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The asphalt contractor

September 1997 PAVING AMERICA

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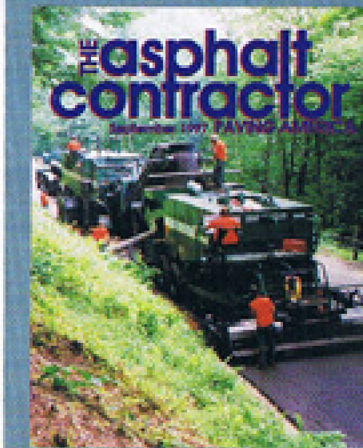
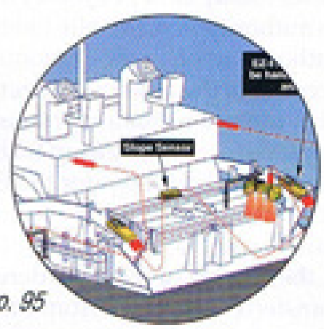


A Gorman Brothers cold in-place recycling train winds its way through the Appalachian Mountains. Photo courtesy of Midland Machinery.

This issue of THE ASPHALT CONTRACTOR begins a series on the state of the practice for all methods of asphalt recycling.

Here's How It Works



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The ASPHALT CONTRACTOR (ISSN 1055-9205) is published 13 times each year by Group III Communications, 204 W. Kansas, Ste.103, Independence, Mo. 64050. Phone: 816-254-6462 or 816-254-8735; FAX: 816-254-2128 , http://www.asphalt.com, E-mail: lucy@asphalt.com.Publisher: Nina Furstenau.

SUBSCRIPTIONS: The ASPHALT CONTRACTOR is mailed free to all asphalt plant owners, asphalt contractors and pavement maintenance firms in the United States and Canada. Non-qualified subscription in the U.S. is $48, in Canada $60 for one year. Other foreign subscriptions are $96 per year. Single copies are $4 in the U.S.

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A contractor's guide to paving fabric and installation

There is a growing market for product that is an effective water proofing membrane and crack retarder

By Mounque Barazone

The use of paving fabric in asphalt overlays has increased nearly 2,000 percent during the past 17 years. In 1980, about 5 million square yards (4.2 million meters squared) were used worldwide. In 1996, more than 100 million square yards (84 million meters squared) were used and the market is growing. The fabric has proved to be an effective water proofing membrane and reflective crack retarder for highways, city streets, airport runways and parking lots.

Fabric installation is far more critical than the fabric itself when it comes to obtaining the desired fabric performance. Improper installation has been traced back to almost every fabric overlay failure. The costs of installation can make or break the contractor on a fabric project. Understanding the differences, specifications and installation criteria can turn a marginal project into a profitable one.

Geotextiles are woven and non-woven fabrics used in construction for numerous civil engineering applications. The main functions of geotextiles are reinforcement or stabilization, drainage, separation, liner cushioning and paving. Paving fabric has been placed in asphalt overlay systems since the 1960's.

The concept is to bond the new asphalt to the old asphalt through a fabric membrane system. This system consists of a fabric and a bituminous tack coat sufficient to saturate the fabric and penetrate the old and new asphalt to form one integral, flexible structural system with a membrane in between.

It is hard for the contractor to determine what information on fabrics and installation is correct and which is not. Often, different installation criteria is recommenced or discounted around the individual fabric's installation benefits and problems. To further complicate matters, there is a wide range of varying specs by both public and private engineers based on their personal experiences. This has caused a wide range of specs both for the fabric and installation criteria.

Various names have been given to the use of fabric in membrane systems. The most common is "pavement reinforcement fabric." This is incorrect terminology. Lab testing has shown a fabric interlayer is not a significant tensile reinforcing element in an asphalt pavement. Reinforcement is obtained from high modulus fabrics wovens and geogrids. The proper terminology is changing to fabric interlayer membranes.

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The fabric installation machine can be mounted to the bucket of a tractor for laydown.

Mounque Barazone is the owner of Geotextile Apparatus Co., San Diego. He has been involved in the use, installation, distribution and consulting of geotextiles for 18 years.

