Geotextiles: The new glamour industry

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EVERY few years, a mood of excitement is created in the textile industry by the emergence of a new generic fiber, fabric type, processing breakthrough, product group, refined technology or other developments. They fire the imagination of textilemen with the visions of vast new and profitable markets which, as a rule, attract many new entrants eager to establish themselves ahead of competition. In the past such excitement has been created by the introduction of nylon, polyester and acrylic fibers, new tufting, double and warp knit technology, the new breed of textured and spandex yarns; premanent press; the denim craze; laminating, and transfer printing.

The most recent addition to this list of glamor developments and products is geotextiles. This area has become the fastest growing volume user of fabrics within a few short years.

As the name implies, geotextiles are products applied on or under the ground to provide support for earthworks or concrete construction, soil stabilization, dams, canals, protection from water or wind erosion, etc. They are also used in agriculture, sewage and waste management, drainage and for many other such uses.

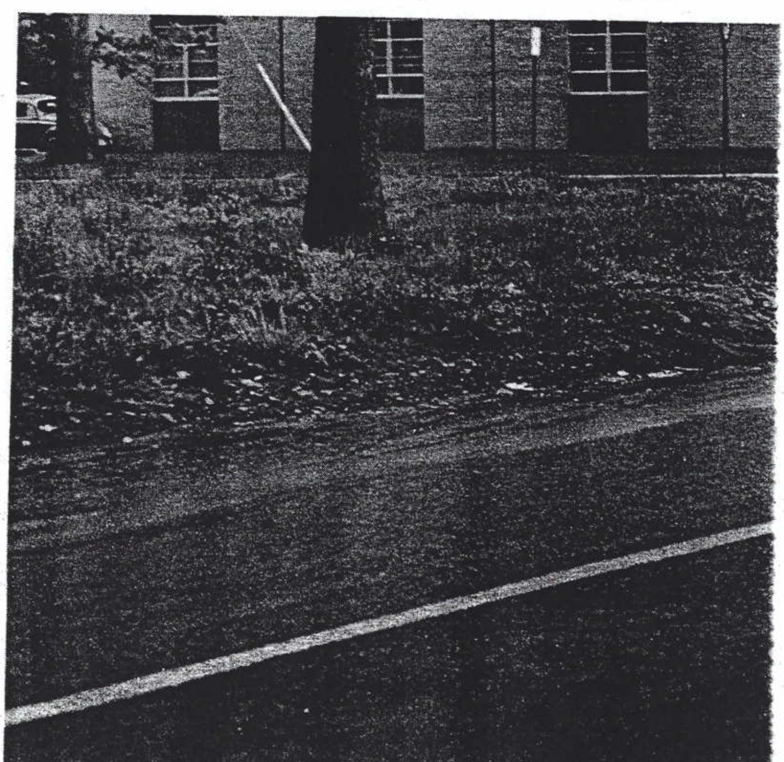
1982 sales of geotextiles are estimated at more than 100 million square meters, up from 85 million square meters in 1981. 1991 shipments, however, are projected at a whopping 700 million square meters with only 40-45 per cent of the market potential having been fully exploited at that time.

Recently an international conference on geotextiles sponsored by the Industrial Fabrics Association International in Las Vegas, drew an attendance of over 700 specialists from 30 countries who delivered more than 100 papers on the subject. The proceedings were published in three volumes running into hundreds of pages. It was obvious to those attending the conference that geotextiles was a vibrant new field poised at the verge of rapid, if not explosive growth.

Geotextiles are of prime interest to the makers of non-wovens, of considerate interest to the weavers and, to a minor extent, to knitters. The fiber producers also view this field with a great deal of excitement for two reasons. First, many of the non-wovens are made by these firms. Secondly, geofabrics do consume vast quantities of all kinds of filament, staple, and spun yarns and tape and sheet materials. While geofabrics are made of polypropylene, polyester, polyamide and acrylic fibers, polypropylene has become the dominant fiber.

When making a selection of fibers for a specific end use, the geotextile engineer must take into consideration its chemical, mechanical, weathering and biological degradation properties, as well as its cost and formability into a web or fabric.

