TEXAS TECH UNIVERSITY
Multidisciplinary Research in Transportation

Draft Updates to TxDOT Surface Treatment Training Manual

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Sanjaya Senadheera and M. Vignarajah

Performed in Cooperation with the Texas Department of Transportation
And the Federal Highway Administration

Center for Multidisciplinary Research in Transportation

Texas Tech University

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Draft Updates to TxDOT Surface Treatment Training Manual

By

Sanjaya Senadheera, Ph.D. and M. Vignarajah

Department of Civil Engineering
Texas Tech University

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Chapter 2

Guidelines for Treatment Selection

Section 5 — Surface Treatments (Insert on second page of the section)

The surface treatment is the primary tool in the pavement engineer's arsenal to seal the pavement layers such as the base, subbase and subgrade. Whether one uses a surface treatment as a wearing surface, or as an underseal, it does perform this function more effectively than any other.

When a surface treatment is used as an underseal, it can also prolong the life of the pavement structure through improved fatigue resistance. It also can be used as a temporary wearing surface for a limited time until the hot mix asphalt concrete is placed. A surface treatment wearing surface is very cost effective when used under appropriate conditions such as low traffic and rural settings. In such applications, it is important to keep in mind that the surface treatment does not provide structural strength to the pavement. Therefore, appropriate construction techniques for the base layer, and taking good care of the base are very important.

A surface treatment wearing surface is a proven wearing course for flexible pavements. It is very important that appropriate projects are selected for surface treatment work. The following factors are considered in selecting projects for surface treatment.

1. Traffic level (ADT)
2. Location of highway (urban or rural)
3. Percent trucks on highway
4. Availability of funds for construction
5. Highway functional classification
6. Feasible traffic control plan during construction
7. Characteristics of the existing pavement, if any
8. Pavement located in an area with moving subgrade
9. Presence of turning traffic on the highway

The traffic level, usually expressed by Average Daily Traffic (ADT) of the highway section, is the most widely used project selection criterion. This is followed by, possibly in the order of decreasing use, highway location (urban or rural), percent trucks on the highway, funds available for construction and the highway functional classification. Less often used project election criteria include the nature of traffic control plan needed, characteristics of the existing pavement (surface, etc.) and the presence of turning traffic.

Successful past experience with surface treatment wearing surfaces indicate that they can be effectively used in highways with ADT values up to 5,000. It has been reported that surface treatments have been successfully used in highways with ADT values as high as 12,000 in a few cases.

Approximately 40-45 percent of roadbed miles statewide have an ADT of less than 1000 and another 14% has ADT values between 1000 and 2000. This shows that over 50% of statewide roadbed miles could easily be potential candidates for surface treatments. If sufficient funds are available, most highway agencies would like to use HMAC instead of surface treatments as a wearing course. However, surface treatments can be an effective option when considering pavement performance and life-cycle cost.

Pavements with surface treatments as wearing surfaces are considered to generate higher levels of traffic noise compared to hot mix asphalt. However, research ahs shown that highway noise is not a direct function of the pavement surface type, and several other factors influence it. When the highway section is located in or near a residential area, highway noise considerations may be a deciding factor in project selection. However, it should be noted that surface treatments can be constructed to generate less highway noise by proper use of materials including binder type and aggregate grade.

Pavements constructed on 'moving' subgrades such as expansive soils, have a very high likelihood of cracking. Design of the pavement structure on such subgrades is likely to result in a very thick asphalt concrete layer which may not be cost effective for roads with low traffic levels. A surface treatment wearing course that uses a binder with low susceptibility to cracking can be a candidate for such projects. If HMAC has to be used, a surface treatment underseal would be a viable option.

Chapter 3

Material Selection and Plan Preparation

Section 1 — Communication and Coordination

Section 2 (New Section Insert) – Surface Treatments on Base

There are some issues that are unique to surface treatments constructed directly over base when compared with preventive maintenance seal coats. These issues distinct to surface treatments that are relevant to material selection and plan preparation are discussed in this section.

Prime Coat

Almost all TxDOT districts that use surface treatments either as a wearing course or as an underseal typically use a prime coat. The prime coat plays a very important role in pavement structures. Its primary benefit is the facilitation of bond between the surface treatment and the base layer. The binders that are used in the surface treatment courses need to be strong and durable. Such binders do not have the low viscosity needed to penetrate the base layer and grip it, to prevent it from de-bonding due to shear stresses exerted by traffic and due to other factors. A prime coat which uses a low viscosity binder can act as an intermediary between the surface treatment binder and the base. The gripping effect of the prime coat onto the base also strengthens the base layer by providing more cohesion to the top of the base.

The penetration of the prime coat into base is very important to get the maximum benefit from the prime coat. The amount of penetration would depend on a number of factors including the prime coating method, prime coat binder, base material, base finishing technique and the porosity of the base course. Typical penetration of a sprayed cutback prime could be in the range of 1/8-3/8 inches. Figure 3.1 shows a schematic of prime coat penetration into the base layer. The picture in the inset shows the penetration of an MC-30 prime for a specimen prepared in a laboratory.

There is usually a time lag between the completion of base layer construction and the application of surface treatment. A well-applied prime coat can protect the base layer from adverse weather conditions and from wear due to construction and regular traffic until the surface treatment is applied. It can also either prevent or slow down the formation of dust on the surface that will have a serious negative impact on the bonding of binder to base.

