Asphalt Materials and Uses

Construction Division
Materials and Pavements Section

Introduction

You can find all asphalt binder materials used on TxDOT projects in Item 300, "Asphalts, Oils, and Emulsions," and a few special provisions to Item 300. Item 300, Table 18 (shown below) describes material applications and the typical materials used for that application.

Table 18
Typical Material Uuse

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binders Types I and II
Surface treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P,CRS-2P, CHFRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG Binders, SS-1H, CSS-1H, EAP&T
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, emulsified recycling agent
Crack sealing	SS-1P, polymer mod AE crack sealant, rubber asphalt crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE

A more in-depth explanation of the use and the asphalt binder characteristics of the various materials (including some found in special provisions) follows.

Section 1. Nomenclature

Understanding the nomenclature will go a long way in helping to understand material properties and how to select a particular binder for a specific application.

Performance Graded (PG) Binders

PG binders are normally used for production of hot-mix asphalt concrete (HMA). Embedded in the PG binder nomenclature are the temperature extremes under which the HMA pavement must perform (to resist rutting, fatigue, and thermal cracking). The nomenclature uses the form "PG XX-YY." A grade is determined by indicating the high temperature (XX) and low temperature (-YY) for performance. The "-" is really a negative sign, as the low temperature is a negative number. As an example, we (the user) expect PG 64-22 to perform at a high temperature of 64°C (metric) and a low temperature of -22°C. The grading system uses increments of 6°C for the high and low temperature designation. The specification (Item 300, Table 17) shows high temperatures of 58, 64, 70, 76, and 82 and low temperatures of -16, -22, -28, and -34. The high temperature designation represents the 7-day average high pavement temperature. The low temperature designation represents the low pavement temperature. For a discussion of the development of the PG binder specification, refer to the Superpave Binder Specification.

Asphalt Cement (AC)

Most AC binders are used in hot applied surface treatments, but other uses include precoating, tack coat, and recycling. The AC nomenclature uses numbers to indicate the stiffness or viscosity of the asphalt. As the number gets higher, the binder gets stiffer/harder. Designations are added for polymer additives: SBR for styrene-butadiene-rubber, P for styrene-butadiene-styrene block copolymer, and TR for tire rubber. Application temperatures of asphalt cements, especially the more viscous grades, are from 300°F to 400°F.

Asphalt-Rubber (A-R) Binder

A-R binders are typically used in surface treatments and A-R HMA. A-R ingredients are PG or AC binder and a minimum of 15% crumb rubber modifier (CRM), with the blend to meet the requirements of Item 300, Table 16. (CRM is recycled granulated tire rubber from passenger and truck tires. The requirements for CRM are in Section 300.2.G. and Table 13.) Manufacture of A-R requires mixing the asphalt and rubber in specialized tanks at high temperature and digesting or “cooking” for an hour or more to partially dissolve the rubber. This imparts a rubbery gooey characteristic to the blend. Types I, II, and III are the designations. For A-R Binders, as the number (Type) gets higher, the material gets softer (opposite other designation nomenclatures). These designations and properties are the same as in ASTM D 6114. Application temperatures approach 400°F.

Asphalt Emulsion

Emulsions are mixtures of AC- or PG-type binders, water, emulsifying agents, and may contain other additives. They are suspensions of very small asphalt droplets in water. The emulsifying agent keeps the droplets suspended. This suspension allows the use of lower application temperatures, typically ambient to 180°F.

Emulsion nomenclature is more complicated than any other binder nomenclature. Emulsion nomenclature describes the type, speed of break, viscosity of the emulsion, stiffness/hardness of the residue binder, and presence of any additives in this order. A “C” is the designation for cationic (positive charge) emulsions. Emulsions not using a “C” are anionic (negative charge). An “HF” designation indicates “high float” which is a gelling property that prevents runoff after application. An “RS” for rapid set, “MS” for medium set, and “SS” for slow set describes the speed of emulsion break. A number, usually a “1” or “2” designate the emulsion viscosity. The “1” is a low viscosity (resistance to flow usually measured at application temperatures) emulsion used for such applications as fog sealing where we want the emulsion to flow into cracks and crevices. The “2” is a high viscosity emulsion used for such applications as surface treatments. An “H” suffix indicates a stiffer/harder emulsion residue (the asphalt that remains after all the water evaporates). The designation for an additive may be a “P” for (polymer – either SBR or SBS) or an "S" for added solvent or fuel oil modifier for longer cold-mix stockpile life. The addition of polymers and other modifiers is intended to increase adhesion, increase service life, and increase the chances of success of a seal coat.

