An Introduction to Geotextiles in Pavement and Drainage Applications

An Online Continuing Education Course for Engineers

Course Number: C-3031

Credit: 3 Hours / 3 PDH / 3 CPD

An Introduction to Geotextiles in Pavement and Drainage Applications

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1. GEOTEXTILES IN GENERAL

1.1 Scope

This course covers physical properties, functions, design methods, design details and construction procedures for geotextiles as used in pavements and drainage applications. Geotextile functions described include pavements, filtration and drainage. This course does not cover the use of other geosynthetics such as geogrids, geonets, geomembranes, plastic strip drains, composite products and products made from natural cellulose fibers.

1.2 Geotextile Types and Construction

1.2.1 Materials. Geotextiles are made from polypropylene, polyester, polyethylene, polyamide (nylon), polyvinylidene chloride, and fiberglass. Polypropylene and polyester are the most used. Sewing thread for geotextiles is made from Kevlar or any of the above polymers. The physical properties of these materials can be varied by the use of additives in the composition and by changing the processing methods used to form the molten material into filaments. Yarns are formed from fibers which have been bundled and twisted together, a process also referred to as spinning. (This reference is different from the term spinning as used to denote the process of extruding filaments from a molten material.) Yarns may be composed of very long fibers (filaments) or relatively short pieces cut from filaments (staple fibers).

1.2.2 Geotextile Manufacture*.*

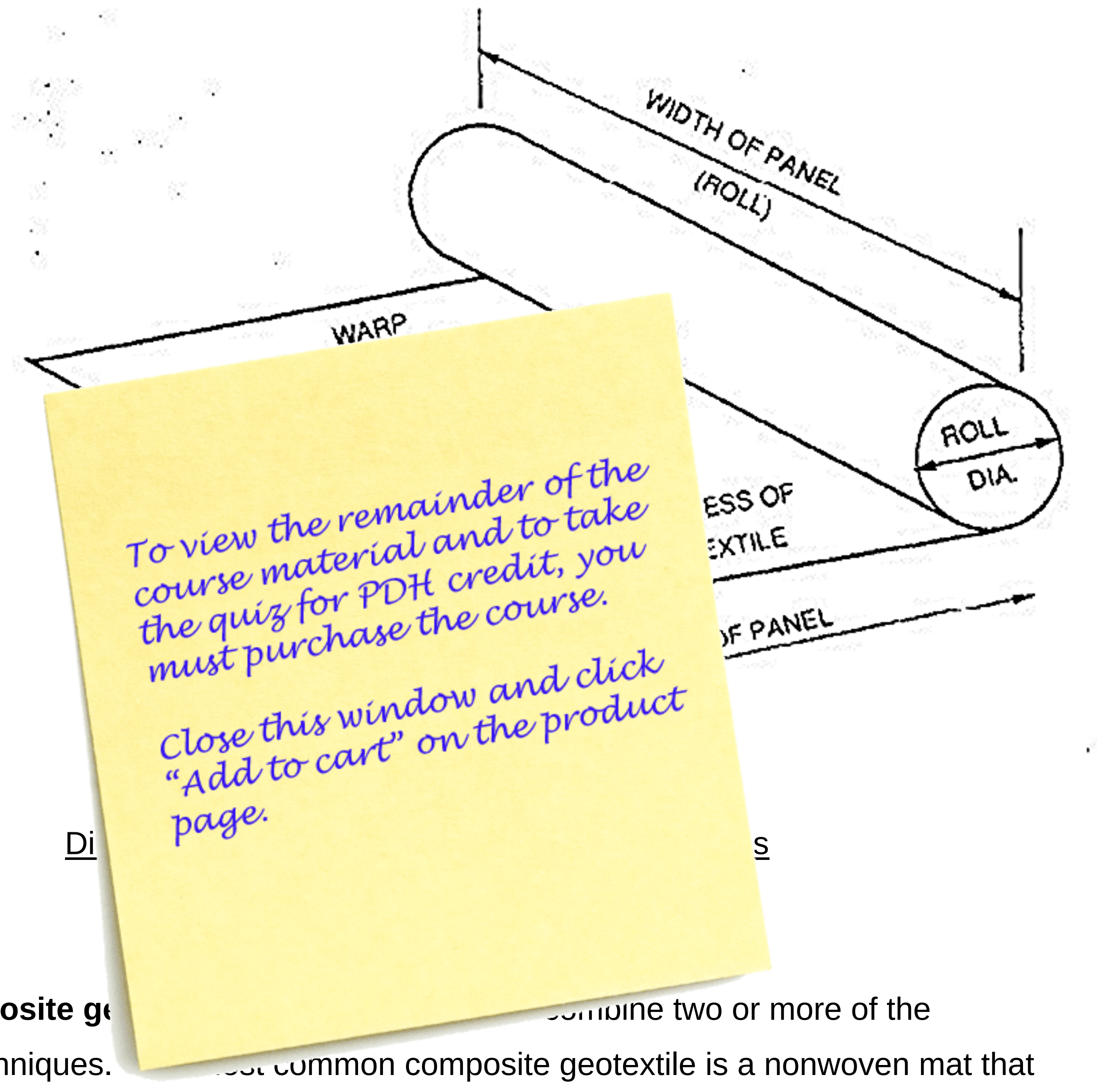
1.2.2.1 In woven construction, the warp yarns, which run parallel with the length of the panel (machine direction), are interlaced with yarns called fill or filling yarns, which run perpendicular to the length of the panel (cross direction as shown in Figure 1-1). Woven construction produces geotextiles with high strengths and moduli in the warp and fill directions and low elongations at rupture. The modulus varies depending on the rate and the direction in which the geotextile is loaded. When woven geotextiles are pulled on a bias, the modulus decreases, although the ultimate breaking strength may increase. The construction can be varied so that the finished geotextile has equal or different strengths in the warp and fill directions. Woven construction produces geotextiles with a simple pore structure and narrow range of pore sizes or openings between fibers. Woven geotextiles are commonly plain woven, but are sometimes made by twill weave or leno weave (a very open type of weave). Woven geotextiles can be composed of monofilaments or multifilament yarns. Multifilament woven construction produces the highest strength and modulus of all the constructions but are also the highest cost. A monofilament variant is the slit-film or ribbon filament woven geotextile. The fibers are thin and flat and made by cutting sheets of plastic into narrow strips. This type of woven geotextile is relatively inexpensive and is used for separation, i.e., the prevention of intermixing of two materials such as aggregate and fine-grained soil.

