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TEXAS PAVEMENT PRESERVATION CENTER

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Our Mission

The mission of the TPPC, in joint collaboration with the Center for Transportation Research (CTR) of the University of Texas at Austin and the Texas Transportation Institute (TTI) of Texas A&M University, is to promote the use of pavement preservation strategies to provide the highest level of service to the traveling public at the lowest cost. The executive sponsor for the TPPC is the Texas Department of Transportation (TxDOT).

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INTERNATIONAL SLURRY SURFACING ASSOCIATION

2009
SLURRY SYSTEMS WORKSHOP

Now including Chip Seal & Crack Treatment

HANDS ON PROGRAM FOR ENGINEERS, INSPECTORS, AND INDUSTRY PERSONNEL

Past and Upcoming Events

ISSA 2009 Slurry Systems Workshop

The TPPC was represented by Cindy Estakhri and Dr. Yetkin Yildirim at the International Slurry Surfacing Association (ISSA) 2009 Workshop held in Las Vegas, Nevada in January. This intense training workshop attracts over 275 attendees per year and is taught by industry experts. At this meeting, the TPPC acquired valuable information regarding the application and quality control of slurry seals, microsurfacing, and other maintenance treatments which can be used to shape future training courses. Included in this newsletter are brief summaries of some of the presentations given at the ISSA workshop.

TPPC Seal Coat Training Courses

As part of our continuing mission to advance the field of pavement preservation, the Texas Pavement Preservation Center offered training courses on seal coats. The courses served two main groups: engineers and inspectors. The course designed for inspectors, entitled "Seal Coat Inspection and Applications," focused on proper inspection methods and the equipment used during chip seal construction. The other, "Seal Coat Planning and Design," instructed engineers on planning, designing, and constructing chip seals. The purpose of both courses was to increase the awareness and understanding of pavement preservation by providing instruction on a common preservative maintenance treatment.

Slurry and Microsurfacing Overview

A slurry seal is a designed mixture of emulsified asphalt, mineral aggregate, mineral filler, water and other additives that are mixed to be uniformly spread over a properly prepared surface. Microsurfacing is similar to a slurry seal, except that in microsurfacing, the asphalt emulsion is polymer modified and break retarder is commonly used to control the mixing and working time of the material. The modification of residual asphalt with a polymer reduces the temperature susceptibility of the treatment. Microsurfacing mix can be placed in thicker lifts than slurry seal, and these thicker lifts can help maintaining the macrotexture and enhance the durability of the mix.

A slurry seal can be used to seal minor surface cracks, slow surface raveling, and improve surface friction. This treatment is usually applied to low-volume roads, such as city and county streets. Depending on the type of emulsion in the slurry mix, a curing period of two hours or more maybe be required before traffic can be readmitted on the roadway.

Slurry seals can be highly sensitive to local conditions and require an experienced crew to place properly. The crew must consider upper and lower air and pavement temperature limits, and adjust the mix accordingly.

Slurry seals are not effective treatments for badly cracked pavements. For slurry treatments to be successful, the pavement must be stable with no excessive rutting or shoving.

Microsurfacing is essentially a variation of slurry seal technology that employs polymer modified emulsion and crushed aggregates. Microsurfacing can be used for texturing, sealing, and rut filling on asphalt pavements. On cement pavements, it is used mostly for texturing.

Microsurfacing can be used to fill ruts if the underlying surface is stable, but for successful application, the existing pavement must be in a structurally stable condition. Microsurfacing does not increase the structural capacity of the pavement, although it does preserve the structural capacity by reducing moisture infiltration.

Microsurfacing requires that the pavement surface be prepared prior to treatment. Potholes should be repaired and cracks should be sealed before the application of a microsurfacing treatment. But when applied to properly prepared pavements, microsurfacing can resist wheel rutting and provide a skid resistant surface for up to 7 years.

However, microsurfacing and slurry seals each require special application equipment and a highly trained contractor for successful implementation.

2009 Slurry Systems Workshop

"Introduction to Slurry and Microsurfacing" by Mark McCollough

Slurry seals and microsurfacing can be both preventative and corrective. As a preventative maintenance treatment, slurry seals and microsurfacing can be used to protect existing pavements from the effects of aging and weathering, delaying the formation of surface distresses and maximizing the existing pavement's surface life.

Residential streets

As a corrective maintenance treatment, slurry seals and microsurfacing can be applied to rehabilitate older pavements that already exhibit surface distresses. Slurry seals and microsurfacing can be used to restore raveling, rutted, or cracked pavements to serviceable condition.