Several examples of nomenclature are in order.

- CRS-2 is a cationic, rapid-setting, high-viscosity emulsion.
- HFRS-2P is an anionic, high-float, rapid-setting, high-viscosity, polymer-modified emulsion.
- CSS-1H is a cationic, slow-setting, low-viscosity, harder residue emulsion.
- CMS-2S is a cationic, medium-setting, high-viscosity emulsion with some added fuel oil for increased stockpile life (used for patching mixes).

For a more in-depth discussion on asphalt emulsion chemistry, the differences between anionic and cationic emulsions, and how the chemistry affects the break and cure, refer to Asphalt Emulsion.

Cutback Asphalt

Cutback asphalts are mixtures of asphalt cements and solvents. Solvents lower the viscosity of the asphalt cement in order to apply cutbacks with less heat, at lower pavement temperatures (such as wintertime surface treatments), or allow the asphalt to penetrate a base (priming). Cutbacks have a nomenclature that describes their curing rate and viscosity. Curing rate designations are either rapid curing (RC) or medium curing (MC). This describes the volatility of the solvent used to manufacture the material. A rapid curing cutback uses naphtha or gasoline type solvent (highly volatile). A medium curing cutback uses kerosene type solvent (less volatile). Additionally, there is a number from 30 to 3000 to describe the viscosity. The lower the number, the more solvent the product contains and the lower the viscosity of the cutback. MC-30 contains approximately 35 to 40% solvent while an MC-3000 contains only about 5% solvent.

Cutback asphalts are generally not environmentally friendly. While the added solvent reduces the viscosity for application, the solvent eventually evaporates and becomes a source of emissions that affect nonattainment requirements. Regulations, enforced by the Texas Commission on Environmental Quality, prohibit or limit the use of cutbacks for certain applications and time periods in ozone nonattainment areas. Specifically, cutback asphalt cannot be used in non-attainment areas from April 15 to September 15, except for priming bases and making patching mixes.

Section 2. Asphalt Selection

Hot-Mixed, Hot-Laid Asphalt Mixtures

All current hot mix specifications require the use of either *performance graded binders* or *asphalt rubber*. Item 340, "Dense-Graded Hot-Mix Asphalt (Method)"; Item 341, "Dense-Graded Hot-Mix Asphalt

(QC/QA)"; and Item 344, "Performance-Designed Mixtures," all require the use of PG binders. Item 342, "Permeable Friction Course," and Item 346, "Stone-Matrix Asphalt," requires either a PG 76-YY binder or Asphalt-Rubber (Type I or II).

- *Performance Graded Binders*—Select PG binders based on climate, confidence level, traffic speed, and traffic volume. There are several tools a designer or an Area Engineer can use to select the binder. There are climate-based maps at 95% and 98% confidence levels and an automated Excel spreadsheet (PG Grade Selection) that uses longitude, latitude, and confidence level as inputs. These allow the selection of the climate based binder grade. High traffic (load) volumes or slow speeds may be reasons to increase the high temperature portion of the binder grade by one or two levels. For a discussion and help in selecting a PG binder, refer to Superpave Binder Materials Selection Procedures.

  The TxDOT specification for PG binders includes a test called Elastic Recovery (ER) for any binder with a temperature grade span of 92 or more. This ER requirement gets higher for increasing grade span. This requirement effectively requires the use of an elastic polymer additive in the manufacture of the binder. Polymers add cost (materials and processing) to the base binder and result in increased price. The higher the grade span, the more polymer, and generally a higher price.