Government reports offer insight

Numerous states have published dozens of reports with the Federal Highway Administration (FHWA) since 1975 in regards to the use and performance of pavement fabrics under different climactic conditions. Temperatures ranged in excess of 104°F (40°C) and as low as -30°F (-34°C). The majority of reports show great success while some show failures. In most instances, the failures have been traced back to improper installation techniques and the fabric chosen.

The most extensive studies were by Caltrans, published in 1991 with the Federal Highway Administration. Three reports by Nelson Predoehl studied 24 various test and control sections paved over 12 years and concluded: "AC overlays incorporating paving fabric interlayers (PRF) had less alligator cracking than conventional AC overlays that were up to 0.10 foot (0.03 meter) thicker. It is recommended that PRF be used to replace approximately .10 foot (0.03 meter) of DGAC where additional tensile and flexural stiffness is not required." This results in savings as much as $1.13 per square yard ($0.95 per meter squared) over a thicker overlay. "PRF appears to reduce transverse cracking in thinner overlays by 0.2 to 0.4 foot (0.06 to 0.12 meter) over distressed PCC pavement by approximately one transverse crack/100 feet (30 meters) after 8 years of service," the reports continues.

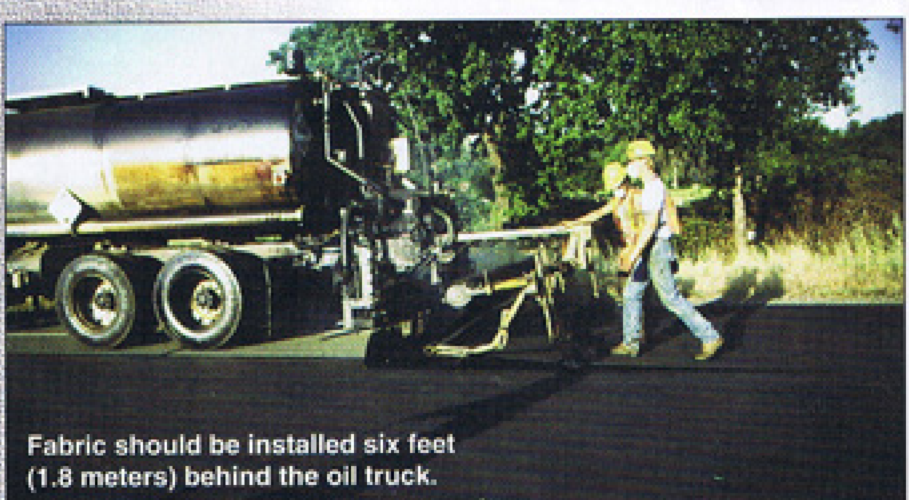
Manually rolling and brooming the fabric by hand can be a time consuming and slow process and requires additional workers.

Geotextile types and differences

Understanding fabric differences is necessary to choose the fabric that will install the fastest, with the least labor and problems. Many fabrics meet all the design specs and are priced similarly, yet some will take longer to install, require more labor and have installation problems.

There are two major manufacturing processes for geotextile fabrics — woven and non-woven. Both of these can be further broken down into various sub processes which give each fabric individual qualities. Woven fabrics were found to be ineffective because they have no interior plane to hold asphalt tack coats to form a membrane. Woven fabrics are used primarily in slope protections, separation and stabilization applications. Non-woven fabrics are primarily used for drainage, separation, pond cushioning and paving. The non-woven fabric provides an interior plane so that a tack coat can saturate the fabric forming a membrane.

Non-woven fabrics are formed from four different manufacturing processes and use thin filaments of polypropylene or polyester. Polypropylene fabric is slightly more absorbent to oil, is less expensive to manufacture and is easily recyclable in milling. It's only drawback is that it has a low shrinkage and melt point and can be damaged during installation if placed to close to the oil. Polyester fabric is stronger per ounce (gram) and has a much higher shrinkage and melt point making it virtually impossible to damage during installation. Its drawbacks are that it is usually more expensive and questions surround it's recyclability.