Slurry seal surfacing and microsurfacing both act to seal the pavement surface and prevent further weathering of the underlying pavement. They also can help restore surface texture, fill cracks and voids, and provide the pavement with a new wearing surface.

Before application of slurry and microsurfacing, the pavement surface needs to be prepared by crack sealing, patching, protecting utility access points, blowing, and sweeping.

There are three gradations of aggregate for slurry sealing (Type I, II, III) and two for microsurfacing (Types II and III). Type I aggregate for slurry seals is generally used for the purpose of crack filling and fine sealing. The application rate is 8 – 12 lbs/yd2 based on weight of dry aggregate and Type I contains 10 – 16% residual asphalt. Type I slurry seal is mostly applied in residential streets, parking lots and airports.

Type II is the most widely used slurry seal gradation. Type II slurry seal is used to protect the underlying pavement from oxidation and water damage, correct severe raveling, and improve surface friction. It is used primarily for moderate traffic density pavements. Type II has an application rate of 10 – 20 lbs/yd2 and a residual asphalt content of 5.5 – 13.5 %.

Type III slurry seal is used to attain heavy application rates and high surface friction values on heavy traffic density roadways. Type III slurry seal can be used for pavement resurfacing. Type III has an application rate of 13 – 30 lbs/yd2 and a residual asphalt content of 5.5 – 12 %.

While slurry seals and microsurfacing both perform similar preventative functions, there are a few differences between them to be noted as well. In terms of their material capabilities, slurry seal is designed for one stone thickness while microsurfacing allows for stone stacking. Microsurfacing sets quicker than slurry seals, allowing for the least traffic disruption. Microsurfacing has more stringent performance criteria than the slurry seal, which requires a different mix design.

Slurry seals correct distresses such as raveling and light cracking, while microsurfacing corrects leveling course, light flushing, and rutting. Finally, the application equipment requirements are different for each treatment. Conventional slurry equipment can only apply slurry, while microsurfacing equipment can apply both slurry seal and microsurfacing.

Success in slurry seal and microsurfacing applications depends on site selection, equipment calibration, material consistency, contractor performance, project inspection and information.

"Slurry Seal and Microsurfacing Basics" by Barry Dun

Microsurfacing

Slurry or microsurfacing can prevent surface distress while a pavement is still in good condition. These treatments protect pavement from the effects of aging, but only if they are applied before distresses become apparent. As preventative maintenance treatments, slurry and microsurfacing must be applied to a structurally sound system in order to provide substantial cost benefits.

By changing the binder in the mix, specific pavement conditions can be addressed. If its primarily function is sealing, the slurry mix should be rich in binder, whereas if the primary function of the treatment is to improve skid resistance, some asphalt should be removed from the mix, to make it a little drier.

To reduce reflective cracking, a chip seal may do a better job than slurry seal or microsurfacing. But slurry seals and microsurfacing have a unique ability to deposit the surface seal according to the surface demand of the pavement. Slurries do a better job than microsurfacing because they are richer in asphalt. Microsurfacing treatments tend to be fairly brittle, though not as brittle as a hot mix pavement.

When designing a mix, it is essential to know what kind of condition the mix will be placed on top of. Just because the emulsion and the aggregate both meet their respective specifications does not mean that they will be compatible with each other or with the existing pavement. A detailed understanding of the interactions between the different materials involved in the microsurfacing mix is required for a successful treatment application.

Crews should communicate with emulsion manufacturers regularly, for frequently proper slurry or microsurfacing emulsion formulations are determined by the weather conditions. When it is hot, more emulsifier is needed to allow sufficient working time. Inversely, at the end of the season when the weather is cool, the manufacturer can remove some emulsifier from the mix.

Too much water in the slurry or microsurfacing mix causes segregation. The slurry should be a creamy homogeneous mixture rolling over in the box rather than something that looks too wet and is splashing and segregating.

The individual components should be prequalified to ensure that the emulsion, the aggregate, the mineral filler, and the additives all meet specifications, then they can be combined according to the specific needs of the project. When the components have been combined into a good system, samples of the system should be subject to physical testing, which is part of the mix design process.

"Slurry and microsurfacing mix design" by Tony Ng

Material selection, mix design, and testing procedures are different for slurry seals and microsurfacing. But in both cases, the function of mix design is to ensure that the finished product utilizes suitable materials in the correct proportions in order to meet the required standards.

