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NPME: Advancing The World of Pavement

Features

Cover: The 1993 National Pavement Maintenance Expo (NPME), March 4-7 in Tampa, Fla., is dedicated to Advancing the World of Pavement. NPME 1994 will be held January 20-23 in Nashville, Tenn. Design by Susan Schwenkler.

Departments

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Paving fabrics, such as the one used at the San Francisco Airport, have been used since the 1960s to help bond the old pavement to a new asphalt concrete overlay.

Terms of entanglement

Understanding the jargon is the key to using the new generation of paving fabrics

By Mounque Barazone

Needle-punched. Nonwoven. Calendered.

Paving fabrics have changed so dramatically since they were introduced to the paving industry in the 1960s that many contractors don't know the meaning—or importance—of these state-of-the-art terms.

But today, following years of extensive material testing, it's possible to prescribe paving fabrics, also known as geotextiles, to solve a variety of pavement maintenance problems. Provided you understand the terminology.

Geotextiles are woven and nonwoven fabrics used in reinforcement (stabilization), filtration (drainage), separation, and liner cushioning. They have also been used in asphalt overlay systems since the 1960s to reduce and delay reflective cracking and to act as a waterproofing membrane.

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, forming one integral, flexible structural system with a membrane (the fabric) in between.

It can be hard for contractors to determine what information on fabrics and installation is correct and what is not. Different manufacturers with varying proprietary interests suggest various reasons why their fabric is better than another. Often different installation criteria are recommended or discounted based on a particular fabric's installation benefits and problems.

To further complicate matters, there is a wide range of varying specifications by both public and private engineers based on their personal experiences. This has resulted in a wide range of specifications both for the fabric and installation criteria.

Terminology

Various names have been given to the use of fabric in membrane systems. The most common term is pavement reinforcement fabric. But this terminology is incorrect. A Caltrans laboratory test showed that a fabric interlayer is not a significant tensile reinforcing element in an asphalt concrete pavement. Reinforcement is obtained

from high modulus fabrics (wovens) and geogrids. Nonwoven fabrics have a high elongation and low modulus. This enables them to work within an asphalt system and remain flexible, but they provide little or no reinforcement. The terminology is changing to fabric interlayer membranes.

Fabric manufacturing

Paving fabrics are manufactured from two types of material, polypropylene and polyester.

Polypropylene fabric is slightly more absorbent to oil, less expensive to manufacturer, and easily recyclable in milling. Its only drawbacks are that it has a low shrinkage and melting point and can be damaged during installation.

Polyester fabric is stronger per ounce than polypropylene fabric and has a much higher shrinkage and melting point, making it virtually impossible to damage during installation. Its drawbacks are that it is usually more expensive, and questions surround its recyclability.

There are two primary manufacturing processes for geotextile fabrics—woven and nonwoven. Each of these processes can be further broken down into various subprocesses that give each fabric its individual qualities.

Paving fabric must be nonwoven. The fabric needs an interior plane (dimensional thickness) so that the tack coat can saturate the fabric, forming a membrane. Woven fabrics were found to be ineffective as fabric interlayer membranes as they have no interior plane to hold asphalt tack coats to form a membrane.

Nonwoven fabrics use thin filaments of polypropylene or polyester, which can be formed into a fabric by one of four different manufacturing processes:

- Needle-punched (entangled)
- Heat-bonded (calendered), two sides
- Needle-punched and heat-bonded, one side
- Resin-bonded

Each type of nonwoven fabric performs differently during installation, although their individual specifications may appear to be nearly identical.

Entangled

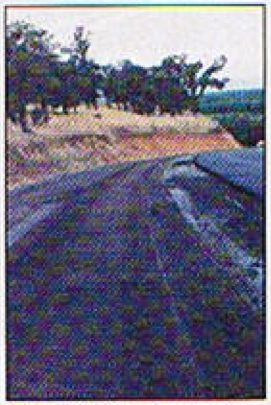
Needle-punched (entangled), nonheat-bonded fabrics can be formed by two processes. One process uses long continuous filaments spun together. The other uses short staples of filaments 6 to 12 inches long arranged on cards.

In both manufacturing processes, the filaments are moved on a crowded conveyor system while barbed needles go up and down through the filaments, entangling the strands together to form the fabric. This fabric is thicker, fuzzier, softer, and more pliable than non-needle-punched fabrics. It is best suited for drainage, separation, and pond-cushioning applications.

Many of its features are desirable in a paving application, but due to inherent installation problems it has not been found to be good for use as a paving fabric. The Federal Highway Administration (FHWA) Texas report 261-2 mentions problems with nonheat-bonded fabrics on every test section, including delaminating and fuzzing up in the wheel paths of traffic during construction.

The benefits of needle-punched, nonheat-bonded fabric is that it installs smoother with fewer wrinkles due to its high elongation (stretch) characteristics. This type of fabric also seems to bond better to the oil and old asphalt.

Numerous reports find the fuzzy side—when placed into the asphalt tack coat on the old pavement surface—provides reinforcement at the interface. The fuzzy side provides a greater effective surface area, which offers better adhesion and shear strength with far less slippage.



