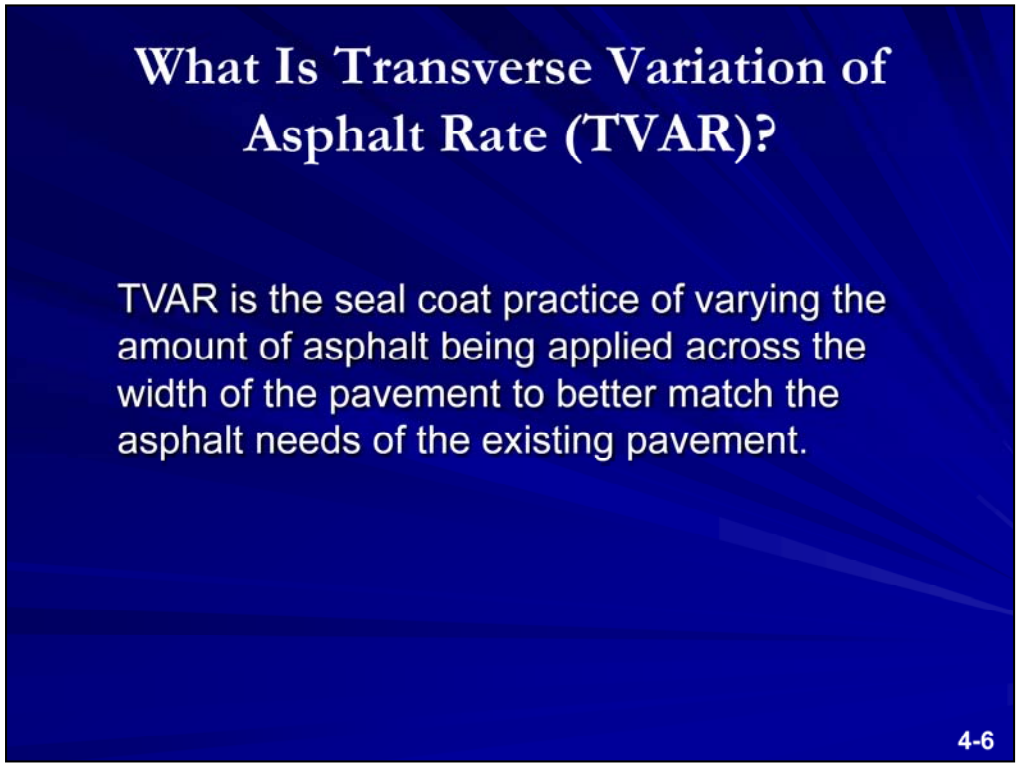
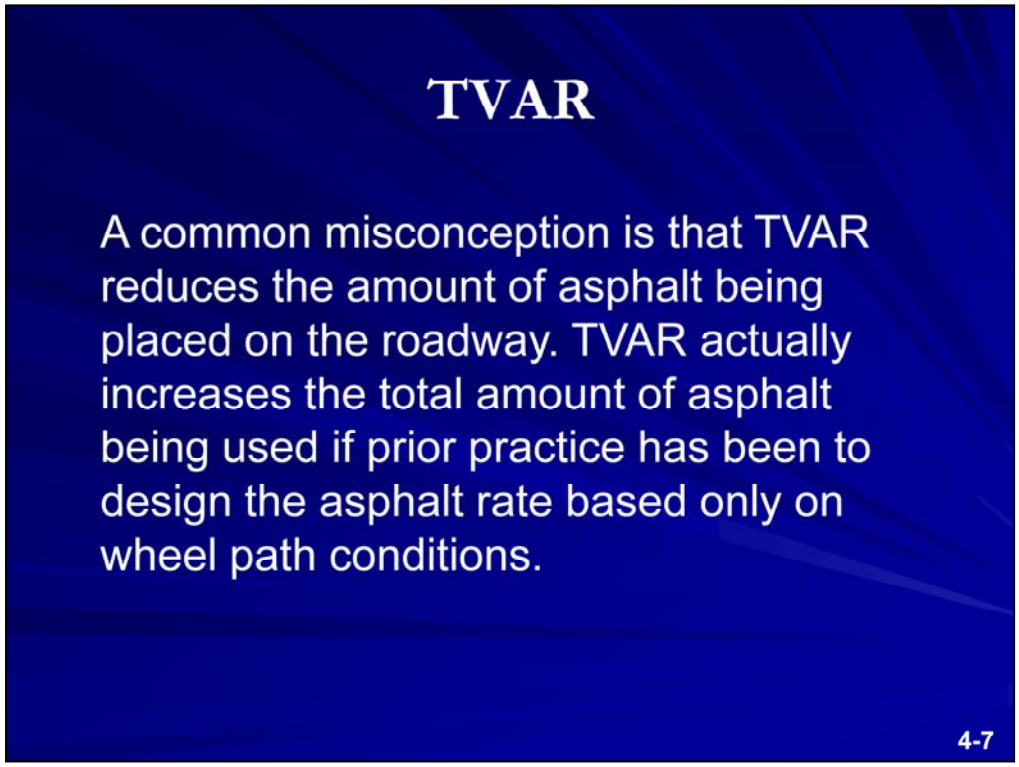
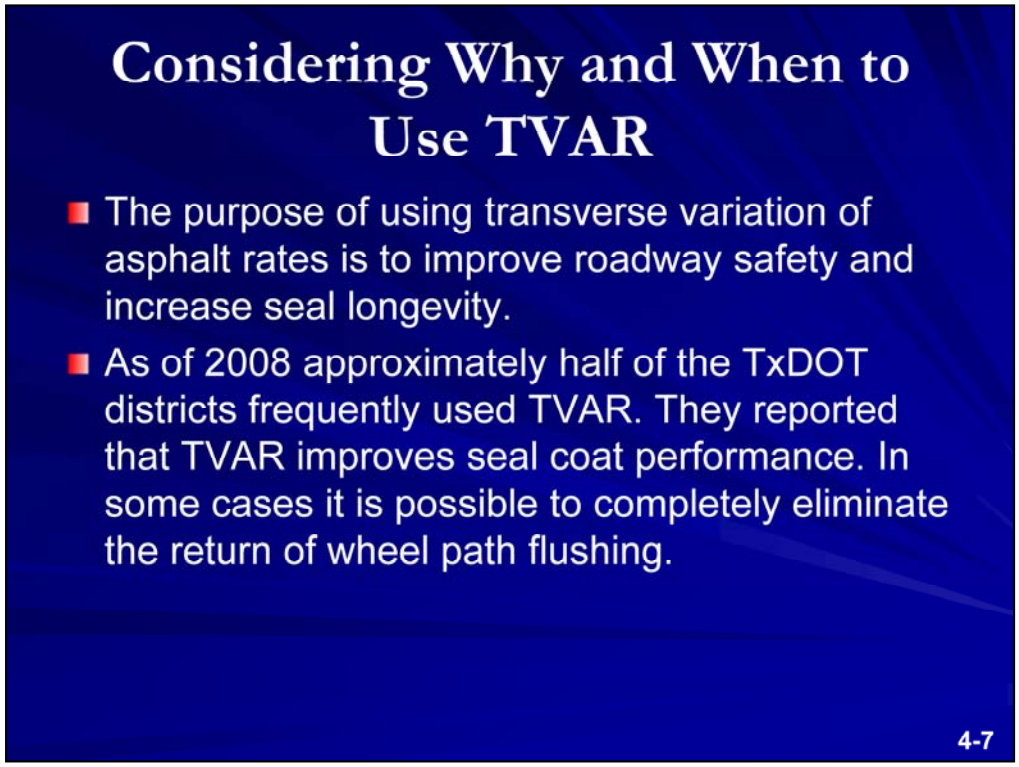


I shouldn’t assume that everyone is completely familiar with some of these terms and the acronym, TVAR, so let me start by defining the subject just a little bit.