Fabric should be installed six feet (1.8 meters) behind the oil truck.

Each manufacturing process has individual fabric specs that may appear to be nearly identical, yet the different manufacturing processes of non-wovens perform very differently during installation. Of the four types of manufacturing processes — needle-punched or non

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Contractors can remove the bucket of a tractor to attach the fabric installation machine.

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heat-bonded, needle-punched and heat-bonded one side, heat-bonded two sides and resin-bonded — only needle-punched and heat-bonded one side have the qualities that are desirable in a paving fabric: installs with the least problems and expense.

Needle-punched, or entangled, fabrics are formed using two types of filaments. One uses long continuous filaments spun together while the other uses short staples of filaments 6 to 12 inches (150 to 300 mm) long which are arranged on a carded conveyor system. The barbed needles go up and down through the filaments entangling the strands together forming the fabric. A calendering, or heat-bonding, finish can be applied to the fabric at the end of the manufacturing process.

The fabric is thicker, fuzzy, softer and more pliable then non-needle-punched fabrics. Benefits are that it installs smoother with less wrinkles due to its high elongation and seems to bond better to the oil and old asphalt. Numerous reports state the fuzzy side, when placed onto the asphalt tack coat on the old pavement surface, provides reinforcement at the interface. The fuzzy side provides a greater effective surface area of the fabric which offers better adhesive and shear strength with far less slippage.

Non heat-bonded needle-punched fabrics have inherent installation problems and are not good for paving. Major installation problems include delimitation and fuzzing during installation. FHWA-Texas report 261-2 mentions problems with non heat-bonded fabrics on every test section, delimitating and fuzzing up in the wheel paths of traffic during construction. These problems cause increased labor and slows construction.

Heat-bonding on one side is a process where one side of the needle-punched filaments are heated to form a tough wearing surface on that side of the fabric while the other side remains soft and fuzzy, making for a better bond. A light heating is called calendaring. The benefit is that the fabric holds up well during construction without fuzzing. The only installation problem that can occur is that the fabric can be placed upside down. The heat bonded side must be up and the fuzzy side to the tack coat. Otherwise both delamanation and slippage can occur.

Dual-sided heat-bonded fabric is very thin and stiff. Installation problems with dual-sided heat-bonded fabrics include difficulty in placing the fabric smoothly and the wrinkles and folds transverse the full width of the fabric. They have no fuzzy side and have been prone to slippage problems. The thin fabric does not hold tack coat easily and bleed through occurs causing hazards to the workers and equipment.

Resin-bonded fabrics add a chemical process which forms the fabric. This is similar to gluing and is seldom used in any geotextile anymore. The fabric is thin, stiff and has problems absorbing a tack coat since much of the absorption area is full of the chemical used for bonding.

Understanding specs helps the process

Specs contain the individual properties of the fabric that the engineer or agency has found desirable and can be tested, usually by American Society of Testing Materials (ASTM) standards. Manufacturers publish their standard specs to show the fabrics properties and to make it easier to match fabric to engineering spec. The problem is that not all manufacturers use the same ASTM tests.

The basic properties used in paving fabric by the top agencies such as Caltrans and the Texas Department of Transportation (TxDOT) are: weight per square ounce (square gram); fabric thickness in mills; grab tensile strength; elongation; asphalt retention; heat shrinkage; and fabric storage.

Weight per square ounce (square gram) is an easy way for the engineer to see that he is getting the quantity of fabric necessary to absorb the sufficient amount of tack coat to form a membrane. This is usually 3 to 6 ounces (85 to 170 grams) and many specs are written around the standard 4 ounce (113 gram) plus or minus 0.5 ounce (14 grams).

Fabric thickness in mills measures the fabric in a device that puts a certain pressure on the fabric. This causes all the fabric to test at the same point. Most fabric

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specs are for between 30 to 100 mills. Many agencies are limiting this in recent changes to 30 to 60 mills. The thicker the fabric the more tack coat required to saturate the fabric and make a bond.

Grab tensile strength determines the fabric strength when pulled between the jaws of a testing machine until it ruptures. This spec is often the most easily misreported because the fabric has a strong and weak direction. Most agencies only care about the strength in the weakest direction.