Severe delamination of nonheat-bonded, needle-punched fabric.

Calendered

Heat-bonding (calendering) is a process where one or both sides of the filaments are heated together to form the fabric. A light heating is called calendering. The benefit is that the fabric holds up well during construction without delamination or fuzzing.

Fabric heat-bonded on both sides is very thin and stiff. Installation problems with dual-sided, heat-bonded fabrics include difficulty in smooth placement—the wrinkles and folds span the full width of the fabric.

Because these fabrics are heat-bonded on both sides, they have no fuzzy side and have been prone to slippage problems. Also, the thin fabric does not hold tack coat easily, allowing bleed-through, which creates hazards to the workers and equipment.

A fabric that is needle-punched and heat-bonded on one side combines the benefits of the entangling process with the durability of heat-bonding. This fabric does not experience delamination, severe wrinkling, or bleed-through problems during construction. It provides the fuzzy side for bonding and enough thickness to hold the tack coat in the interior plane to form a solid membrane.

The only installation problem is that the fabric can be placed upside down. The heat-bonded side must be up, while the fuzzy side must be placed into the tack coat. Otherwise both delamination and slippage can occur.

Resin-bonded fabrics use a chemical process to form the fab-

When dual heat-bonded fabric is changed to fabric heat-bonded only on one side, bleed-through stops because the fabric is more absorptive.

Dual heat-bonded fabric (left) is very stiff, and wrinkles span the fabric width.

The bleed-through (right) here resulted from the use of dual heat-bonded fabric, which is thin and has poor absorption characteristics.

ric. This is similar to gluing and is seldom used. The fabric is thin, stiff, and has problems absorbing a tack coat.

Government reports

Numerous states have published dozens of reports with FHWA since 1975 concerning the use and performance of pavement fabrics under different climatic conditions. Temperatures ranged in excess of 104° F and as low as -30° F.

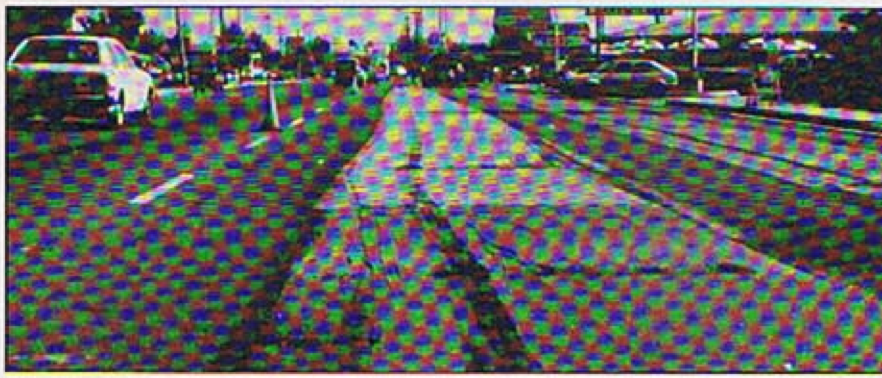
Most of these reports show great success with fabrics, but some show failures. In most instances the failures have been traced to improper installation techniques and the fabric chosen.

The most extensive studies were conducted by Caltrans and published in 1991 with the FHWA. The studies covered 24 test and control sections paved over 12 years and concluded:

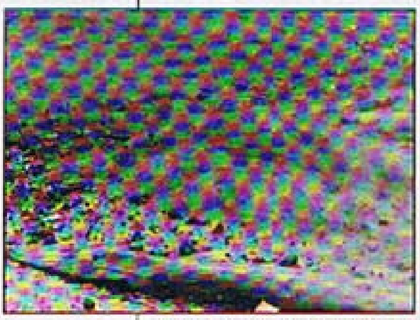
"Asphalt concrete overlays incorporating paving fabric interlays had less alligator cracking than conventional asphalt concrete overlays that were up to 0.10 foot thicker. It is recommended that [fabric interlayer membranes] be used to replace approximately .10 foot of [asphalt concrete] where additional tensile and flexural stiffness is not required."

This results in savings as much as $1.13 per square yard over a thicker overlay.

As far as overlays on PCC pavement are concerned, studies have found that "[paving fabric interlays] appear to reduce transverse cracking in thinner overlays. . . by .20 to .40 foot over distressed



This needle-punched fabric, heat-bonded on one side, was installed upside down, causing delamination of the fabric.



A closeup of the fuzzing of a nonheat-bonded fabric.

PCC pavement by approximately one transverse crack per 100 feet after eight years of service.

"In a comparison of performances of 12 different proprietary fabrics in 24 test sections over distressed PCC pavements, there were no significant differences in cracking between any of the fabrics." At least two other studies confirmed these observations, provided the fabric was placed properly.

In 1989, after 15 years of field evaluation, Caltrans changed its specifications to permit only nonwoven, needle-punched fabric, heat-bonded on one side. In 1991, Los Angeles County also changed to this type of fabric and has recently introduced the most comprehensive specification in existence today. PM

Mounque Barazone is president of Geotextile Apparatus Co. (GAC), San Diego, Calif. This is the first in a series of articles on the state-of-the-art of paving fabrics.