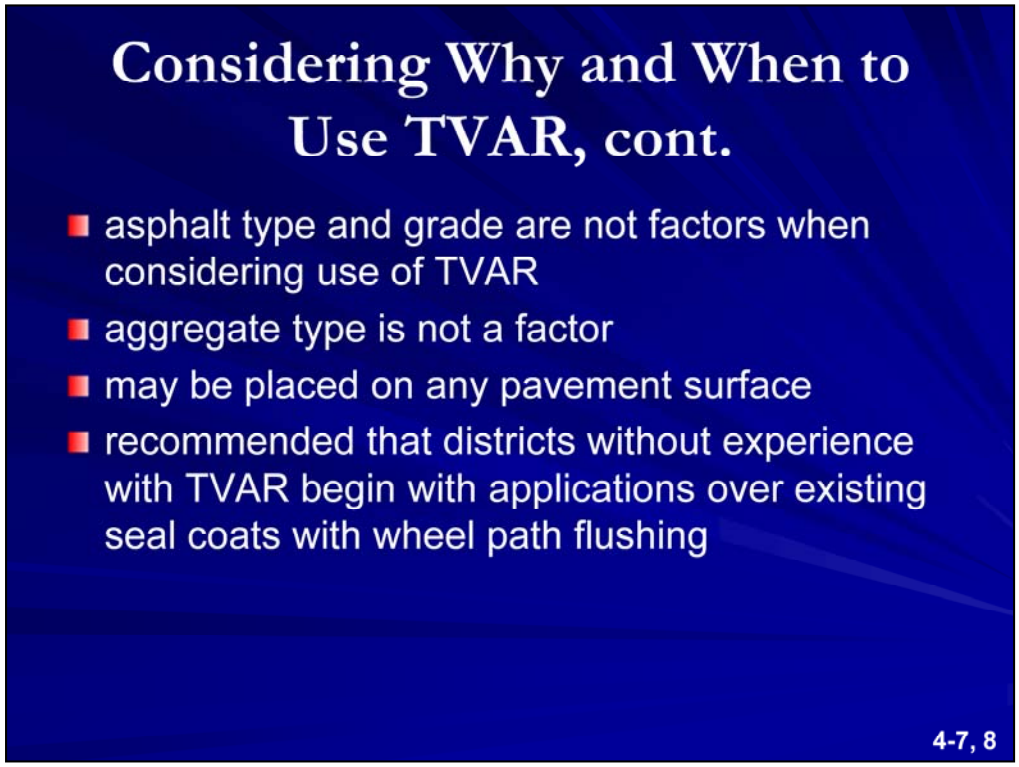
And here you see a pavement where pavement texture varies across a pavement. It's a prime candidate for using the TVAR technique. The reason why is more obvious when you look at the magnified pavement surfaces in the wheel path, on your right, and outside of the wheel paths, on your left. One can readily see that less new asphalt is needed in the wheel paths to hold the new aggregate than is needed between the wheel paths. Between the wheel paths, there's some texture that needs to be filled with asphalt before the remaining asphalt can effectively embed and hold the new aggregate. So if you are shooting one rate across the pavement width, either you have more asphalt than needed in the wheel paths (with the consequences quite obvious), or you have at best marginal asphalt being placed between the wheel paths (increasing the chance of losing aggregate).



Some when first hearing about TVAR think that TVAR reduces the total amount of asphalt they will shoot on a roadway. That just shouldn't be the case. It's definitely not the case if the rate otherwise to be shot across the entire width was selected to optimally meet asphalt needs in the wheel paths.



Explain various factors that may influence the decision to use TVAR. Include the advantages. Discuss the districts that use TVAR and the success they have. Another option is to ask districts with TVAR experience attending the course to comment on their experience.



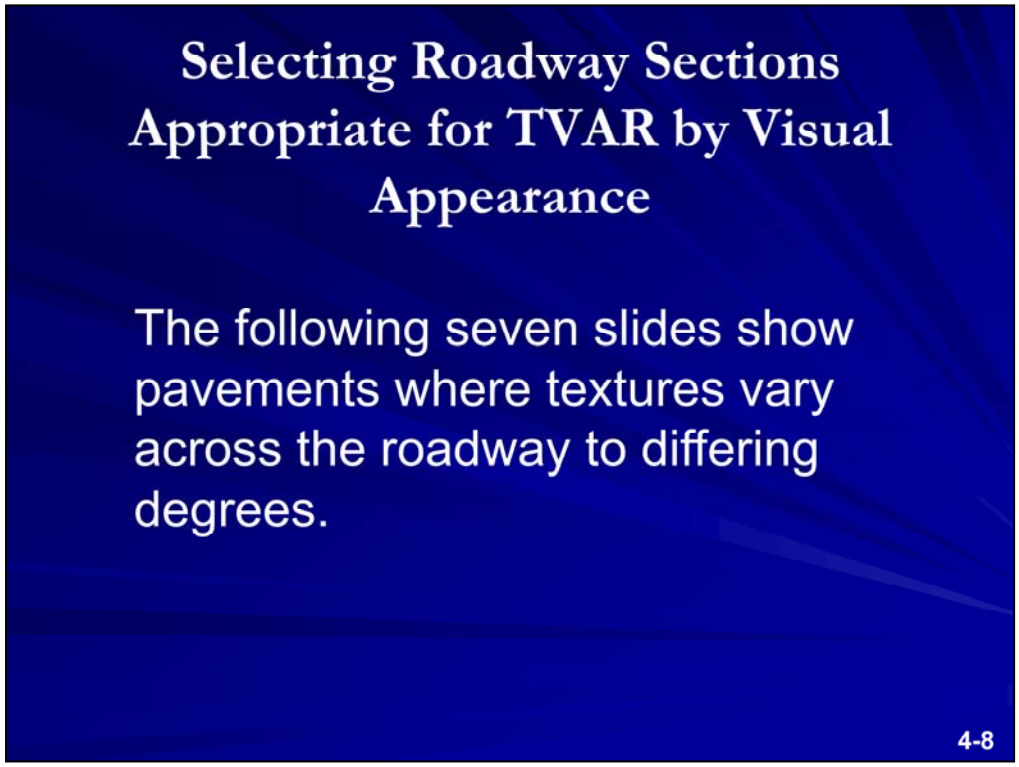
Continue discussion of the factors that may influence whether or not use TVAR:

TVAR works using both emulsified asphalts and hot asphalt cements.