Nylon, while characterized by high strength and abrasion resistance, absorbs large amount of moisture, is susceptible to light degradation and to damage by soil chemicals. Acrylics have the best all round properties, but are by far the most expensive. Polyester has generally the most desirable performance, but is costlier than polypropylene. The latter has a tendency to creep and its UV degradation resistance leaves something to be desired, though it has been substantially improved by new production techniques.



Woven geotextile fabrics are produced from spun or filament yarns, tapes or a combination of these. Using appropriate weaves, high tensile strength can be achieved in both directions exceeding several times that of non-wovens. For this reason, woven fabrics are used as reinforcements, such as jacketing material and for the construction of platforms under road or track foundation.

Non-wovens have the optimum properties for most of the geotextile applications because of their excellent conformability to the ground topography and contours. Non-woven fabrics are produced from staple fibers or filaments. In some geotextile uses, the staple based non-wovens are reinforced with warp threads, scrims or a woven substrate to form compound fabrics. Individual fibers, whether filament or staple, can be bonded thermally, checmically or mechanically through needle punching. The latter is the preferred method for geotextiles as it involves no degradable chemical binders and is also available in widths of up to 6.6 m. The fibers have a staple length of 60-100 mm and a fineness of 3.3-17 tex.

Most major fiber makers have now entered the geotextile field with their own non-woven and other products, in addition to supplying a range of staple fibers, filament yarns and film to the manufacturers of geofabrics.

Thus, Celanese has a line of its Mirafil woven and non-woven polyester cloths expressly designed for civil engineering. Du Pont has its Typar spunbonded olefin fabrics. Phillips offers its Petromat non-woven product made with olefin staple for use as reinforcing membrane. This is used in re-surfacing highways and other asphalt paved roads. Phillips also has the Supac, another non-woven olefin material, used primarily in soil reinforcement, stabilization, erosion control and drainage.

Monsanto Textiles promotes its Bidim, a 100 per cent polyester spunbonded non-woven. American Enka is also in the market with its Enkamat, a tough matting made from fused nylon monofilaments used in turfgrass areas to preserve the turf, promote drainage and prevent erosion.

Described below are some of the more interesting geotextile applications:

ROAD CONSTRUCTION: Unpaved roads are a growing market for geotextiles. The fabric, usually woven or in combination with non-wovens, serves to equalize the uneven road loading and also assures segregation between the subsoil and the fill without impairing the passage of water. The latter is essential for prevention of ice formation which is the archenemy of all roadbeds.

Geotextiles proved very effective in improving cracking resistance of the pavement structure by creating a moisture barrier which protects the underlying pavement base from further degradation. Also, the presence of geofabrics can significantly reduce the amount of asphalt required for pavement by providing a degree of reinforcement to the bituminous concrete overlay which is characteristically weak in tension.

Drainage of the roadside ditches is improved by using woven monofilament materials. Polypropylene and polyester non-wovens are beginning to be applied in road retaining walls.

Culverts designed to bridge streams and canals are another field for geofabrics. The same holds true for the construction of roads over marshy, muddy or otherwise unstable soil where a suitable fabric underlay offers the only practical way of getting the job done.

The enormous potential demand for geotextiles is underscored by the fact that the major portion of U.S. highway expenditures will be for reconstruction, rehabilitation and maintenance of existing facilities rather than construction of new ones. A major contributing factor to the alarming deterioration of the U.S. road network is its poor drainage which new geotextiles can certainly improve. The new 5 per cent per gallon tax designed for overhauling of the

road system will provide billions of dollars for this purpose.

RAIL ROADBEDS: As with highways, the U.S. railroad network is in need of major overhaul, particulary the run-down roadbeds. Much effort is being expended therefore towards the development of materials suitable for this purpose. Success has already been achieved with woven fabrics composed of polypropylene oriented split film.

One of the most serious problems associated with rehabilitaion of railroad beds is the need to provide adequate drainage without which the tracks become unstable and reduce the safe running speed of trains. Geotextiles can solve the drainage problems better and cheaper than any other material. They are also being used at locations which are difficult to maintain, such as grade crossings, diamonds, swithes, yards, etc., where proper track drainage is essential.

DAMS , DIKES, CANALS , PONDS , EMBANKMENTS : Geomembranes (synthetic, flexible, impervious liners) are increasingly used to line ponds, reservoirs, canals and dams. These liners are susceptible to damage caused by mechanical stress induced by the accumulation of liquid or gas underneath them. Geotextiles solve this serious problem by draining away the liquid and gas beneath the membrane. Together they provide an excellent composite material where one component is impervious to liquid, while the other, conducts it away.