Elongation is derived from the same grab tensile test. It determines how far the fabric stretched prior to rupturing. Elongation has many effects on fabric installation and is different for woven and nonwoven fabrics.

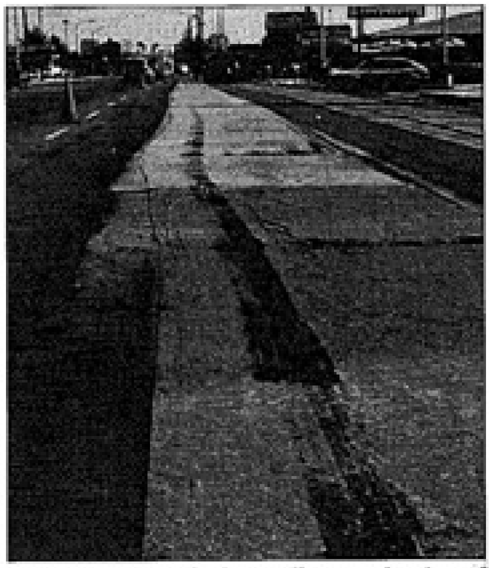
Asphalt retention determines how much oil is necessary to saturate the fabric and make a bond. Various fabrics will absorb different amounts of tack coat depending upon weight and thickness. A typical 4 ounce (113 grams), 50 mil fabric will absorb 0.20 gallons/square yard (0.76 liters/square meter). An additional 0.005 gallon/square yard (0.0184 liters/square meter) of tack coat must be included for penetration into the old and new asphalt. The quantity of tack coat used during construction is very important in the final membrane system. To much tack will bleed through the new asphalt, while to little will fail to complete the bond. The proper quantity of tack coat is based on the thickness and weight of the fabric and the condition of the old asphalt.

Improper fabric storage can cause numerous problems from moisture and ultra violet rays. Wet fabric creates steam which will cause stripping of the asphalt from the fabric due to a poor bond. Wet cores create two problems: First, they become weak and break. Second, if the ends of the cores become damaged from water the various cones on mechanized equipment can not grab the core to hold the roll.

Fabric installation

Caltrans and TxDOT reports conclude that placing fabric properly is the single most important part in the performance of the interlayer system. Improperly placed fabric will reduce the long term benefit of the membrane system, resulting in less waterproofing, stripping and cracks from heat damage and wrinkles and overlaps in the wheel paths. Fabric shrinkage and damage due to a higher heat exposure than the polymer's shrinkage or melt point is a serious installation problem.

Manual placement involves hand rolling the fabric and using a half dozen or so laborers to broom it in place and to slit wrinkles. This is time consuming slow process and requires an additional labor force. Often the fabric gets off course in rolling causing large wrinkles. The laborers are exposed to the hot tack coat and it can be hazardous.



This heat bonded needlepunched fabric was placed upside down.

Various installation equipment for fabric exists, from very simple homemade units to very sophisticated patented units with features that install fabric much faster and with less labor costs. In many cases, these machines can install four times as much fabric as hand placement or simple machine placement in the same amount of time. This equipment has been mounted as attachments on tractors, the back of the oil spreading trucks and other equipment. The equipment aligns, tensions, stretches and places the fabric while it is placed. Usually, a roll can be installed in a couple of minutes.

Equipment may be able to install different size rolls. The standard for fabric width is 12.5 feet (3.8 meters). Other standard sizes are 6.25 feet (1.9 meters), 10.5 feet (3.2 meters) and 14.5 feet (4.4 feet). In some states, such as Illinois, 2 and 3 foot (0.6 and 0.9 meter) fabric is used to cover edge drain trenches. Some machines have features that can place fabric next to guard rails, curbs, prior asphalt passes and walls while others can not. On those the fabric sits well inside the outer edge of the machines and will hit poles and other obstacles, requiring some hand placement.

Some machines can be mounted directly onto the tractors' end loader arm, some clamp on buckets and some do both. When doing a large project, removing the bucket improves the operators visibility. On smaller jobs such as parking lots where the tractor will be used for other duties as well as installing fabric, clamping onto the bucket can save considerable time.