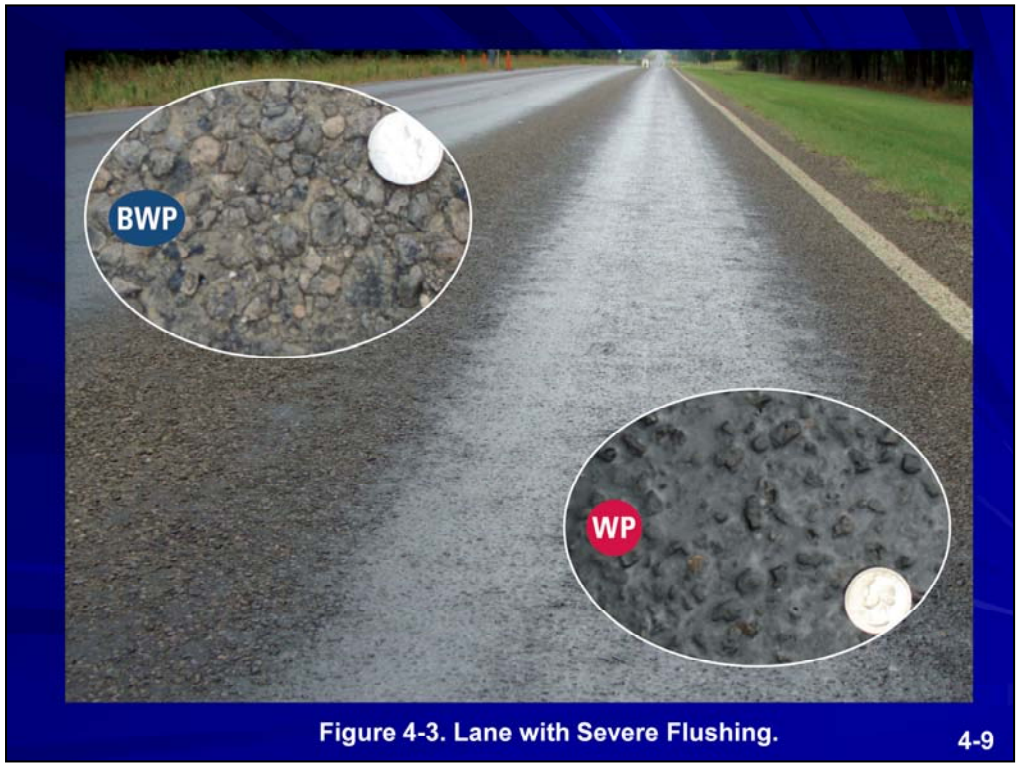
It's been done at least once with asphalt rubber (Ernest Teague in Paris District).

TVAR is used with both synthetic and natural aggregate, precoated and plain.

Most experience using TVAR seal coats is putting them on top of existing seal coats, particularly those showing lack of macro-texture or flushing in the wheel paths. That's really where a district without TVAR experience should start. TVAR seals on hot mix and microsurfacing can be tricky, and there's less experience out there doing them on them. They just tend to be tighter surfaces between the wheel paths, so the need for increasing asphalt between the wheel paths probably isn't as great if you do use TVAR on them.

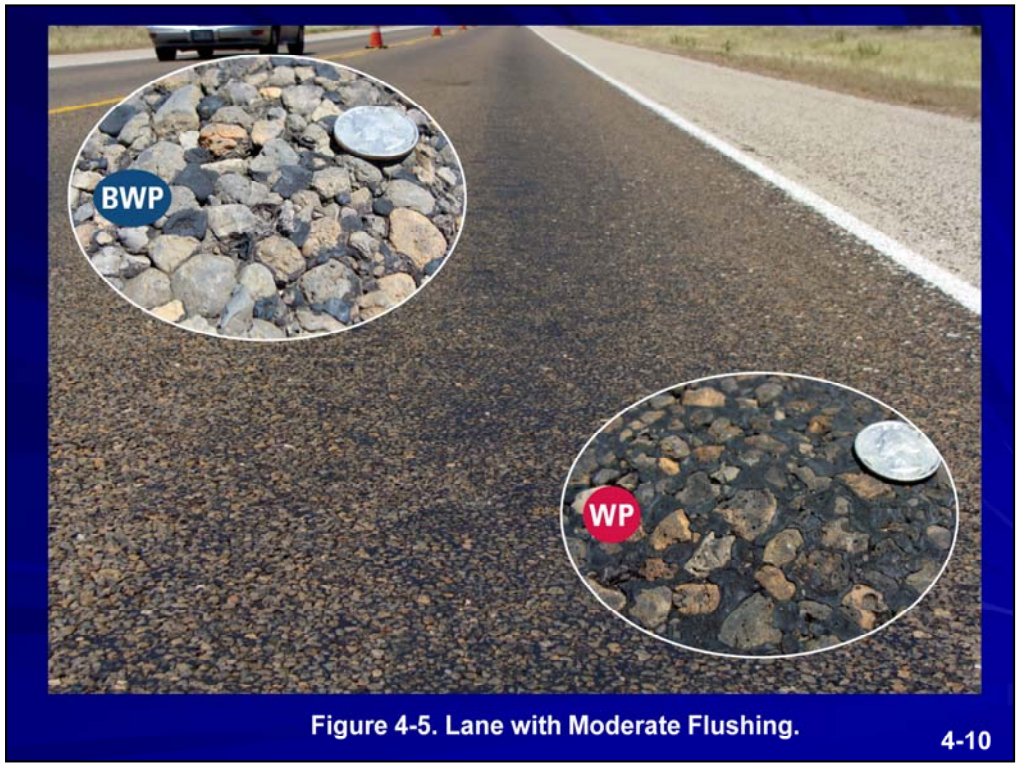


Explain that for the following seven slides, “WP” in the red circle represents a close-up of the wheel path, and "BWP" in the blue circles represents a close-up of the road section between the wheel path.



The pavements in the next two figures show severe flushing and are desirable candidates for TVAR use. The surface asphalt in the wheel paths in the first figure is sticky once the sun hits it for awhile. The conditions of the roadway wheel paths in these figures clearly indicate the need for corrective action. While TVAR should be used when the next seal coat is placed on roadways similar to these two, other corrective treatments are usually required in addition to TVAR in cases this severe to obtain significant and long term wheel path texture improvements.

Figure 4-4. Lane with Moderate to Severe Flushing.



The roadways in the following three figures have somewhat less wheel path flushing. These are ideal situations for improving future seal coat performance with TVAR.