- *Asphalt Rubber*—A-R Binders, Types I and II, can be used in PFC and SMA. Type I is a stiffer/harder product than Type II. Due to the addition of CRM and the processing that is required, the price of Asphalt-Rubber is higher than that of a standard PG binder and may be higher than many high-grade PG binders.

Surface Treatments (Hot and Warm Weather)

For Item 316, "Surface Treatments," generally use AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-20XP, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, or CHFRS-2P. Alternatively, asphalt-rubber binders may be used, such as AR Type II or Type III. The choice of binder is dependent on material, traffic, and environmental factors.

The first consideration is to use hot applied AC binders or asphalt emulsion binders. AC binders are 100% asphalt, while emulsions are approximately 2/3 asphalt and 1/3 water.

- *Hot-Applied Binders*—Among the AC binders typically used for surface treatments, AC-5 and AC-10 contain no polymer additives. Before the introduction of polymer modified binders, these were the workhorses of the surface treatment industry. The distributor typically applies these binders at 275°F–350°F. They are the least expensive materials but the probability of success is less than modified materials and the probability of success decreases with increasing environmental requirements (increased traffic, cooler temperature, etc.). These materials have performed well in the past and can provide for good service under the right conditions and application procedures.

  TxDOT began using polymer-modified binders for surface treatments in the 1960s on bridge decks. Polymer modified binders have a reputation for better initial rock retention (adhesion) than their unmodified counterparts. Increased traffic and the desire or requirement to open the road to traffic faster has resulted in polymer-modified binders being the material of choice. Polymers used are typically SBR Latex, SBS Block-Copolymer and Tire Rubber. Application temperatures for modified binders are typically 300°F–375°F. However, polymer modifiers will degrade with prolonged storage at high temperatures and application temperatures should be as low as possible.

In 2005, polymer modified binders had 2/3 of the AC market compared to unmodified binders.

All AC binders for surface treatments, whether polymer modified or not, require the application of aggregate before the hot AC binder cools. Heat reduces the binder viscosity, allowing aggregate to embed in and adhere to the binder. If the binder cools before aggregate application, the chances of a successful surface treatment are diminished.

- *Asphalt Emulsions*—Emulsions have their modified and nonmodified versions too. In the past, the predominant materials were CRS-2 and HFRS-2. Now, the predominant materials are CRS-2P and HFRS-2P. CHFRS-2P, a relatively new material, is gaining use. Polymer modified emulsions are used 4 to 1 over nonmodified emulsions. CRS-2P is the most specified asphalt emulsion for surface treatments.

  Application temperatures for emulsions (polymer modified or not) are typically between 140°F and 160°F. Since they are 1/3 water, they can never be heated above 212°F. The lower application temperatures will not damage polymers in the asphalt and are much safer for field personnel.

  "HF" emulsions contain an additive that functions as a thickener (or viscosity builder) under low shear conditions but does not affect the flow properties under high shear. This produces an emulsion that has application properties like their non-"HF" counterparts, but thickens and resists flow after application. This helps prevent runoff on roads with significant cross-slope or vertical-slope.

  Asphalt residue is what holds the aggregate on the seal coat. Emulsions require higher emulsion application rates than hot applied systems since they contain approximately 1/3 water. However, the residual asphalt does not have to be quite as much as hot applied systems due to a meniscus effect of the emulsion on the aggregates. Rocks are initially embedded in the emulsion (aggregate should be applied as soon as possible after emulsion application, before the emulsion starts to break), and as the emulsion loses its water, the remaining residual binder level is lower between the rocks, but still is attached to the rocks at the initial embedment depth. The result is higher effective embedment depth with a lower residual asphalt rate.

- *A-R Binders*—Item 316 also allows use of A-R Type II or III. Type II is a stiffer/harder binder that could be useful in hotter climates. Type III is softer and useful in not-quite-so-hot areas. Most people specify A-R binders in areas that are more demanding in performance than where they would use a standard surface treatment, such as locations with higher traffic or turning movements. A-R binders are typically more costly than any of the AC or Emulsified Asphalt binders, so this additional performance justification is necessary.