When using machinery, two laborers and an operator make up a crew. The laborers change rolls of fabric, broom fabric edges that may curl from heat after placement and slit any wrinkles that may appear.

Different equipment will install fabric at different speeds. Units that do not include proper tensioning and stretching features must install fabric at a much slower speed to avoid wrinkles. Units on larger horsepower tractors and behind oil trucks can install around curves almost wrinkle free. The faster the fabric turns and is tensioned the smoother the installation with these units.

Planing around cardboard cores

Since there are many different manufacturers of fabric, the contractor needs to check more than just if the

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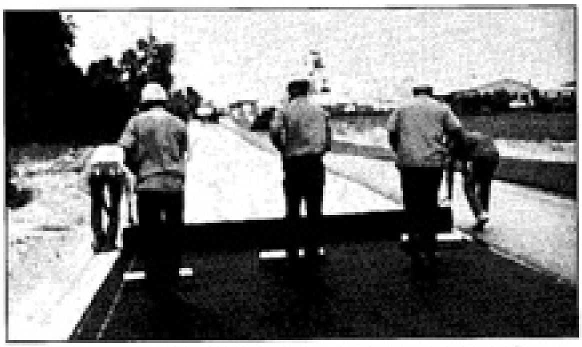
fabric meets spec. Each manufacturer may use different diameter cardboard cores from 3 inches (75 mm) to 6 inches (150 mm) to roll the fabric on. Equipment cones should be checked to make sure that the diameter of the core will fit on the cones of the contractors equipment. Not all cones fit all cores and second core thickness is important. Some manufacturers have learned to use thicker cores — 0.75 to 1 inch (19 to 25 mm) — to insure core strength so that the core will not break during installation. Thin drainage fabric cores are not suitable for equipment installation. This can cause the roll to sag in the middle during installation causing wrinkles. The thin core may break causing a possible accident if it jumps of the machine. It also causes a possible injury as the workers must pull the fabric up to remove the roll from the oil that is already down.



After wrinkles are cut, all overlapped wrinkles and all overlaps in the fabric should have an additional tack coat applied.

The simplest way to fix core problems should they occur is to obtain an aluminum or steel pipe slightly smaller than the diameter of the fabric core and about a foot (0.3 meter) shorter than the fabric width to allow the cones to grab the core without hitting the pipe. This will reinforce the core from breaking and sagging. Having more than one pipe will speed installation, preload the rolls so the new roll can be loaded and the tractor on it's way while the other pipe is retrieved. If one end of the pipe is cut and welded into a point the pipe can more easily be pushed through a roll that the core is already broken on.

Fabric is rolled onto the core by the manufacturer two ways, with the heat bonded side up or down. Hand placement fabric and machine placement fabric need to be exact opposites. When placing fabric by hand it is important to order the fabric to unroll with the heat bonded side up. Otherwise, the laborers will have to hold the fabric up off the ground and walk backwards when unrolling the fabric. When ordering fabric for equipment installation it should be rolled onto the core in reverse direction. When the fabric is placed on the equipment it should come off the back of the roll, providing for more stretch while placing the heat bonded side up. If the fabric comes off the front of the roll, less tension is derived and more wrinkles are likely.

Wrinkles and overlaps in the fabric can cause cracks in the new overlay if not properly handled during the construction process. Wrinkles twice the thickness of the fabric should be slit and laid flat. Excess fabric more than 2 inches (50 mm) should be trimmed off. Overlaps and slit wrinkles should be shingled in the direction of the paving. If shingled in the wrong direction the paver is likely to lift or tear the fabric during construction.

The overlapped wrinkles and all overlaps in the fabric should have an additional tack coat applied and be sufficient enough to saturate the two layers of fabric and make a bond. If this is not done a slip plane will exist at each overlapped joint, resulting in a crack and potential stripping of the asphalt from the fabric. Overlaps should be no more than 6 inches (150 mm) on longitudinal joints, and one foot at transverse joints.