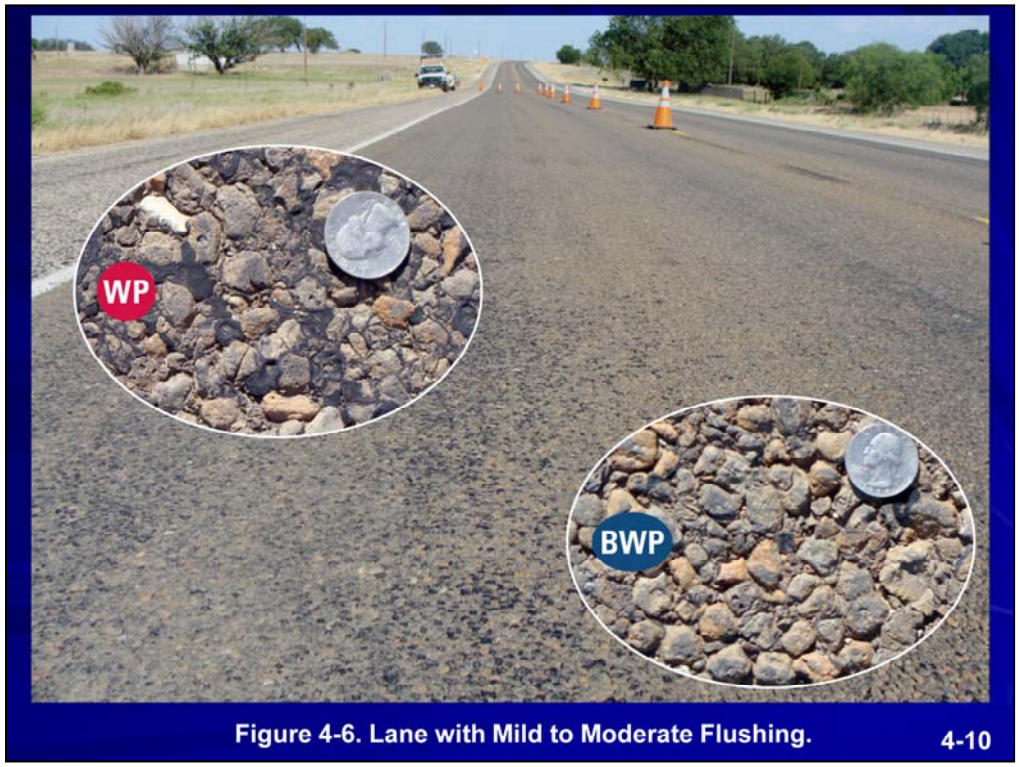


Figure 4-6. Lane with Mild to Moderate Flushing. 4-10

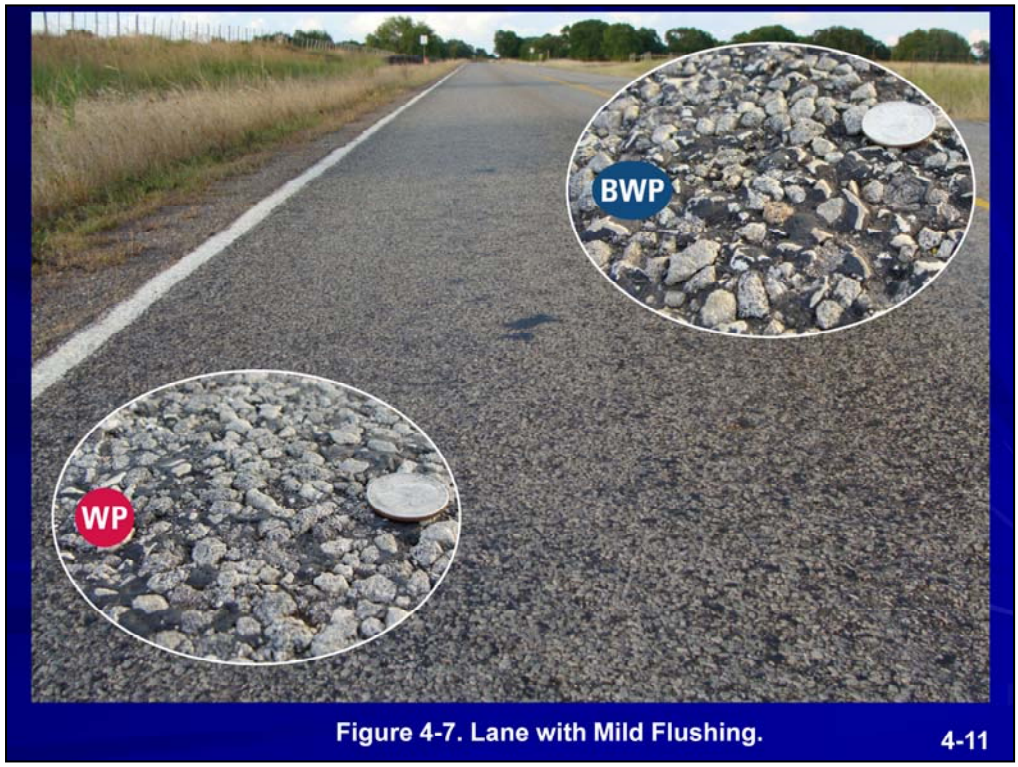


Figure 4-7. Lane with Mild Flushing. 4-11

If you look closely at the BWP close-up on this one you'll notice that some of the aggregate appears to have rolled and some has apparently been lost as well. Even though the wheel path isn't all that flushed or tight, the openness of the macrotexture between the wheel paths indicates that a healthy TVAR percentage on this road would probably be desirable to hold the aggregate better this time.