Material Selection Considerations

- AC Binders
  - They are 100% binder, and binder is what will be left on the road to hold the aggregate in place.
  - The road can be opened to traffic as soon as the rock is rolled and the binder has cooled.
  - Polymer-modified versions are available to help early chip retention and handle higher traffic volumes and wider temperature extremes.
  - They must be applied at high temperatures, which are more dangerous for field personnel and could harm polymer modifiers.
  - They may not work well with wet or dusty aggregate, therefore usually require aggregate pre-coating.
- Asphalt Emulsions
  - They require break and cure times, resulting in more elapsed time before opening to traffic.
  - Cationic rapid-setting materials (CRS) break and cure faster than any other emulsion type.
  - Polymer-modified versions are available to help early chip retention and handle higher traffic volumes and wider temperature extremes.
  - Application temperatures are lower, which are safer for field personnel and don't injure polymer modifiers.
  - They usually do not require pre-coating of the aggregate and can better handle damp or dusty aggregate.
  - Residual asphalt rates do not have to be as high as hot applied systems due to the meniscus effect.
  - Additives, like high float, can change the emulsion application characteristics without affecting residue properties.

Surface Treatments (Cool Weather)

When applying surface treatments in cool weather, we (the user) are concerned with getting the aggregate to bond with the asphalt at lower temperatures. This is more difficult and requires that the materials maintain a lower viscosity at the lower road temperatures, so the aggregate can embed in the binder layer and adhere to the asphalt. The way to do this is by either using a softer asphalt (or emulsion residue) or by adding solvents. The materials to use include RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, or MC-2400L. The RS-1P and CRS-1P are emulsions formulated with the softer residues needed for the cool temperatures. The RC and MC cutbacks use solvents in varying amounts to lower the viscosity. When the solvent evaporates, a harder binder is left. The MC-2400L contains an SBR modifier and is very sticky.

Applying surface treatments in cool weather can be a hit-or-miss proposition. If the weather turns warm, these softer materials can be too soft to hold the rock. We rely on low viscosity on application for the aggregate to adhere, but we need environmental aging to stiffen the binder before warmer weather arrives. Work in the late fall to early wintertime is actually safer than working in later winter to early spring. There will be enough time to cure/harden/loose volatiles in the late fall to early winter, so the binder will not be too soft when the warmer weather arrives.

To make success more likely, users may want to select RS-1P, CRS-1P, MC-250, MC-800, MC-3000, or MC-2400L in the late fall to early winter period, as these materials are softer for a longer period and need the time to develop the stiffness needed for warm weather. Use RC-250, RC-800, and RC-3000 in the late winter to early spring, as these materials will lose the solvent more rapidly and gain the stiffness needed for warm weather faster. Cutbacks require a curing period before placing subsequent courses to prevent trapping volatiles in subsurface layers. Remember that cutback usage may be limited or prohibited in certain areas.

Pre-Coating

The purpose of pre-coating is to reduce aggregate dust and improve adhesion. Materials usually used for pre-coating include AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, and CSS-1H. The ACs and PG are 100% asphalt binder products. The emulsions are SS for “Slow Setting” and can coat aggregate before they start to break. Sometimes people question whether an incompatibility could exist when using emulsions for pre-coating. The pre-coating process removes the water, and there should be no compatibility issues—even when using an emulsion for a surface treatment binder. Opinions differ on the amount of coating that pre-coated aggregates should have. Some want the aggregate to look like a robin’s egg (speckled), and others want to see a complete coating. The answer is, what works is good. Pre-coating should be sufficient to reduce dust and provide for good adhesion. The one sure thing is you can have too much pre-coating, which will cause the aggregate to clump together, making it difficult to impossible to load and distribute. Pre-coating is a good idea for aggregates that tend to generate dust during transportation and manipulation. Pre-coating slows down the break and cure of surface treatments constructed with asphalt emulsion binders. (The rock cannot absorb moisture, which would hasten the break and cure.)