The mix design methods for slurry and microsurfacing are outlined in the ISSA Technical Manual. While states and other U.S. authorities may have different requirements with regard to mix design test procedure, they usually use the same test procedures as ISSA guidelines. Different countries use different or modified ISSA test procedures.

Cohesion Test Results

According to ISSA A-105 and A-143, a "slurry seal is a designed mixture of emulsified asphalt, mineral aggregate, mineral filler, water, and specified additives that is proportioned, mixed and uniformly spread over a properly prepared surface." Microsurfacing on the other hand is a "designed mixture of polymer modified emulsified asphalt, mineral aggregates, mineral filler, water, and other additives," that is similarly prepared and applied to the pavement surface.

Some of the major differences between slurry seal and microsurfacing are the differences in material, durability, and application time. Material specifications are more stringent for microsurfacing than for slurry seals. Also, microsurfacing can be opened to traffic less than an hour after application, while slurry seal requires a longer curing time. Finally, microsurfacing must meet stricter durability standards than slurry seals.

The size and shape of the aggregate used will greatly affect the texture of the cured seal, so it is important to specify aggregate type in the mix design. In thicker lifts, the crushed aggregate provides the interlock needed for stability. Aggregate in thin surfacing must have excellent durability due to its increased exposure to the elements

Aggregate gradation also plays an important role in mix design since the proportion of fines and filler in the aggregate will greatly affect the mix time, workability, and the final consistency of the slurry. The proportion of the top size aggregate in the mix will also affect the final texture of the seal, and oversized aggregate will leave drag marks in the seal surface.

Mix design can be evaluated prior to application by the cohesion test, wet track abrasion test, loaded wheel test, and the Schulze-Breuer and Ruck (SBR) test. The cohesion test utilizes a power steering simulator that measures the torque required to tear a specimen. Different mixtures will develop adequate cohesion at different times, so the cohesion test can also be used to determine how quickly after curing a treatment can be opened to traffic. The SBR test is used to measure the compatibility of asphalt with the finest aggregate components. If the mix components are incompatible, long term moisture damage could destroy the finished pavement. The wet track abrasion test and loaded wheel test are used to determine the minumum and maximum emulsion content required for optimum material performance characteristics.

"Spreader Box Principles" by Scott Bergkamp

A spreader box is an instrument that receives and contains the slurry or microsurfacing mix from the slurry machine. This tool evenly distributes the material across the paving width of the box, meters the material onto the road surface, and applies the final texture to the road surface.

The spreader box can be calibrated to typical application rates for slurry seals and microsurfacing through the application of a test strip. First, the paving box width must be set and recorded. Then the downward pressure of the primary strike-off should be adjusted to produce a J-shape. With the slurry or microsurfacing machine counters zeroed, the mix should be laid over a flat measured distance.

After the test strip is finished, the application rate can be determined by dividing the weight of aggregate used by the area of pavement surface covered. Adjustments to the spreader box can be made to ensure premium application of the slurry seal or microsurfacing mix. The box width, strike-off pressure, type and length of rubber/urethane, and auger clearance can all be adjusted for a precise application of the mix material. Too much pressure on the strike-off can result in the removal of larger aggregates from the system, and the length and stiffness of the rubber/urethane at the end of the strike-off will greatly affect the final surface texture.

Rut filling

"Introduction to Rubberized Emulsion Aggregate Slurry" by Mike O'Leary

Rubberized Emulsion Aggregate Slurry (REAS) describes a polymer modified asphalt emulsion mixed with ground tire rubber. The application of REAS can help prevent surface distress, correct surface texture, and minimize the oxidation of pavement.

REAS is a pavement preservation tool that not only improves the existing pavement, but creates a new use for waste tire rubber. REAS is easily applied in cold form, is long-lasting, and has an aesthetically pleasing finish. REAS is a pavement preservation tool where the new pavement surface is ready for traffic just hours after treatment.

Slurry Truck

The materials used in REAS include crushed graded aggregate, specialized asphalt emulsion, SBR latex polymer, graded ground tire rubber, break control additives and stabilizers. Additionally, each gallon of REAS contains over one half pound of recycled tire rubber. For every mile of street (24 ft wide) treated with REAS, over 265 scrap tires are recycled. Since 1996, this pavement preservation treatment has accounted for the recycling of over 15 million pounds of used tires.