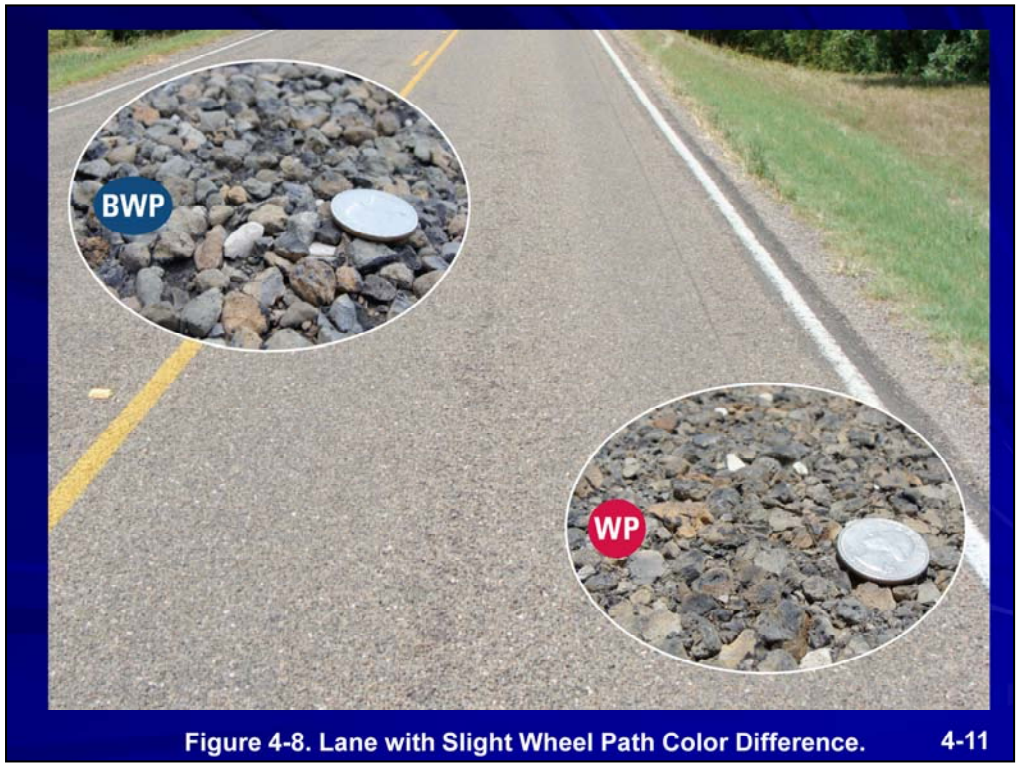
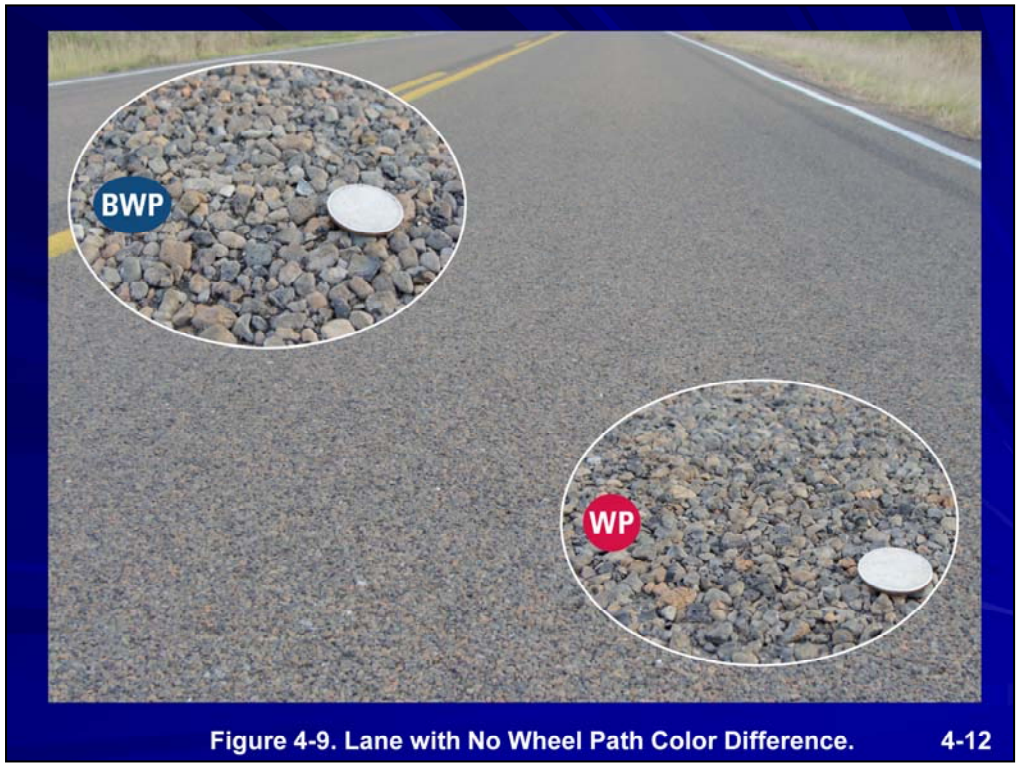


Figure 4-8. Lane with Slight Wheel Path Color Difference. 4-11

The lane in this figure has a just-perceptible wheel path color difference. The close-up also shows some increased openness of macrotexture between the wheel paths. It is a candidate for TVAR, but probably only if the contractor can vary the asphalt rate by smaller percentages, maybe 15% or thereabout.

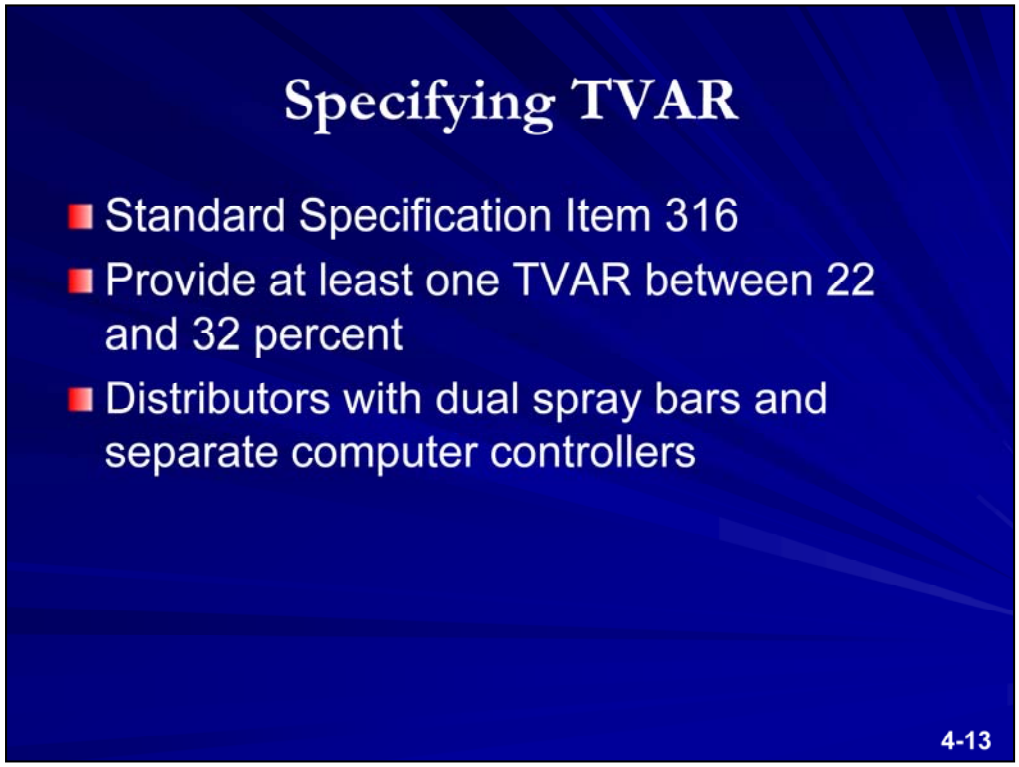


The lane in this slide has no readily visible texture difference in the wheel paths. This pavement surface is on a short one-year-old maintenance seal coat within the limits of a district seal coat program pavement. Pavements in this condition definitely don’t need higher percentage TVAR and usually aren’t given even smaller percentage TVAR treatment.