Tack Coat

Tack coat binders include CSS-1H, SS-1H, and PG Binders. Other materials must be shown on the plans or require the Engineer’s approval. There have been some problems using emulsion tack coats when the emulsion is diluted before application. The main thing to remember is to ensure the proper amount of residual asphalt is applied. Emulsions are already 35% water, and diluting them further reduces the asphalt content. Field debonding problems have arisen when the emulsion was diluted several times, and no one ended up knowing the asphalt content. The resulting “dirty water” being applied as tack did not result in sufficient residual asphalt to provide a good tack for next layer of HMA. If you use an emulsion, make sure you get the residual asphalt application you want. The specifications state that the Engineer sets the rate at between 0.04 and 0.1 gallons per square yard of residual asphalt.

Fog Seal

Fog sealing is a practice to fill small cracks in HMA or provide additional binder to a surface treatment that may be losing aggregate. As such, the binder must be very fluid. Fog seal materials are asphalt emulsions such as SS-1, SS-1H, CSS-1, and CSS-1H. The SS emulsions are slow setting and very stable. They are low viscosity and they can be further diluted with water (make sure the water is not too hard, or the emulsion could break) to thin them even more. The low viscosity of the diluted emulsion enables it to flow into fine cracks or between aggregate pieces. The “H” designation emulsions have a harder asphalt residue that you may want for hotter climates. Field observations verify that fog seals can assist in retaining aggregate, whether placed on dry patches under surface treatments or placed between the travel lanes and between the wheel paths after the application of a surface treatment.

Hot-Mixed, Cold-Laid (HMCL) Asphalt Mixtures

Item 334, “Hot-Mix Cold-Laid Asphalt Concrete Pavement,” requires a binder that, after mixing in a HMA plant (not as hot as a HMA), can be laid at ambient temperatures and retains workability when stockpiled. Mixtures lose workability when they lose volatiles and get so stiff/hard that they cannot be removed from the stockpile or cannot be placed in potholes or bladed into place. Binders typically selected for these materials include AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, and CMS-2S. The AC binders are actually just softer versions of the ones used for surface treatments. Being softer, they are more workable in a HMCL mixture. The emulsions typically have a very soft binder residue. The addition of some fuel-oil-type material to any of these binders can help the mixture remain workable in the stockpile longer. See the specifications and look for the residue penetration (higher is softer) and oil distillate (more means longer stockpile life). The AES-300 and AES-300P are anionic emulsions with very soft residues that do not fit the standard emulsion nomenclature.

Limestone Rock Asphalt (LRA)

Limestone Rock Asphalt contains a quarried limestone naturally impregnated with native asphalt, to which the producer adds a flux oil or blend of flux oil and aromatic oil. The flux oil softens the natural asphalt and allows this flux oil-asphalt blend to bind the particles of limestone together in a mixture. LRA is produced at ambient temperatures and behaves similar to HMCL asphalt mixtures. LRA can be stockpiled for use and can remain workable in the stockpile for 6 months or more. The flux oil is usually blended by the LRA producer and may be a proprietary formulation. There are no binder choices to be made on the part of TxDOT.

Patching Mix

Patching potholes can require a specialized material. Patching mixes are similar to HMCL. They usually have specialized gradations and slower curing binders with solvents added to help them remain workable in a stockpile in cold, wet weather. Stockpile life can be up to 1 year. The materials typically used include MC-800, SCM I, SCM II, and AES-300S. MC-800 has a kerosene-type solvent added to an AC binder. The SCM materials are similar to AC-10 with varying amounts of diesel fuel added. They also usually have anti-strip agents added to prevent stripping in the stockpile and in the pothole. The AES-300S is an anionic emulsion as described in the HMCL section, except that is contains additional fuel oil for stockpile life.

Recycling

Recycling agents fall into two types: soft asphalts and true recycling agents that try to correct deficiencies in aged binders. Typical materials used are AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, and emulsified recycling agent. The goal in recycling is to bring the binder back to some specified condition. For instance, one could specify that the blend of binders in a new mixture composed of virgin binder, RAP binder, and recycling agents needs to meet the requirements of a PG 64-22.