1.2.2.2 Manufacturers literature and textbooks should be consulted for greater description of woven and knitted geotextile manufacturing processes which continue to be expanded.

1.2.2.3 Nonwoven geotextiles are formed by a process other than weaving or knitting, and they are generally thicker than woven products. These geotextiles may be made either from continuous filaments or from staple fibers. The fibers are generally oriented randomly within the plane of the geotextile but can be given preferential orientation. In the spun-bonding process, filaments are extruded, and laid directly on a moving belt to form the mat, which is then bonded by one of the processes described below.

- **Needle punching.** Bonding by needle punching involves pushing many barbed needles through one or several layers of a fiber mat normal to the plane of the geotextile. The process causes the fibers to be mechanically entangled. The resulting geotextile has the appearance of a felt mat.
- **Heat bonding.** This is done by incorporating fibers of the same polymer type but having different melting points in the mat, or by using heterofilaments, that is, fibers composed of one type of polymer on the inside and covered or sheathed with a polymer having a lower melting point.
- **Resin bonding.** Resin is introduced into the fiber mat, coating the fibers and bonding the contacts between fibers.

- **Combination bonding.** Sometimes a combination of bonding techniques is used to facilitate manufacturing or obtain desired properties.



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1.2.2.4 Composite ge… …ombine two or more of the fabrication techniques. …st common composite geotextile is a nonwoven mat that has been bonded by needle punching to one or both sides of a woven scrim.

1.3 Geotextile Durability

Exposure to sunlight degrades the physical properties of polymers. The rate of degradation is reduced by the addition of carbon black but not eliminated. Hot asphalt can approach the melting point of some polymers. Polymer materials become brittle in very cold temperatures. Chemicals in the groundwater can react with polymers. All