Situations to Avoid TVAR Use

- when a Grade 5 aggregate is being used
- when shooting emulsions on full super-elevated curves, as it may increase asphalt migration prior to rock placement
- on new construction because the degree of potential benefit is small compared to potential loss of performance due to smaller amounts of asphalt sealing the pavement where stresses are the greatest
- on shoulders and other non-traffic locations
- in continuous left-hand turn lanes where traffic patterns are random
- in intersections where the side street also carries considerable traffic volume, and
- on flushed or bleeding hot mix pavements that may have stripping or an otherwise unstable pavement layer below

4-12



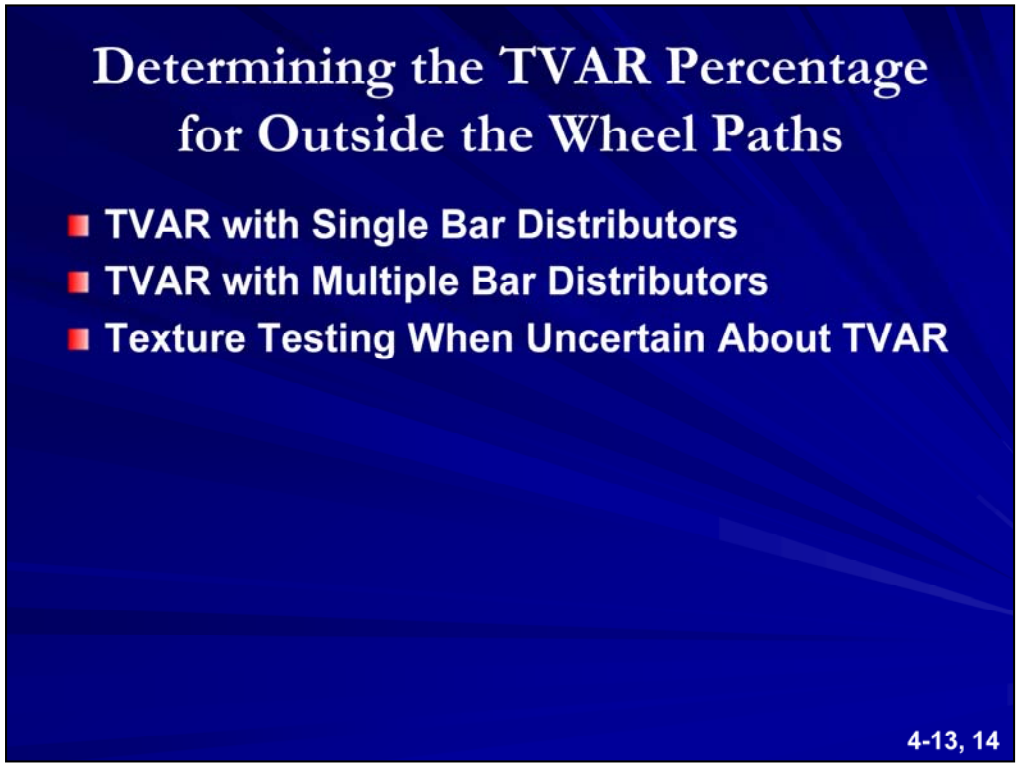
Refer the class to the recommended plan note language on page 4-13.

The somewhat odd percentage range suggested, 22% to 32%, is based on some good work that the Brownwood district did some years back to find out how much variation different nozzle sizes obtained from different nozzle manufacturers would give. One combination gave a little more variation than 30%, so it's recommended to allow up to 32% in case your contractor has nozzles of that type.

If your contractor's distributor has dual spray bars controlled by separate computers in the cab, you should be able to get almost any percentage variation you want within this range as well as outside of it.

This is a very important point to understand if your district hasn't been using TVAR.

If your district hasn't been using TVAR, you need to ask yourself if in the past you have let between wheel path considerations limit how low of an asphalt shot you use on flushed pavements. For instance, if you have had in your mind an absolute minimum design shot rate for Grade 3 rock that was based on holding the rock between the wheel paths, with TVAR you may be able to shot less than that to slow or reduce reoccurrence of wheel path flushing.



Once the design asphalt rate has been determined for the wheel paths of a given roadway, the next decision is if the asphalt rate should be increased outside of the wheel paths. And if so, how much should it be increased.

When the contractor is using a distributor with a single spray bar and only one TVAR increase is practical, the decision to be made is whether or not to vary the asphalt rate on a given pavement, not how much to vary it. TVAR is recommended in the specified 22 to 32 percent range whenever wheel path flushing is as evident as in the roadways shown in Figures 4-3 through 4-7 which we just looked at. Otherwise, no variation in asphalt rate is usually the best choice.

When the contractor has the capability of varying asphalt rates at percentages below the specified range, such as when using dual spray bar distributors, a broader and more optimal use of TVAR is possible. An asphalt rate increase between 10 and 15 percent is also recommended for roadways similar to the one shown in Figure 4-8. An asphalt rate increase of no more than 10 percent is recommended if TVAR is to be used on sections of roadway similar to Figure 4-9.

A simple and quick pavement surface test is available and should be used when there is uncertainty about the TVAR difference to be selected. This is the sand patch test, which takes only minutes to run and is described in Tex-436-A. The following two slides show this test being performed on a pavement surface.

A known amount of Ottawa test sand or glass beads (such as for traffic paint) is poured onto the pavement spot to be tested. The sand is spread out with a rubber-faced tool until the tops of the pavement aggregate are reached. Since the same volume of sand is always used, how far the sand spreads to get to that point indicates how much texture void space there is. The sand won't spread as far on a rough and open texture as it will on a smooth and tight texture.

You can see in the slide that the test kit comes with a wind shield for windy days.

Figure 4-11. Measuring Four Diameters of the Resulting Circle for Averaging 4-15

The diameter of the “patch” is measured at four places and averaged since the patch rarely comes out round.

Since texture and flushing amount varies down the road even on more uniform pavements, it’s recommended that four test locations be selected to represent a stretch of pavement to be shot. Both the wheel path and between the wheel paths should be tested at each of the four locations. The average difference in patch diameters of wheel path and between wheel path tests is then used to help select the TVAR percentage for that stretch of pavement. Some judgment is necessary in selecting the specific test locations. Avoid locations that have unique surface imperfections.

The sand patch test is known to be sensitive to techniques of the individual doing the testing. This doesn’t create much of problem in this application though, since we are looking for the difference in patch diameters. So if an operator has a tendency to work the sand a little further out when he or she runs the test, it will happen for both the wheel path and between the wheel path tests. The difference in diameters shouldn’t be affected much at all.

Table 4-3. Sand Patch Results

Roadway and Condition	Sand Patch Average Diameters, mm		
	Wheel Path	Between Wheel Paths	Difference
Figure 4-3 – Severe Flushing of Grade 3 Seal Coat	199	111	88
Figure 4-4 – Moderate to Severe Flushing of Grade 3 Seal Coat	200	117	83
Figure 4-5 – Moderate Flushing of Grade 3 Seal Coat	174	129	45
Figure 4-6 – Mild to Moderate Flushing of Grade 3 Seal Coat	177	129	48
Figure 4-7 – Mild Flushing of Grade 3 Seal Coat	184	121	63*
Figure 4-8 – Slight Color Difference across Recent Grade 4 Seal Coat	121	99	22
Figure 4-9 – No Visible Color Difference across Recent Grade 4 Seal Coat	121	112	9**

To give an indication of how sand patch diameters vary on different pavement textures, the average diameters found when testing the sections of pavement shown in Figures 4-3 through 4-9 are shown in this Table 4-3. The test results can reveal texture differences across the roadway that otherwise would go undetected if relying solely on visual observation. The notes below Table 4-3 describe two such instances.