Geotextiles are extensively used in the construction of gold tailings dams for the handling of gold bearing slurry in South African goldfields. The fabrics are employed here as the underdrains beneath the dams to remove the slurry water.

Geofabrics applied in earth dam construction increase the safety factor by protecting the walls from rain erosion. River, canal and lake embankments are increasingly protected by geofabrics providing reinforcement and filtration functions.

COSTAL ENGINEERING : Here, the geocloth prevents stones, which have been lowered into the sea to protect unstable beds, from sinking into the subsoil. In beach erosion control, it prevents the sand from passing through earth embankments out to the sea. In some cases, sandbagged revetments protect the beach from erosion by the wave action.

Perhaps the largest single undertaking involving geotextiles is Netherland's projected closing of several major sea inlets which will shorten its coastline more than 300 miles. This will create some new land and protect the beaches from wave erosion.

One of the key materials in this project is a prefabricated filtermat with a base woven of multiple plies of fibrillated polypropylene yarns. A graded aggregate goes over this foundation followed by a layer of spunbounded Typar.

Then, a coarse aggregate is put on and covered by a woven monofilament fabric on which more aggregate is spread and the whole work is topped with a multifilament polypropylene cloth. Fabric consumption here is enormous.

FABRIC FACED RETAINING WALLS : Such walls, whether vertical or inclined, are substantially cheaper and faster to erect than conventional, concrete faced structures. Here, strong, open weave polypropylene fabaric separates the earth wall in heights up to 6 meters. The fabric's meshes allow the water to drain without, however, permitting any solid matter to shift or trickle out. Such walls have an estimated life of 10-15 years.

GEOTEXTILES in SPORTS , TRAINING and PLAY GROUNDS : Needled non-woven polypropylene products are used in the construction of grounds or fields designed for various physical activities. The presence of the non-woven underlay stablizes the ground, provides good drainage and prevents any relative movement of the top and bottom soil or sand layers.

WIND EROSION BARRIERS in DESERT AREAS : The desert is advancing in some arid areas at an average rate of 5 kilometers a year by the action of wind. Wind erosion is a major contributing factor in the phenomenon of desertification which aggravates the world hunger problem. Methods involving geotextiles have been developed to stabilize sand dunes and stop their encroachement on the agricultural lands at the fingers of desert areas.

The sand is stabilized and protected from wind by a woven grid fabric or by a very light spunbonded olefin sheeting which does not interfere with the growth of new vegetation. This method has been successfully used in African desert regions.

AGRICULTURAL APPLICATIONS : Polyester net and mesh products, either warp knitted or woven, are used on a growing scale in agriculture for such applications as seed protection from wind and birds, sprinkler or rain water erosion, wind breakers, fruit and vegetable ground harvesting and shade growing nets. There is also turf protection nets on grazing grounds designed to stop the cattle from uprooting the grass.

FORMING DEVICES for CONCRETE : Since the advent of concrete as a construction material, engineers have been restricted in its use by the rigid forms of steel and wood required to contain the cement mix until its initial set. In the 1960s, synthetic fabrics were developed as flexible forming systems for concrete placement thus greatly expanding the potential uses of this material and at a much lower cost than available through the traditional methods.

Within the next 10 years, geotextiles will represent a 700 million square meter industry consuming enormous amounts of fibers and yarns. Although only of minor interest to knitters at this point, the payoff in geotextiles can be substantial in view of the sales being measured not just in terms of square meters, but in acres and square kilometers.

In a typical application designed for slope and river embankment protection, a dual wall woven fabric is used. The fabric, made of polyester, has its walls joined intermittently in the process of weaving so as to form a grid pattern. Concrete is poured between the fabric walls. The excess water escapes through the fabric's pores.

This only covers some of the more promising fields of geotextile usage. The whole art is still in its infancy, but already there are indications of a potentially large volume business.

It will not be easy to cater to the exacting requirements of civil engineers, road builders, railroad track contractors and other construction specialists to whom geotextiles are just another form of structural material like steel, wood or aggregate. Yet, the payoff can be very substantial in view of the sales being measured, not in terms of square meters, but acres or even in square kilometers.