"A Guide to Quality Construction" by Pierre Peltier

The development of clear specifications can greatly improve the quality of a microsurfacing treatment. Agencies have certain expectations of pavement preservation treatments, like improved skid resistance, filled-in voids, and the ability to allow traffic on the road within one hour after treatment. Therefore, it is vital to the success of the project that the agency develop specifications thoroughly enough for the contractor to know what is expected.

Microsurfaced pavement

Mix design is a major variable that affects the quality of finished microsurfacing treatments. The types of materials used should be those specified and selected for the project, and materials testing should be performed on a regular basis. The existing pavement condition is also highly important; a properly prepared surface can increase the quality of a job significantly.

The field inspector and crew must be capable and knowledgeable in their respective areas. Good communication between everyone working on the project is crucial, in order for quality specifications to be met

Surface treatments fail due to material incompatibility, improper preparation, improper control of materials during application, poor traffic control, improper road selection, and poor timing. Quality control means avoiding these things and motivating workers to produce the best product possible.

Quality Assurance Guideline Summary for Microsurfacing

A summary of the specifications prepared by TxDOT for inspectors, engineers, and crew members involved in the application of microsurfacing treatment is presented below.

According to TxDOT's guidelines, the selection and testing of the mixture components is the first step in designing a successful microsurfacing mixture. Materials acceptance requirements are the first specifications that must be considered in a microsurfacing treatment. Mixture design must also be approved before any microsurfacing work can commence.

During construction, inspectors may sample the material from the jobsite stockpile in a laboratory location. Mixture tests also may be conducted on samples taken from the microsurfacing application machine. These tests will ensure that the application machinery is performing at an acceptable level.

The Field Observation Checklist can be used to record information relating to the limitations that occurred during construction such as weather conditions, as well as the workmanship of the application crew. As a general guideline, microsurfacing should not be applied in rainy weather or if the temperature is below 50˚ F.

The surface must be cleared of all debris and slightly wet before the microsurfacing treatment can be spread. The surface should pre-wet so that the entire surface is damp but there is no free-flowing water. After the treatment, the finished surface should show no marks or streaks. Oversize aggregate particles can become lodged in the strike-off device during application, causing tear marks and furrows in the finished surface. If these surface marks occur too frequently, the treatment will not function properly.

More severe scratch and tear marks may be caused by improper strike-off equipment or an inappropriate surface thickness. It is not possible to place a microsurfacing layer that is thinner than 1.5 times the nominal maximum aggregate size.

If there are occasional problems with the microsurfacing application, workers can repair the aberrant sections with handwork, using a squeegee mop. However, areas of handwork should match, in texture and color, the surface produced by the spreader box.

Longitudinal and transverse joints should not appear disruptive. Joints with gaps or uncovered areas and joints with over a ½ inch buildup are not acceptable. In general, the total number of transverse joints should be minimized, unless the specific project plans dictate otherwise.

The edges of a microsurfacing application should also be uniform in appearance. When the edge of the pavement is not uniform, the machine operator must follow the edge as closely as possible, without allowing the spreader box to travel off the edge of the pavement.

"Calibration of Slurry/Microsurfacing equipment" by Doug Hogue & Chad Davis

In slurry surfacing, the mix design proportions are based on the combined weight of dry aggregate and mineral filler. To calibrate the machines to a given mix design, accurate information on the machine, aggregates, emulsified asphalt, water, and additives is necessary. Since the mix design is based on dry aggregate and dry mineral filler, corrections for moisture could be necessary.

Dry Additive Calibration

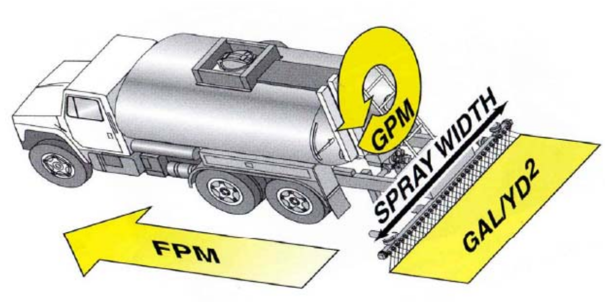
Calibration is necessary in order for the equipment to give accurate readings and measurements and to deliver a quality treatment application. The key component of calibration is the emulsion to aggregate ratio. Another important variable is water, which is typically adjusted by the operator during application.

The materials used for the calibration of slurry/microsurfacing equipment include water, mineral filler, aggregate, liquid additive, and polymer modified emulsion. Two types of pumps that are used for emulsion calibration are the Fixed Displacement Pump and the Variable Positive Displacement Pump.