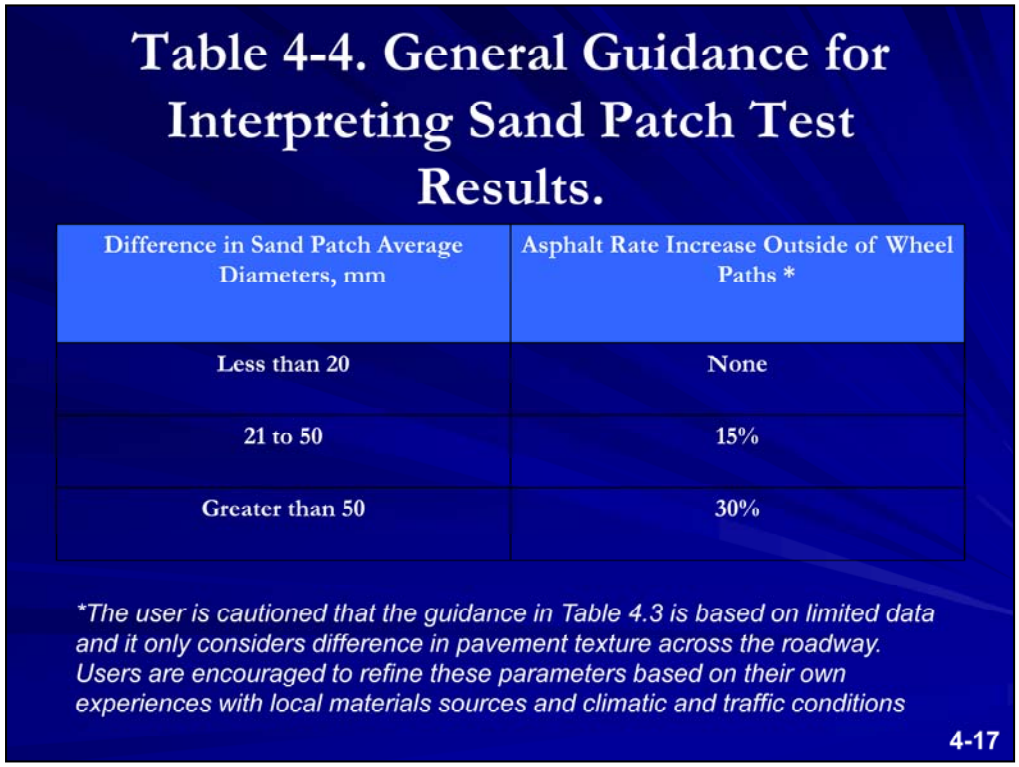
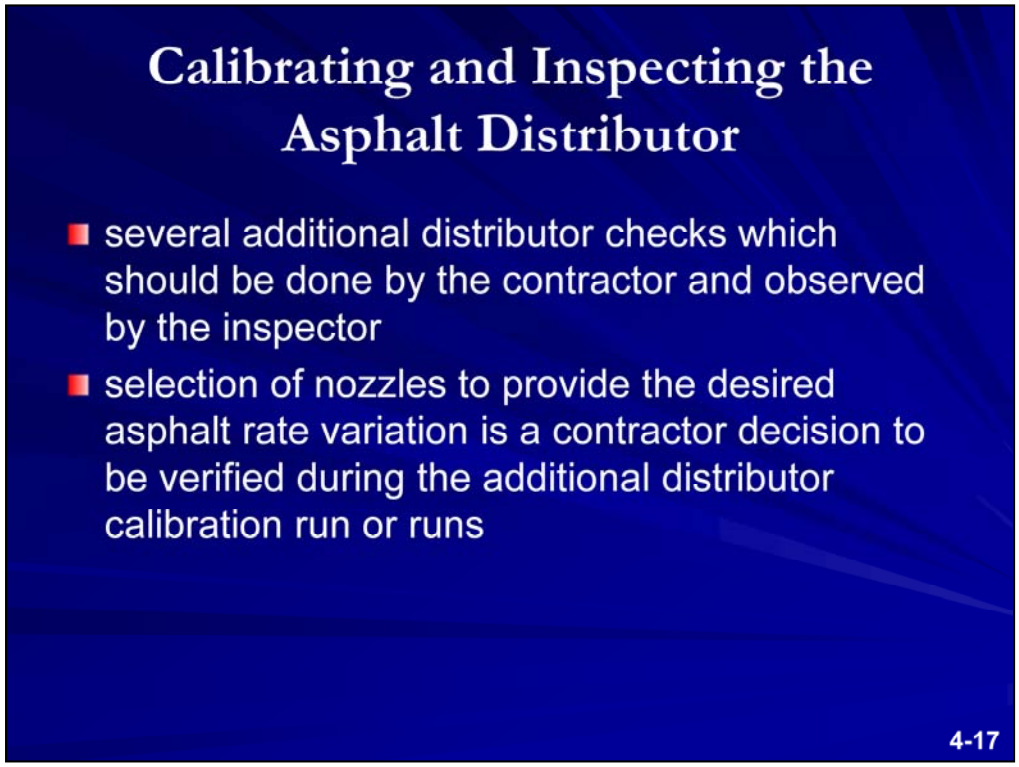


Table 4-4 provides general guidance for relating sand patch test results to desirable asphalt rate increases for outside of the wheel paths. These percentages are to give you a feel for approximate desirable TVAR rate adjustments. They aren't magic, and contractor's equipment usually can't hit the percentages shown exactly. Use this information as a starting place and general guidance if you haven't used TVAR in the past.



There are only a couple of additional things to keep in mind when calibrating and inspecting the asphalt distributor for TVAR use.

For one thing, in addition to the normal distributor calibration to show that same-sized nozzles don't vary more than the allowed 10%, you should have the contractor do a calibration test showing that his distributor will give a percentage increase in asphalt outside the wheel paths that meets your TVAR specification requirement.

If the distributor has one spray bar, the contractor will have to decide which nozzle sizes should be used to meet the TVAR spec. If the distributor has two spray bars, then the contractor has more options on how to meet the TVAR spec. But he should still be required to demonstrate that the method he wants to use meets the spec.

Table 4-5. Suggested Nozzle Configurations.