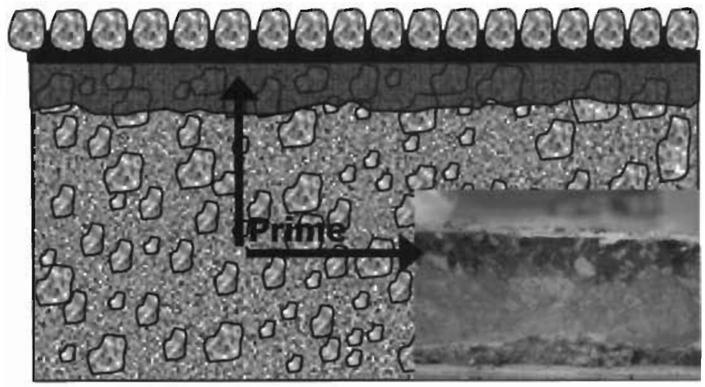


Figure 3.1 Schematic Showing Prime Coat Penetration into Base with Picture in Inset Showing Actual Penetration in Laboratory Compacted Limestone Base

The design of prime coat includes the following elements.

1. Selection of an appropriate prime coat method
2. Selection of a prime coat binder type and an application rate

The selection of the prime coat type to use for surface treatments depends on several factors including the following.

1. Past experience
2. Availability of a contractor pool with expertise in prime coat type
3. Traffic control plan during construction
4. Base material

Prime Coat Types

At least four different prime coat types are typically used including the following.

1. Spray prime with or without blotting material
2. Worked-in (or cut-in) prime
3. Covered prime
4. Mixed-in prime

Spray Prime

Figure 3.2(a) shows a MC-30 cutback prime coat sprayed using an asphalt distributor. The typical rate of application of the prime coat binder is 0.2 gallons per square yard that may be adjusted depending on the "tightness" of base finish and on whether construction traffic has to be allowed quickly on the primed surface. If the project is constructed under traffic, a blotting material such as field sand may be spread on sprayed binder minutes after the prime coat binder is sprayed [Figure 3.2(b)].

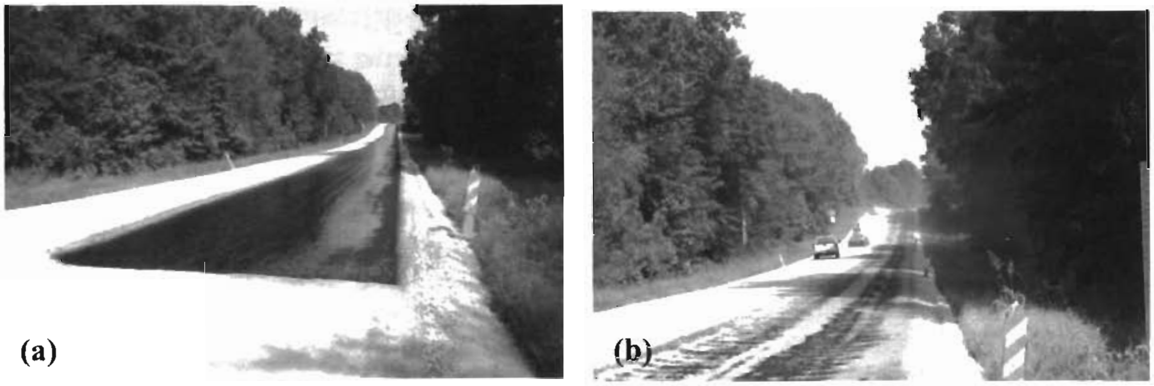


Figure 3.2 Spray Prime (a) MC-30 Cutback Prime (b) Blotting Sand Applied on Prime

Worked-in Prime

Figure 3.3 shows a worked-in prime coat application where diluted emulsified asphalt is sprayed on the finished base, which is then covered with a thin coating of fine base material dust working the windrow with the motor grader. This process is usually repeated 2-3 times to get a total emulsion application rate of 0.2 gallons per square yard. The emulsions commonly used for this purpose are SS-1, CSS-1h and MS-2. This leaves an asphalt-sand layer on the finished base that is approximately 1/8 in. thick (see inset).

Figure 3.3 Application of worked-in (cut-in) prime on limestone base

Covered Prime

Figure 3.4 shows a covered (or inverted) prime applied on the finished base. This covered prime is similar to a course in the surface treatment where RC-250 cutback is first applied on the finished base and then covered by spreading Grade 5 rock. This 'priming' technique is particularly useful when traffic has to be allowed on the primed surface before the other half of the roadway is primed. This type of a prime can provide 2-3 months of satisfactory service as a very temporary wearing course under favorable traffic conditions including little or no turning traffic or heavy traffic.

Figure 3.4 Covered (or inverted) prime using RC-250 and grade 5 rock

Mixed-in Prime

The fourth type of prime coat is the "mixed-in prime". In this type, when the base density is achieved and the base is completed up to the blue-tops, the top 2-3 inches of base is remixed with a diluted emulsion and then re-compacted.

There is some ambiguity in the way terms such as "Cut-in", "Worked-in" and "Mixed-in" are used to describe the prime coat. "Cut-in" or "Worked-in" prime essentially means the same in which the prime coat binder, a diluted emulsified asphalt, is sprayed on the finished base and the base material windrow is worked back and forth to create a thin sand-asphalt layer that acts as the prime coat. A mixed-in prime is one where the top 2-3 inches of base is remixed with diluted emulsion and then re-compacted.