The emulsion pumps can be calibrated by first determining the gross weight on the machine when loaded with the appropriate materials. Then, with the pump outlet secured to a second container, the desired number of counts can be run on the head pulley/emulsion counter. The weight of the emulsion in the second container is the weight of emulsion pumped. This weight, divided by the number of counts, equals the emulsion weight per count.

For aggregate calibration, the moisture content of the aggregate must be determined in the laboratory in accordance with ASTM C566-97. Then, three gate settings, or openings should be selected that will be used to perform the calibration. Next, the aggregate should be loaded into the hopper, and the loaded machine should be weighed. The calibration process is done three times for three different gates. The information from each run (trial) is recorded and weight per count is calculated.

"Distributor Trucks – Calibrating today's computerized distributor trucks" by Brian Horner



Calibrating a distributor truck requires adjusting the components in order to accurately achieve the shot rate preset in the computer. It is important to check the distributor calibration in order to make sure that the computer application rate reading matches the actual application rate. This will help avoid bleeding or flooding of the material, make sure there is enough material to retain the chip, and avoid increased cost of material due to over application.

Four key elements must be considered in the calibration of the distributor truck: the desired application rate in gallons per square yard, the forward ground speed in FPM, the asphalt pump output in gallons per minute, and the spray bar width in feet.

The distributor calibration can be checked by sticking the tank while the distributor is in level, or through the longitudinal rate test. Other distributor truck components to consider for calibration include the spray bar height, the nozzle angle, and the nozzle size. A spray bar set too high or too low relative to the pavement surface can cause streaking.

"Seal Coats for Pavement Preservation" by Tom O'Leary

A seal coat is generally a single, double, or triple application of asphalt material each covered with aggregate. Surface treatments are applied to prepared base courses or other surfaces. Seal coats are applied to existing pavements to extend the life of the pavements, and they have a life expectancy of approximately five years. The service life of a seal coat varies depending on situational conditions such as traffic volume and weather and the condition of the pavement they are placed on. Seal coats correct deficiencies such as cracks, raveling (or shelling), bleeding, aged or oxidized pavement, low skid resistance and also provide the appearance of a uniform surface.

Seal coats, however, will not strengthen existing pavement, increase load-bearing capacity, smooth out rough pavement, bridge major cracks wider than 1/8" (cracks wider than this size must be crack sealed in advance), or eliminate the need for maintenance or reconstruction. Typically, within the first three-quarters of the life cycle of a pavement, there is a 40% reduction in quality, but in the following 12% of the life cycle, the quality of the pavement plummets. Thus a seal coat should be applied early in this initial three-quarter period to be most cost effective.

Some factors affecting seal coat quality are: existing pavement surface condition, the experienced capability of workers applying the seal coat, equipment, materials, application technique, traffic, and weather. A raveled surface will require more binder; a slick surface will require a lighter binder. Bleeding pavements requires a lighter binder application rate.

Seal Coat Application

Seal coating is an art, not a science, and seal coat design is simply a starting point: be prepared to deviate from the design. It is necessary to have a good eye once you get out onto the road to see exactly what is going on. The contractor superintendent, engineer designer, inspectors, operators, suppliers and taxpayers all play a role.

Inspectors need to be adequately trained and need to have the freedom to make timely and informed field decisions. They need to develop partnering relationships with the contractor and suppliers and understand that plans are only a guide and that each road requires special considerations.

Suppliers are excellent resources for information on their respective products. Before applying a seal coat, an old roadway should be patched, crack sealed, and thoroughly cleaned. Likewise, unpaved surfaces need to be primed unless inverted prime techniques are being used. Keep in mind that hot or cold mix patches need adequate curing time. If this is not possible, then a fog seal on the new patches should be considered prior to the chip seal. Herbicide should be applied to surrounding vegetation, and gutter areas and curbs should be vacuumed, particularly in urban environments.

To prepare for seal coating, it is necessary to calibrate equipment, know proper design rates, understand factors affecting rate adjustments, determine rock lands, strap the distributor for accurate readings, and ensure that proper signing and traffic control are in place.

Calibrate the distributor's spray bar height, nozzle angle, spray bar pressure, and computer or asphalt meter. A double coverage spray nozzle pattern is most commonly used; a triple coverage spray nozzle pattern is not recommended because it is susceptible to wind, which will affect binder consistency. Computer-controlled aggregate spreaders need to be calibrated for proper rate distribution, and the gates and hitch need to operate properly. The area of the shot should be set to the quantity of the aggregate on hand rather than the size of the distributor so that binder gets covered in a timely fashion. Stockpiles should be placed in strategic locations for better production.