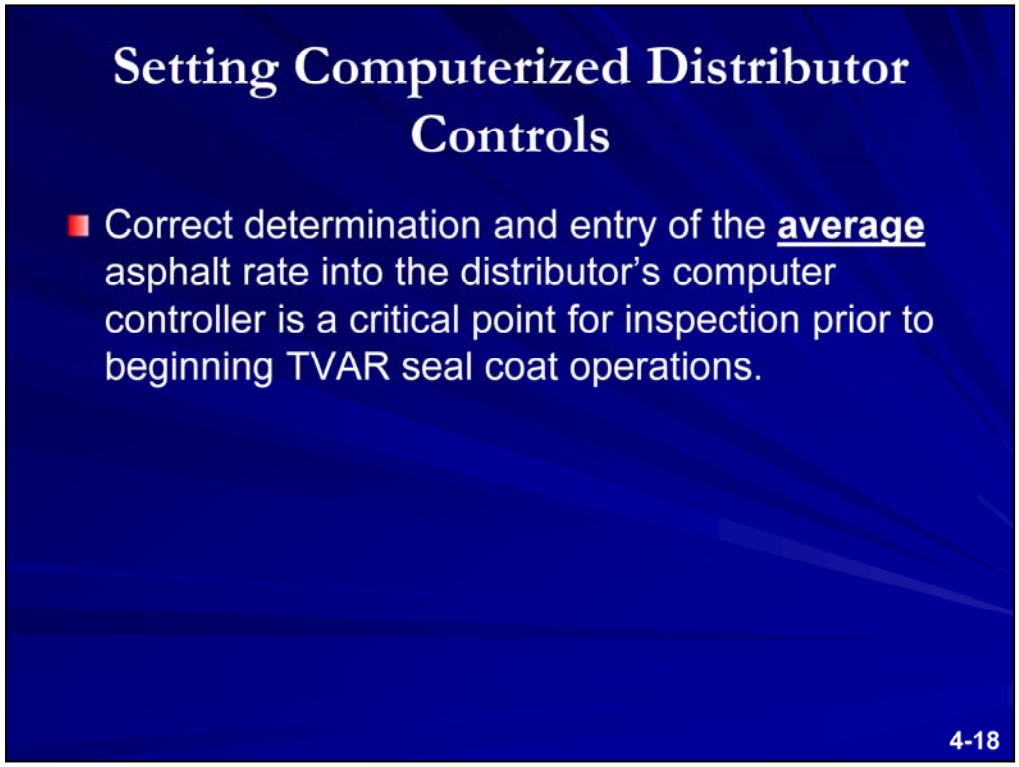
Lane Width, Feet	Center Line to Wheel Path Nozzles	Inside Wheel Path Nozzles	Between Wheel Path Nozzles	Outside Wheel Path Nozzles	Wheel Path to Pavement Edge Nozzles
9	1	9	6	9	2
10	2	9	6	9	4
11	4	9	7	9	4
12	5	9	8	9	5
12 (with edge line)	6	9	8	9	4
13	7	9	8	9	6

This table is based on recommendations provided by the Brownwood and Bryan Districts.

4-17

The inspector, however, must define the desired wheel path locations to allow the contractor to position the larger nozzles appropriately. Potential nozzle configurations to establish three-foot wheel path locations for various roadway widths are shown in Table 4-5. Many factors affect where the majority of traffic will track on a given roadway. The inspector may elect to use a different nozzle configuration than that shown to better approximate average wheel path locations on given roadways.

Correct positioning of the larger and smaller nozzles is something that should be inspected every morning at a minimum. This is a must. Also, since nozzles do get changed out or replaced from time to time, you need to observe the change outs whenever you can. An error can go unnoticed and cause problems with future performance of the seal. The problems might not show immediately. They may show up only after traffic has been on the new seal for a good while, possibly a year later.



Modern asphalt distributors have computer controls for the asphalt rates to be applied. The contractor and inspector must understand the meaning of the asphalt rate entered into the distributor's computerized controller(s).

If you haven't been using TVAR, you need to listen and remember this for sure. When a distributor with a single spray bar is being used, unless otherwise indicated in the distributor's operation manual, the computer setting establishes the **total** amount of asphalt to be applied. Therefore, when transversely varying asphalt rate with a single spray bar, the correct asphalt rate to be set on the distributor's computer controller is the **average** asphalt application rate. The average asphalt application rate is determined by the formula on the next slide. If the contractor enters the design asphalt rate, which you figured was right for the wheel paths, instead of the average rate, he won't be shooting enough asphalt either in the wheel paths or outside of them.

The average asphalt application rate in gallons/SY to be set on the distributor's computer when a single spray bar is used with different nozzle sizes may be determined from the following formula:

[(L/100) x (V/100) x R] + R = Average Rate

where:

L = % of larger nozzles = (number of larger nozzles/total number of nozzles) X 100,

V = % increase in asphalt rate selected for outside of the wheel paths, and

R = design rate of asphalt application for the wheel paths in gallons/SY.

4-18

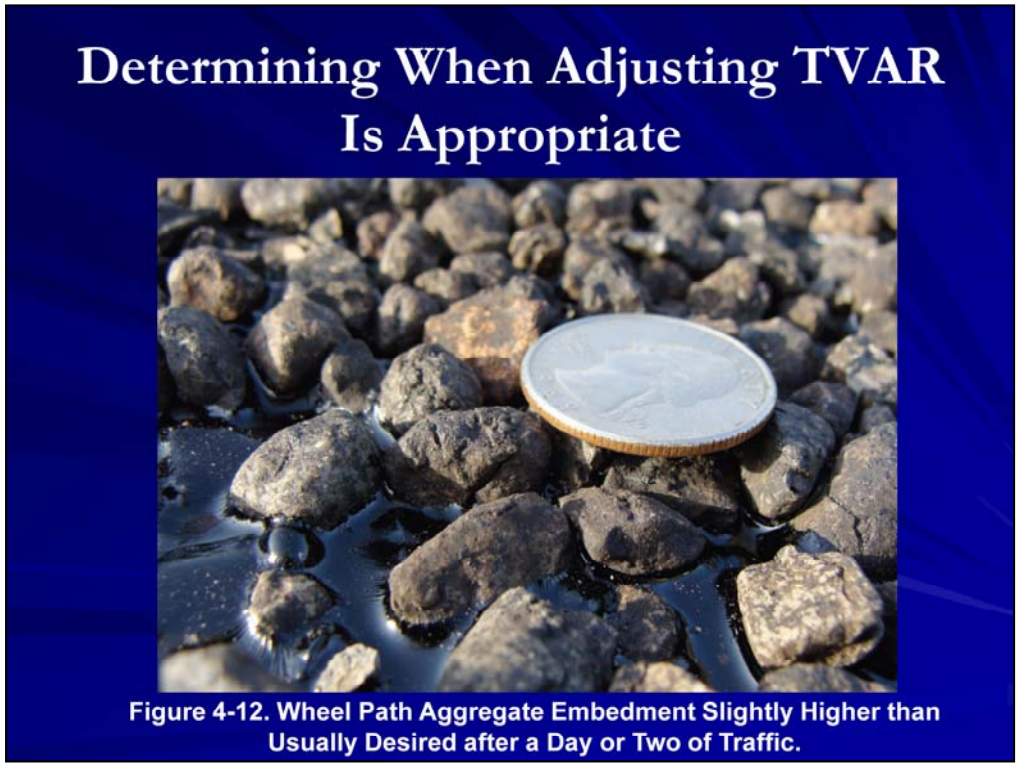


Figure 4-12. Wheel Path Aggregate Embedment Slightly Higher than Usually Desired after a Day or Two of Traffic.

As with regular seal coats, about the only thing you have to help you decide if the asphalt shot rates you chose were really good is to look at the embedment you are getting. For TVAR, it's probably even more important to go back and look at embedment after the traffic has had several hot weather days to begin to work on it. If there had been flushing in the wheel paths, it usually takes awhile for the traffic to work the rock down into the existing asphalt that had been on top of the old surface. Some inspectors like to go back and look a year later before setting TVAR rates on similar pavement conditions the following year.

Figure 4-12 may be helpful in determining if your TVAR shot rates were about right. It shows about the maximum desirable embedment percentage after several days of traffic. A little less than this might be better if there's very much traffic on the roadway.