Surface Treatment Courses

The third and final step in the design process is the design of the surface treatment itself, and this includes the following elements:

1. Decision on the number of surface treatment courses (including their construction sequence)
2. Selection of aggregate type and grade
3. Selection of binder type and grade
4. Design of material application rates

Number of Surface Treatment Courses

In many situations, a one-course surface treatment is applied in late fall, which is used as a temporary wearing surface for several months until the next warm weather season arrives when the subsequent course(s) are applied. If a covered prime, which is really a single course with grade 5 aggregate, the service life one can expect to get as a temporary wearing course may be no more than 3 months. One-course surface treatments are also used for underseals where an underseal to a HMAC layer paved on it subsequently. In some cases, the HMAC may not be applied for several months after the surface treatment course, making it act as a temporary wearing course. However, use of a 1-CST for an extended period is not recommended on a highway with significant levels of heavy traffic.

A 2-CST is the most common surface treatment type used by TxDOT, and it is sometimes applied in two stages, where the second course is applied sometime, typically a few months, after the first course is applied and traffic is allowed on it.

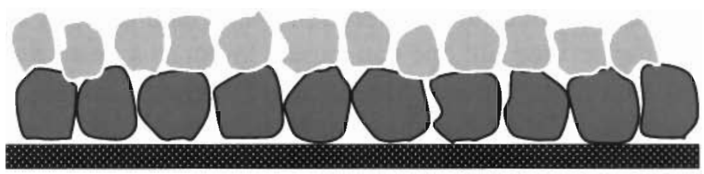
A 3-CST is not as commonly used by TxDOT as it did sometime back, but three districts use it on a regular basis. It is sometimes applied in multiple stages, where the second and third courses are applied months apart. In other districts, after an initial first course is applied and traffic is allowed on it for several months, subsequent courses are applied all in one day within hours of each other. This is done when hot asphalt is used as the surface treatment binder.

Aggregates in Surface Treatment Courses

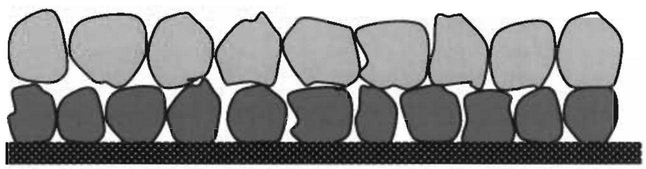
The aggregate rate used for a surface treatment course is an important part of the surface treatment rate design, and it is often the first item that is designed. The selection of aggregate grade and rates for a 1-CST would be similar to that of a preventive maintenance seal coat. The generally accepted practice is to leave sufficient room (i.e. 15-25% in plan view) between rock particles so that they can 'wiggle' and settle to the most stable position when rolled. A 'Board Test' is used by some districts to help determine the rock rate. The board test uses a 1 yard by 1 yard board on which aggregate is spread to the required coverage level, and then determines the application rate by using the calculation method outlined in the TxDOT Seal Coat and Surface Treatment Manual (2004).

Typically, a correction has to be made to the rock rate determined using the board test to suit field conditions. The key is to avoid over-application of stone. If 'too much' rock is applied, rock particles may not be seated in a stable manner, and result in rock loss due to lack of embedment.

When multiple-course surface treatments are designed, the aggregate rates and grades used for the upper courses are generally selected based on experience. Figure 3.5 illustrates two commonly used aggregate combinations for 2-CST. Of the two grade combinations shown, Figure 3.5(a) which has grade 3 rock overlaid by grade 4 rock is the most commonly used combination. Figure 3.5(b) shows grade 4 rock overlaid by grade 3 rock. This is typically used in a highway with low ADT.



(a)



(b)

Figure 3.5 Aggregate Grade Combinations Used in 2-CST (a) Grade 4 on Grade 3 (b) Grade 3 on Grade 4.

Figure 3.6 illustrates three commonly used aggregate combinations for 3-CST. Figure 3.6(a) has grade 5 on grade 4 on grade 3. Figure 3.6(b) has grade 4 on grade 4 on grade 3 rock. Figure 3.6(c) has grade 4 on grade 3 on grade 5 rock. The grade 5 rock in the bottom course is from a covered prime.

<u>Binders in Surface Treatment Courses</u>

A variety of binder types and grades are used by districts in surface treatment courses. These binders can be classified into binders used in warm weather and cool weather. The selection of a surface treatment has to be done with some care. If the designer can determine with some certainty that construction conditions, primarily the ambient temperature, are going to be either warm or cool, it would be acceptable to specify a particular binder in the plans. If not, a better approach would be to provide a choice of binder for the contractor, and the selection of the binder to use can be done by the contractor in consultation with the Engineer. Use of warm weather asphalts in cooler weather is likely to lead to aggregate loss.

The commonly used warm weather asphalts in surface treatment construction are listed below. Modified asphalt binders such as AC-20 5TR are the most commonly used warm weather ST binders.