Seal Coat Application

It is extremely important that trained operators drive the aggregate spreader at a controlled ground speed to reduce skids and prevent rock from turning over. It cannot be overemphasized that the aggregate spreader should never move faster than the distributor. The spreader box should be directly behind the distributor (the quicker the aggregate gets applied, the better the bond will be). On high heat afternoons, however, the spreader box should back off slightly.

Trucks should be of adequate size and quantity. Measure and record the volume within each truck. Control the trucks' speed throughout the project. Stagger the dump trucks in and out of the wheel paths or station them down the roadway. Check tires periodically for proper inflation and cleanliness.

Rollers should be pneumatic only (three medium or four light pneumatic rollers are recommended), and tires should be clean and properly inflated. Rolling must take place immediately after the spreading of aggregate. The slower the roller moves the better, and rollers should always be moving because if it is sitting, it will squeeze aggregate down and push binder up. When a job is delayed for more than 10 minutes, rollers and trucks should be moved off of the fresh seal.

Pneumatic Rollers

For traffic control, flagmen, signs, and a pilot car are needed. The flagging stations should be constantly moved, and the pilot car should maintain slow speeds. Traffic control should also clean up messes; clean-up must be done immediately because on a hot day, a mess will get tracked through a whole job.

The proper aggregate for seal coating should be clean, single-sized, and cubical for optimum performance; avoid flat particle shapes and uncrushed gravel since these do not offer skid resistance. Do not use pre-coated aggregate with emulsion binder because it has a tendency to dramatically slow the break of the emulsion and will stay tender for a very long time. Pre-coated aggregates should only be used with hot AC binders.

The cost of single-sized aggregate deters their usage in most states, but a method to determine the number of "flatter" particles should be used when using graded aggregates. Aggregate with minimal fines should be used since fines will settle at the bottom if there are too many in the mix, preventing the proper embedment of larger aggregate into the binder and resulting in the loss of cover stone and bleeding. Natural and synthetic aggregate can be used. Aggregate selection depends on the type of roadway, volume of traffic, existing weather conditions, availability of aggregate, and cost.

Voids are the spaces between the aggregate particles; as aggregate particles are dropped into wet asphalt settling should occur in disoriented positions. After rolling and traffic, aggregate will be seated in their flattest position. Voids should account for 20-30% of the area before rolling and should account for roughly 20% of the area after rolling. For good performance, voids should not be filled completely with asphalt binder. On low volume roads, voids should generally be 40-50% full. On higher volume roads, voids should be only 30-40% full.

Hot AC is typically applied at 320-350°F. Hot AC loses 150-200°F in the first 30-45 sec. after application, so it is imperative to apply aggregate on AC while it is still very hot. The more fluid the binder is, the better it will adhere to the aggregate. Application of aggregate should be one rock thick, and if aggregate is applied correctly, there should be little or no remaining excess to sweep after a job.

To avoid excess joints, asphalt should be applied to the entire area, including intersections and widening, before aggregate is applied. Paper the joints at all starting and stopping points, and shoot on clean surfaces only. Use 1/2 nozzles or end nozzles on longitudinal joints. Nozzles should never be squared because doing so will actually produce a double shot; two nozzles are needed for a proper shot.

Start and Stop on Paper

Marginal surface temperature requires excellent construction techniques. Do not shoot too late in the day if working under questionable weather conditions; there needs to be plenty of time for proper curing before nightfall, since it is typically the wet or cold nighttime conditions that will ruin a seal coat.

Operators are often under pressure to get a job done and may be inclined to rush. Under these conditions, when tracking occurs, the first instinct is to raise the aggregate rate. This is the wrong thing to do. In reality, trimming the rock rate will stop the tracking. Aggregate rate is extremely important and affects more than just the look of the road. Too much aggregate will cause binder to push up.

In a high traffic situation, skid marks occur where trucks have to stop for traffic. An innovative way to solve this problem is to break up the application. Shoot three miles, and then skip a shot for the next 3,000 feet. This way, traffic always starts and stops on the old surface. At the end of the day, fill in the parts that were skipped. By doing this, skid marks can be avoided and patching will be unnecessary. In a day, one transport load of production may be lost, but no patching will be required.