Crack Sealing

Crack sealing is a preventative maintenance operation with the goal of keeping moisture from entering a pavement structure and weakening the base. Typical crack seal materials are SS-1P, polymer-modified asphalt emulsion crack sealant, and rubber asphalt crack sealers (Class A and Class B). All crack sealers are applied on the crack and squeegeed to force sealer into the crack and remove excess sealer from the surface.

The SS-1P and polymer-modified asphalt emulsion crack sealant are formulated to be applied at ambient temperatures and flow into cracks to seal them. Since they flow into the crack, asphalt emulsions are effective for cracks up to 1/8 inch in width. Squeegeeing removes the surface materials, and they generally do not bleed through subsequent surface treatments.

Asphalt rubber crack sealers, consisting of asphalt and 20% or more recycled tire rubber, are hot applied and squeegeed into a crack. They solidify when they cool. In reality, most of the material ends up as a band on top of the crack. Because they do not tend to flow into the crack, rubber asphalt crack sealers are more effective for sealing cracks 1/8 inch and up. Asphalt rubber crack sealers may have a longer life, but they tend to bleed through subsequent surface treatments.

Microsurfacing

Item 350, “Microsurfacing,” requires the use of CSS-1P. According to the nomenclature, this is a cationic, slow-setting, low-viscosity emulsion with a polymer modifier. Even though microsurfacing uses only CSS-1P, there are several suppliers, and each supplier’s formulation must be adjusted for the microsurfacing system used (aggregate, mineral filler, and other additives).

Prime

Priming is the application of asphalt binder to the finished base material to provide some waterproofing and enable it to bond to a subsequent pavement layer (surface treatment or HMA). Typical materials used are MC-30, AE-P, EAP&T, and PCE. MC-30, according to the nomenclature, is a medium-curing, low-viscosity cutback asphalt. MC-30 contains up to 40% kerosene, enabling it to soak into the base material. The other products are emulsions. Some are emulsions of resins, and others are asphalt emulsions with very fine particle sizes or contain specialized surfactants. Whatever the mechanism, the goal is to penetrate the base, seal it, and prepare it for additional pavement layers. For the emulsions, they penetrate some base materials and not others. Experiment as necessary.

Emulsions like SS-1, SS-1H, CSS-1, and CSS-1H can be used for priming but must be worked into the top of the base because they do not penetrate on their own. Working in the prime (emulsion) generally involves compacting the base, scarifying the top inch or so, adding the emulsion, manipulating to mix, and then recompacting the base. This is generally more costly than using a penetrating prime material because of the added steps.

Some emulsions like PCE can be used for prime coat under traffic because they are not particularly tacky. Subsequent applications maintain the surface under traffic.

Curing Membrane

Curing membrane is an application of an emulsified binder on the surface of a cement, lime, or lime-fly ash stabilized base. The goal is to seal moisture in the base to allow the stabilizing material to react with the soil. Typical materials used are SS-1, SS-1H, CSS-1, CSS-1H, and PCE. These materials usually form a moisture-proof membrane that traffic will destroy. It is imperative that all traffic, including construction traffic, stay off the curing seal membrane until the desired stabilizing actions have taken place.

Erosion Control

Erosion control products prevent soil or base material removal by wind or water action. Typical materials are SS-1, SS-1H, CSS-1, CSS-1H, and PCE. They function similar to a curing membrane, forming a protective crust on base or soil. The SS-1, SS-1H, CSS-1, and CSS-1H can be used as a tacking agents for hay or straw mulch. For erosion control purposes, emulsions are typically diluted 3 or 4 parts water to 1 part emulsion.

Section 3. Binder Selection Support

The Materials and Pavements Section of the Construction Division (CST/M&P) developed a spreadsheet (Asphalt Binder Selection) that addresses selection guidance factors, relative material performance, and relative cost issues. Additionally, the Asphalt, Chemical, and Calibration Branch of CST/M&P is available to answer questions about materials selection and suitability. You may contact Jerry Peterson, P.E. at 512/506-5821.