- AC-20 5TR
- AC-15P
- AC-5
- AC-10+Latex and AC-5+Latex
- AC-15 XP
- CRS-2P

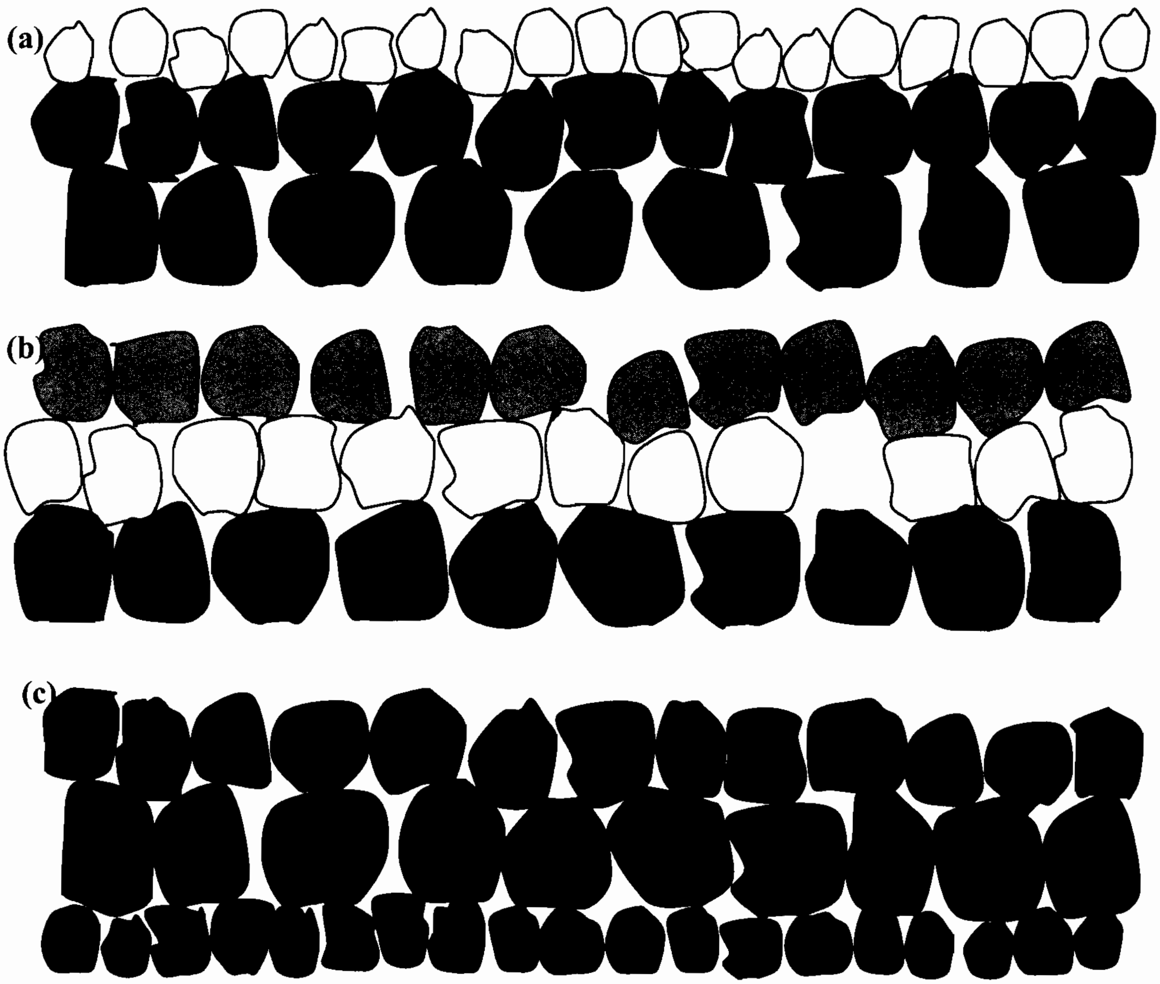


Figure 3.6 Aggregate Grade Combinations Used in 3-CST (a) Grade 5 on Grade 4 on Grade 3 (b) Grade 4 on Grade 4 on Grade 3 (c) Grade 4 on Grade 3 on Grade 5.

The commonly used cool weather asphalts used by districts in surface treatment construction are listed below. The emulsion grade CRS-1P is the most commonly used cool weather ST binder, followed by AC-5 and AC-12 5TR.

- CRS-1P
- AC-5
- AC-12 5TR
- AC 10+Latex
- AC 5+Latex
- MC-2400
- MC-3000

Design of Binder Application Rate

The design of binder rates for a multiple-course surface treatment is done based on a rate design for a single course treatment such as for a seal coat. Districts do seal coat binder rate design in several ways. The most commonly used method is based on the aggregate type & grade, aggregate rate, percent embedment desired, and the traffic level (ADT and percent trucks). The procedure to perform the binder rate design is outlined in the TxDOT Seal Coat and Surface Treatment Manual of 2004. Binder rate determined using this procedure is used in the preparation of plans.

Some districts determine the binder rate based on experience, but this approach is only recommended under the following conditions.

1. The designer has sufficient experience in seal coat work
2. The designs are conducted by a team formed with continuous process improvement in mind.

In either case, the design has to be conducted by TxDOT professionals who have experience with the following conditions that are typically applicable to design of material application rates.

1. Binder type and grade
2. Aggregate type, source and grade
3. Traffic level (ADT and percent trucks)
4. Type base material and base finish specified

Once the contract is awarded, the binder rate specified in the plans has to be adjusted by an experienced surface treatment professional by considering the following factors in addition to those indicated above.

1. Contractor experience with the material
2. Climatic conditions during construction
3. Condition of the surface on which the surface treatment is applied

The binder rate design in seal coats is closely related to the desired percent embedment of aggregate into the binder. Typically, a 30% embedment is used for high traffic volume roads and a 40% embedment is recommended for low traffic roads. The design percent embedment depends on the following factors.