When paving on one pass while installing another care must be taken to leave 6 inches (150 mm) of fabric unpaved to overlap on. Nailing down fabric with case hardened nails and surveying shiners to hold fabric in place is not recommended. This is an old practice that has been found to cause damage later on if recycling is planned at any time.

Installing fabric around curves without excessive wrinkles is the most difficult task. With the proper procedures it can be accomplished with ease. Never attempt to roll the fabric around the curve by hand because it will wrinkle too much. The wrinkles may be so excessive that it will be almost impossible to cut them all without damaging the fabric. Cutting small pie-shaped fabric sections placed by hand around the curve enables you to match the fabric to the curve with a number of overlaps.

Driving the fabric around the curve with machinery is possible if the machinery is the type that includes patented features for stretching and tensioning the fabric. Some minor wrinkles may occur. Mechanical placement around a curve using a small tractor mounted unit involves hopping around the curve. If the equipment has patented tensioning cones tighten the inside cone and loosen the outside cone which places more stretch across the fabric allowing the outside to sweep more. Do not attempt to drive around the curve, instead drive straight passes and then make one big, quick adjustment with the tractor, almost like hopping. This will place one or two large wrinkles in the fabric at each adjustment. Continue this all the way around the curve. After slitting the wrinkles the effect will be similar to pie shape placement.

Units on larger horsepower tractors and behind oil trucks can install around curves almost wrinkle free. The faster the fabric turns and is tensioned the smoother the installation with these units. Two problems exist when using fabrics other than needle-punched heat bonded. The first is if a dual sided heat bonded fabric is very thin and is used the oil may excessively bleed through. The second is when a needle punched non-heat bonded fabric is used and delamanating and fuzzing may occur. Both fabrics require the same installation requirements.

Types of oils and construction

Both hot asphalt cements and emulsions have been used with success. Prior to starting the job the distributor truck should be checked for proper spread rate. Clogged valves, sometimes a common occurrence, must be cleared, otherwise the oil streaks and the fabric is fully saturated or bonded.

To save on clean up of the monuments a piece of fabric can be cut and placed on the monument prior to spraying the oil. The fabric will absorb most of the oil, reducing cleanup time and saving on labor.

Rapid set emulsions work well in the membrane system, but the emulsion must break completely prior to the fabric being placed in the emulsion and this slows the overlay and installation process. Run off problems have occurred when applying emulsions on sloped and crowned roadways, making the application rate difficult to control. Under no circumstances can fabric be placed in the emulsion until all water has evaporated. In one report, steam from water was shown to create bubbles in the overlay. Moisture can cause stripping problems after a short period of time.

Since a 4 ounce (113 gram) fabric absorbs 0.20 gallons /square yard (0.76 liters/meter squared) as a residual, cutback emulsion must be spread at a thicker rate. The residual after it has broken must be sufficient to saturate the fabric so the old and new asphalt can make a bond. It was suggested in one report that petroleum-based solvent cutbacks should never be used as tack or to secure overlaps. They are damaging to most synthetic fabrics.

The thickness of the asphalt must not be less than 1.5 inches (38 mm) if installed under ideal climactic conditions — 70°F (21°C) or above. For temperatures between 50 and 70°F (10 and 21°C) overlay thickness should not be less than 2 inches (50 mm). Overlays should not be attempted with temperatures less than 50°F (10°C). The heat from the overlay draws the tack coat up through the fabric making a bond. If sufficient residual heat is not present to continue the drawing of the tack up through the fabric then the bonding process is disrupted. This results in slippage, stripping and eventual overlay failure. Rolling the asphalt immediately after placement helps to concentrate the heat and supply pressure to start the process of the oil moving up into and through the fabric.

Caltrans found polypropylene fabric to be recyclable during experimental milling research and cohesion values for both the hot and cold recycle briquettes with fabric exceeded the cohesion values of the control mixes. The fabric seemed to provide some tensile reinforcement to the asphalt mix. The surface abrasion test results showed a significant improvement in the hot recycle briquettes and no detriment in the cold recycle briquettes. Polyester manufactures have run tests showing that their product is also recyclable.∎

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