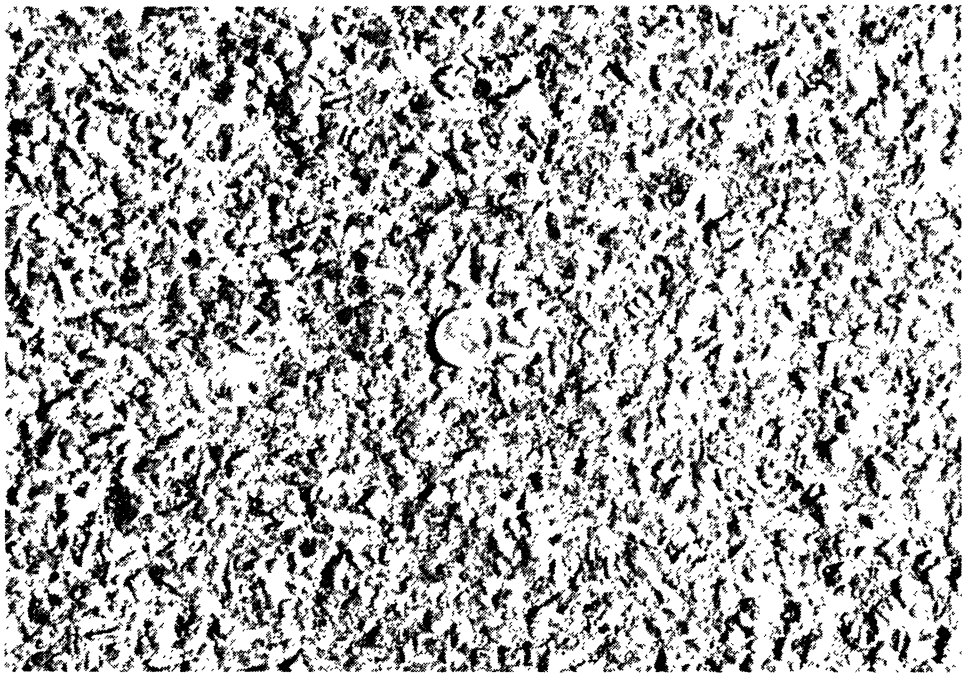

Figure 17. Close-up of one-year-old modified treatment using crushed granite.

Surface Treatments in Virginia in 1991

The cost and quantities being placed in 1991 of the three types of surface treatments that Virginia places are as follows:

Modified Single Seal	$0.45/yd^2	10,798,744 yd^2
Modified Double Seal	$0.66/yd^2	1,634,434 yd^2
Regular Seal Treatment	$0.40/yd^2	24,138,985 yd^2

Even though the initial cost of a modified surface treatment is higher than the conventional type of surface treatment, this is offset by its quality and its longer life cycle. Also, the modified treatment presents fewer problems during and immediately after construction.

Because of the success of modified surface treatments, this year's state advertisement advertises 34 percent of our surface treatments to be modified. However, if our economy were better, this figure would probably be higher, and I'm sure it will be higher in the future.