1. Binder type and grade
2. Aggregate type and grade
3. Traffic level (both ADT and percent trucks)

Generally, a higher percent embedment is used when a larger rock size is used, because more binder is needed to retain the aggregate. Since the asphalt binder is the most expensive item in a surface treatment, the strategy is to use the lowest quantity (i.e. application rate) of binder without allowing rock loss. If too much binder is used, the surface treatment may experience flushing and/or bleeding with time, creating maintenance problems.

Even though seal coat binder rate design can be used to guide the binder rate design for multiple-course surface treatments, the following key adjustments need to be made to account for the design and construction sequence of the surface treatment.

1. If successive courses are applied quickly one after the other, allow for drain-down of binder (i.e. use a lighter rate for lower course, and heavier for the upper course). This may be achieved by designing a rate similar to that of a seal coat by considering the existing surface to be highly textured (coarse).
2. If upper course is applied months later, use a heavier rate at the bottom and lighter at the top.
3. The adjustment of the rate, either an increase or a decrease from a single coarse rate design, is typically around 0.05 gallons per square yard.

Finish Quality as an Acceptance Criterion

One of the most important topics in surface treatment specifications is the use of finish quality as an acceptance criterion in a contract. A finish quality can be specified on the following surfaces.

1. Finished base layer
2. Primed base
3. Finished surface treatment before traffic is allowed on it

It can be used either as a job acceptance criterion, or to introduce bonus/penalty clauses to a contract. The quality is typically specified using IRI per unit length of pavement (typically a mile or 1/10 of a mile) for each wheel path.

Preliminary finish quality specifications written for finished base used IRI values in the range 120 to 125 per mile. Recent studies conducted by several districts on projects constructed by good experienced contractors suggest that IRI values as low as the following can be achieved. However, the specification value for IRI has to be determined based on the capabilities of the average contractor pool in the district.

- 60-90 inches per mile on finished base
- 80-110 inches per mile on covered (or inverted) prime or first course of surface treatment

Chapter 8

Seal Coat/Surface Treatment Application Process

Section 4 (New Section Insert) — Surface Treatments on Base

Even the most effective design may not ensure a satisfactory surface treatment due to the strong influence construction practices have on performance. Similar to the preventive maintenance seal coat operations, the surface treatment process is not that complicated. However, they both consist of systems whose satisfactory functioning depends heavily on the conditions under which they are constructed. The designers of both these systems are constrained by not knowing the field conditions for which to design for. This puts a tremendous burden on the field project manager or chief inspector to make critical adjustments and decisions in the field. Most practitioners call seal coat and surface treatment work more of an "art" than a science for this reason. However, there is more to the science of surface treatments and seal coats than it appears to be.

The surface treatment (ST) construction process can be divided into the following five parts, and the next section will be covered in that sequence.

- Construction Management
- Base Finishing
- Prime Coat
- Surface Treatment Application
- Quality Control

Construction Management

The construction management process plays a very important role in the performance of surface treatment. Surface treatments are generally a part of a larger contract that involves other "high dollar value" construction elements. This can sometimes lead to a situation where the surface treatment may not get the "attention" it deserves from the prime contractor. In some contracts, the surface treatment portion of the work in a larger contract may be subcontracted to a specialist surface treatment contractor. This is a very desirable arrangement from the TxDOT standpoint because of the value of contractor experience in constructing a quality surface treatment. However, the final quality of the product will depend greatly on the subcontractor's expertise and experience with the conditions. The specification writer can introduce language to ensure that whoever does the surface treatment work will have personnel who can ensure good decision making and quality workmanship.

The contractor-related factors that strongly influence surface treatment quality, in no particular order, include the following.

1. Contractor's expertise and experience under job conditions
2. Contractor unfamiliarity with materials used (the binder, in particular).
3. Contractor or subcontractor not mobilizing on time
4. Contractor's job site manager's experience
5. Skill of key equipment operators (e.g. Base finishing skills of motor grader operator)
6. Contractor's work load during the construction period (e.g. multiple concurrent contracts handled by the same contractor will result in use of a sub-standard workforce for some projects)
7. Poor condition of contractor's equipment
8. Contractors' inability to adhere to established asphalt rates
9. Work-zone property access management issues
10. Work-zone safety issues
11. Finish quality of the surface treatment

Base Finishing

The quality of base finish is critical to the bonding of surface treatment to base. In this section, several aspects related to base finishing are discussed. The base materials most commonly used with surface treatments by TxDOT districts are listed below in the order of decreasing use.

- Limestone
- Caliche
- Iron Ore Gravel
- Gravel
- Fly Ash Stabilized Base
- Cement Treated Base
- Asphalt Stabilized Base

Both the pneumatic roller and the steel wheel roller are used to finish the base. The pneumatic roller is used first, followed by the steel-wheel roller. The kneading action of the pneumatic roller helps the initial rolling to even-out the bladed surface. The steel-wheel roller helps to get an even and less rocky surface before the prime coat is applied.

There are three commonly used base finishing methods.

1. Slush rolling
2. Blade and roll
3. Trimming

Slush Rolling

Slush rolling has been commonly used in base finishing. However, this base finishing technique varies among districts depending on the amount of water used. Some districts use little water, whereas others use a lot of water.

Slush rolling with excessive water can create an undesirable base in the pavement. Using excessive amounts of water, as some districts have done, can weaken the base significantly, first by trapping the water in the base, and then by altering the gradation of the base due to the pumping of fines to the top.
Furthermore, excessive slush rolling can buildup a layer of fines on the top of base that will hinder the penetration of prime coat and the prime can de-bond from the base easily. Therefore, it is recommended that base finishing be done using a technique that does not involve use of excessive water. A light sprinkling of water may be used in case of a dry finished base that has dust on the surface.

Blade and Roll

The blade-and-roll technique involves the blading of the base to achieve the desired finish quality and then rolling it. Rolling is typically done first by a pneumatic roller followed by a medium to heavy weight steel wheel roller.

Base Lay-down Machine

The base lay-down machine is a relatively new piece of equipment in the pavement construction market. It is somewhat similar to an asphalt concrete paving machine, and it is capable of laying down both flexible base and emulsified asphalt base (Figure 11). The base material, either flexible or stabilized, is mixed in a pugmill away from the jobsite and trucked to the project.

Experience with a limited number of projects have shown that it can provide benefits by way of better finish of the base and better control of base moisture content because it is mixed in a pugmill. The thickness of base that could be laid-down in one pass would depend on the efficiency with which the material could be compacted. Equipment specifications suggest that thicknesses as high as 7 inches could be laid down in one pass.

The equipment has a hopper with a conveyor taking the base material to the screed area. Trucks bring the material from the pugmill and it is loaded in to the hopper of the lay-down machine. The equipment can move at speeds in the range of 15-20 feet per minute (or 0.2 miles per hour). The material is laid down and compacted by two bars that oscillate vertically.

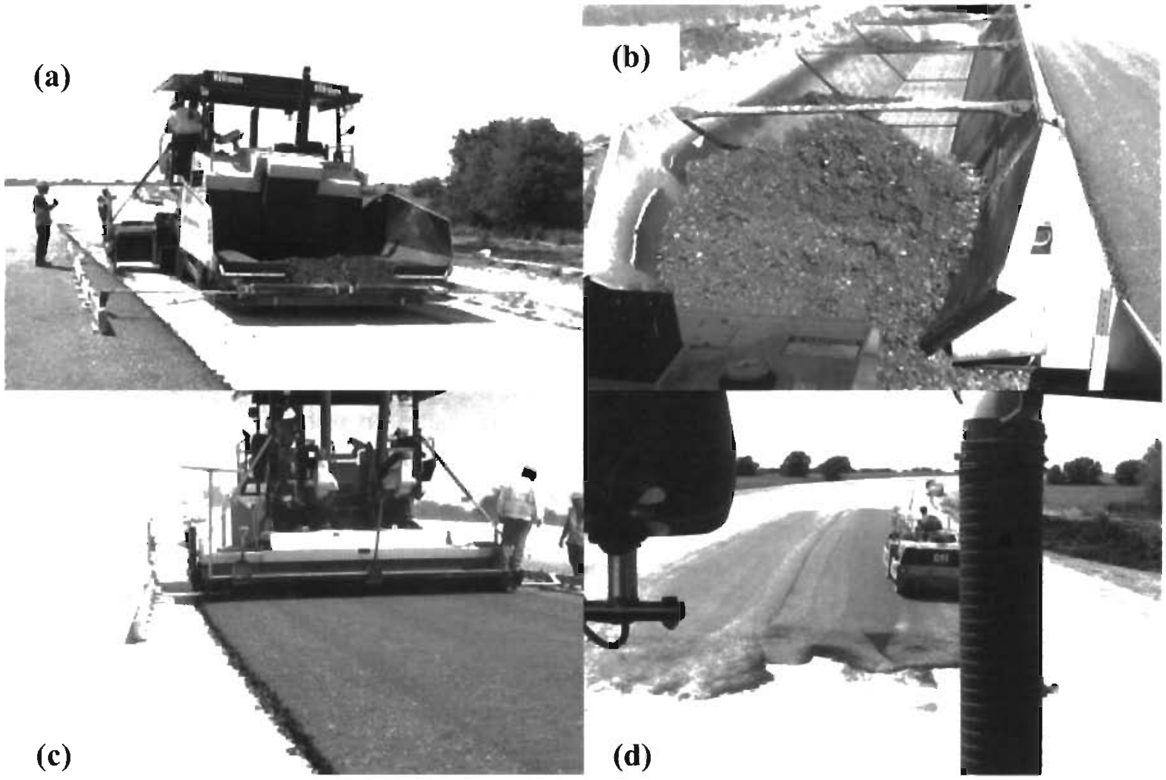


Figure 11 Base Lay-down Machine (a) Hopper and its Conveyor (b) Unloading Base Material Transported from Pugmill to Hopper (c) Lay-down of Emulsified Asphalt Base in Progress (d) Rolling of Laid-Down Base

<u>Application of Prime Coat</u>

One of the most critical elements of surface treatment construction is the priming of base. The prime coat helps the surface treatment binder to adhere to the base course by penetrating and sticking to the base. Four types of commonly used prime coating techniques were described in the Design section of this manual.

Several conditions may be identified as "optimum" for a base to have before a prime coat is applied. Under these conditions, the base should be

1. Reasonably smooth,
2. Reasonably porous
3. Not dusty
4. Structurally strong

The base should not have standing dust when the prime is applied, and the finished base may be broomed to remove the dust. However, brooming has to be done carefully not to disturb the base layer particles.

These "optimum' conditions for the base may not necessarily be "compatible" with each other. For example, a "reasonably smooth" finished base is required to achieve a desirable ride quality in the finished surface treatment. However, an overly smooth base can prevent the prime coat binder from penetrating into the base and achieve a good bond between the base and the prime. Therefore, some porosity (fine or small pores) is needed for this bond to be developed. The desirable pore size is determined by the prime coat binder and its wettability of the base material. In many instances, slush rolling is used to obtain a smooth finished base surface. However, unless care is taken to control the "slushing" water content, excess water can weaken the base significantly by making its density lower.

Timing of Prime Coat Application

The timing of the prime coat application is of great significance in achieving a good bond with the base. The moisture content in the base has to be "just right" for the prime to penetrate into the base. The 2004 TxDOT Standard Specification Item 247.4E stipulates "Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat." Therefore, base must be allowed to dry to some extend after finishing before the prime coat is applied. However, too dry a base can generate a fine dust coating that inhibits the bonding of the prime coat to the base. This can result in freckling of the binder that leaves uncoated open spots on the base where surface treatment binder may not bond well (Figure 12). Therefore, 'skeeting', which involves light sprinkling of water on an overly dry surface to make it more suitable to apply the prime coat binder, is done.

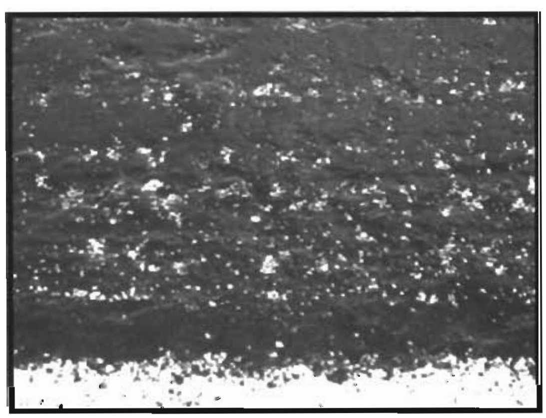


Figure 12 Freckling of Prime Coat Binder on a Dry Base

It is also undesirable to apply the prime coat binder when the base is too wet. Shaded areas, which are common in east Texas, dry slower than non-shaded areas. If the prime coat is applied under these conditions, it may not effectively stick to the base and eventually delaminate. Figure 13(a) shows the removal of prime coat from such a location due to construction traffic. Figure 13(b) shows the "pick-up" of prime coat and surface treatment by construction traffic when the prime coat is applied too wet.

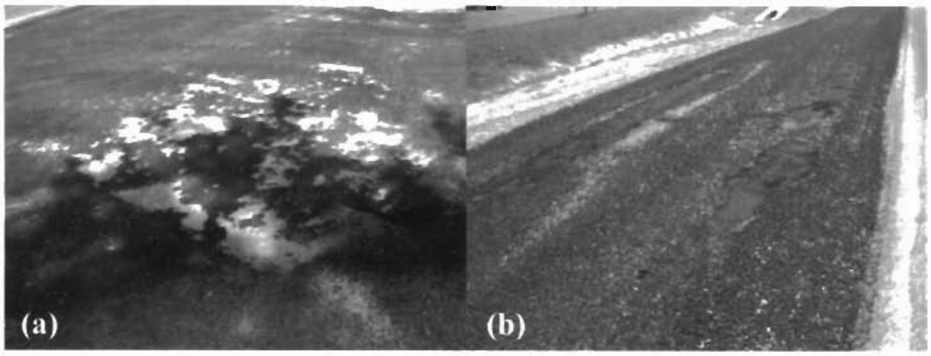


Figure 13 (a) Prime Peeled-off at Shaded Area Due to Construction Traffic (b) Failed Surface Treatment Due to Prime Application When Base is Too Wet

The "worked-in" prime coat layer is strong enough to run traffic for several days when applied under the 'right' circumstances which are given below:

- Prime applied under appropriate base moisture condition
- Do not allow traffic on the primed surface for at least one day
- Allow reduced-speed traffic for the first couple of days, particularly at the intersection approaches

When a "worked-in" prime is used and if traffic is allowed on the primed base for several days, it is recommended that there are drainage paths for storm water.

Application of Surface Treatment Courses

The first decision that a TxDOT project manager or inspector has to make with regard to surface treatment application is whether the primed pavement is ready for surface treatment application. The researchers asked the districts how long they would wait after the priming before applying the surface treatment. The responses received to that question varied from same day to 10 days. This time lag between the prime and the surface treatment depends on the following factors:

- Type and grade of binder (i.e. provide time for cutback volatiles to evaporate and for emulsions to cure and penetrate)
- Type of base (allow prime to penetrate)
- Contractor's construction schedule
- Work-zone management

However, the following general practices are recommended.

- Wait at least 3 days when the prime coat binder is an emulsion
- Wait at least 7 days if the prime coat binder is a cutback.

One of the most often discussed issues in surface treatment and seal coat construction is the timing when aggregate is applied on the binder. For both hot asphalt and emulsion, it is strongly recommended that aggregate be applied "as-soon-as-possible" after the binder is sprayed.

Another important issue is the timing between successive courses of a multiple course surface treatment. Recommended durations between first and second courses for different surface treatment binders are listed below.

1. When hot asphalt is used as the binder in the first course, the timing of the second course depends entirely on factors related to construction scheduling. The second course could potentially be applied within hours after the course. Some practitioners prefer to allow traffic for at least a couple of weeks before applying the second course.
2. When emulsified asphalt has been used for the first course, a minimum curing period for the emulsion of at least a few days (2-7 days) is recommended. Typically, emulsified asphalt is used for the first course when construction is done late in the fall or during winter. In such instances, the second course is not typically applied until the next asphalt season, which could be several months later.
3. In the case of cutback asphalts, the delay between first and second courses depends on the type of "first" course used. When a 'covered (or 'inverted') prime, which can be considered as a first course in a ST is used, the RC-250 cutback asphalt used as the binder would require a minimum of 7 days for the volatiles to escape the rapid curing cutback. For cutback asphalts such as MC-2400 or MC-3000, a minimum of 90 days is recommended before the second course is applied.

<u>Inspection of Surface Treatment Construction</u>

1. The use of an effective method to finish the base is of utmost importance.
    - The inspector has to ensure that the contractor uses an appropriate base finishing method that does not compromising the quality of the base, while ensuring that the finished base surface is compatible with the prime coating method.
    - It is also important to consider the constructability of the activity, particularly if the contractor has the expertise to do the base finishing work as stipulated in the plans.
    - The finish quality of the base has to be checked by the inspector, because it dictates the final ride quality of the surface treatment. It would be much easier to ask the contractor to refinish the base rather than having to ask

the whole surface treatment to be re-done.
  - Traditionally, most inspectors conduct a "seat of the pants" test to ensure the quality of surface finish. However, it is now possible to use the International Roughness Index (IRI) calculated using the profiler measurements to check the finish quality of the finished (or primed) base. This provides inspectors with a more objective technique to evaluate the quality of surface finish.

2. The prime coating process also involves several key steps that require inspector involvement.
   - It is critically important to check the readiness of the finished base for prime coat. The attainment of the right moisture content of the base is of utmost importance.
   - Most experienced inspectors may be able to check the moisture content using simple techniques such as by looking the base surface and by digging into the base at several locations. However, it is recommended that a moisture content measurement be made to verify the state.
   - The new 2004 TxDOT specification recommends a moisture content of base optimum moisture content (OMC) minus 2% to be optimum before prime coating.
   - Having too much water in the base may prevent effective bonding of the prime, and can trap too much moisture in the base making it weaker (low modulus) that it was designed for.
   - A base that is too dry generally creates a thin coating of dust that will also reduce the effectiveness of bonding. In such a situation, a light spray of water (skeeting) can help alleviate the situation.
   - The other key items in the inspection of prime coating process are the use of an appropriate prime coat binder rate and the prime coating technique itself.
   - The inspector must also ensure that the contractor takes all possible precautions to protect the prime coat after it is completed. Wearing of the prime can prevent the surface treatment binder from bonding to the base.
   - It is appropriate to use of cutouts in the windrow to prevent water-logging of the primed base (when base material windrows are used in the priming process).
   - It is important to minimize both construction and regular traffic on the primed base to reduce wear of prime coat.

3. Once the prime coat is applied on base, the next step is to apply the first course of the surface treatment.
   - The inspector has to ensure that the contractor applies the surface treatment course at the most optimum time.
   - If traffic has to be put on the primed base, the surface treatment must be applied as soon as possible to prevent potential damage to the primed base.
   - However, the inspector must ensure that the contractor allows sufficient

time for the prime to cure before the surface treatment is applied.

- If emulsified asphalt is used for the prime, it must be cured appropriately (all the water is evaporated).
- When cutback asphalt is used, all the volatiles must be evaporated from it, and otherwise, the surface treatment will be weakened once applied.
- The surface treatment binder must be applied at the proper rate and temperature.
- The inspector must check the nozzle angles and the spray bar height to ensure proper binder rate application.
- The shots must be marked, and the distributor must be periodically strapped to ensure that the computer readings are accurate.
- Aggregate (rock) must be applied as soon as possible for both hot asphalt and emulsified asphalt.
- The inspector must check the aggregate stockpiles for dust, and debris, and ensure that aggregate gradation is appropriate.
- In the case of precoated aggregate, proper precoating coverage must be ensured.
- The inspector must mark rock lands, and ensure that the loader operator loads trucks consistently so that proper application rate can be checked using rock lands.
- Rolling of the aggregate is very important to ensure that aggregate particles are seated on the pavement in their most stable position (lowest center of gravity). This will ensure that aggregates will maintain a satisfactory bond with the binder.
- The inspector must pay particular attention to the roller coverage of the surface treatment and if the specified number of roller passes is used.
- When surface treatment is done in the morning and later afternoon, particular attention must be made to the binder temperature, and the number of roller passes could be increased in such situations to ensure that design embedment is achieved.
- Loose rock on the pavement can cause numerous problems to the traveling public as well as construction personnel. It is a safety hazard, and it may also contribute to windshield damage.
- Having loose rock on the primed base can damage the prime (and the base), and timely removal of loose rock is very important. One way to reduce damage to prime due to loose rock is to shoot the surface treatment binder a little wide, and then to overlap it with the adjoining binder shot.

4. Under current TxDOT specifications, the acceptance of the job after the completion of surface treatment construction is a key milestone.
    - Once accepted, the roadway becomes the client's (TxDOT) responsibility, and therefore, the inspector must ensure that the job is accepted in good condition.
    - The inspector must ensure that quality of completed construction project is checked as per specifications.
    - An important part of this process is checking the completed structure for

any damage during construction. The inspector must ensure that such damage is repaired by the contractor as stipulated in the contract prior to the acceptance of the job by TxDOT.