

- 1 -

GEOSYNTHETIC MATERIAL FOR A DEVICE FOR REINFORCING GROUND AT
RISK OF COLLAPSE

The invention relates to a geosynthetic material for the reinforcement of earthworks.

Geosynthetic materials and, more particularly, geotextiles, are used more and more often as
5 reinforcements in the construction of earthworks for roads or railways.

Some geotechnical difficulties can be identified relatively easily and be dealt with appropriately and definitively. Other geotechnical
10 difficulties are more complex to overcome and sometimes lead the engineer to incorporate a risk.

This applies particularly when the ground comprises subterranean cavities of natural origin (karstic phenomenon) or anthropic origin (saps, marl
15 pits etc.) which are not listed in an index and are difficult to encircle. Constructing an earthwork on this type of ground is sometimes unavoidable and therefore entails a geotechnical risk associated with the arbitrary formation of collapses of earth
20 (subsidences) in the area of the infrastructure, this risk being incompatible with the level of service required for the structure.

The technical solution involves the use of a reinforcing geotextile of the "parachute" type which is
25 used as a preventive measure. The characteristics of this geotextile depend on its position, whether at the surface or at depth, on the magnitude of the subsidences to be treated and on the maximum deflection permissible at the surface, both permanent and dynamic,
30 as a function of the time required for action in order to repair the structure. It is necessary to take into account the lifetime of the reinforcement after the subsidence has occurred, as a function of the traffic on the way which passes over the structure.

35 Various parameters are involved in defining the tension modulus of the geotextile to be selected.

The object of the invention is to provide a geosynthetic material which allows normal operation during the period of use of the structure and which

- 2 -

affords a safety solution of the parachute type in the event of a collapse of earth.

The invention therefore relates to a geosynthetic material which comprises at least one lap
5 of parallel reinforcing strands.

This geosynthetic material is characterized in that the reinforcing strands are distributed in a first group of strands, produced with a fibre having a high tension modulus and a breaking elongation value close
10 to 5%, and in a second group of strands, produced with a fibre having a tension modulus below the tension modulus of the fibre of the first group of strands and a breaking elongation value at least equal to 12%.

Advantageously, the fibre of the strands of the first group is made of PVA (polyvinyl acetate) which has a breaking elongation of the order of 5%. It should be noted that further fibres may be used, such as glass or aramide, which have a maximum breaking elongation value of 2 or 2.5%, this being insufficiently high for
20 subsidence zones.

The fibres of the strands of the second group are preferably produced from polyester or polypropylene.

If there is no serious disorder in the ground,
25 all the strands of the two groups participate actively in absorbing the stresses, up to a deformation value of 5%.

Beyond this value, which corresponds to the commencement of serious disorder, the strands of the first group begin to break and the forces are additionally absorbed solely by the strands of the second group, thus resulting in greater deformation of the geosynthetic material of the parachute type, but, since the strands of the second group have a breaking
30 deformation value higher than 12%, they can support the structure, in spite of the great degree of disorder in the ground.

In practice, the geosynthetic material according to the invention may advantageously be

- 3 -

combined, when the structure is being constructed, with a second geosynthetic material equipped with filaments capable of breaking at predetermined elongation values of, for example, 4 and 8%, the said filaments being
5 connected to alarm devices, this second geosynthetic material being arranged on the ground and being separated from the geosynthetic material according to the invention by an earth layer which, under its own weight, brings about a deformation of the second
10 geosynthetic material of, for example, 5%, thus causing one of the alarm devices to be activated.

Other advantages and characteristics of the invention will emerge from a reading of the following description made by way of example and with reference
15 to the accompanying drawings in which:

Figure 1 shows the characteristic curve of the elongation of the geosynthetic material according to the invention as a function of the lateral forces exerted on it per unit length;

20 Figure 2 shows an example of the structure of the geosynthetic material according to the invention;

Figure 3 is a cross-section through the geosynthetic material of Figure 2 along the line III-III;

25 Figure 4 shows an example of use of the geosynthetic material according to the invention in a structure above a zone liable to collapse;

Figure 5 is a cross-section through the structure of Figure 4 above a collapsed zone.

30 Figure 1 shows the characteristic curve (C) of the elongation of the geosynthetic material according to the invention as a function of the forces exerted on this geosynthetic material in the longitudinal or transverse direction of the reinforcing strands
35 equipping this geosynthetic material. This curve (C) is given as an indication of the tensile strength. The latter may advantageously be adjusted according to the site requirements.

- 4 -

When elongation is below 5%, the slope of the curve (C) is steep. Up to an elongation of 5%, the forces are absorbed by the reinforcing strands which have the high tension modulus and a breaking elongation value of 5% and which are preferably produced from PVA (polyvinyl acetate), as well as by the other reinforcing strands which have a markedly lower tension modulus and a breaking elongation value above 12% and preferably equal to 18%, these other strands being produced, for example, from polyester or polypropylene.

When elongation exceeds 5%, the PVA strands break, and the load is then absorbed by the polyester strands.

When elongation reaches 5.5%, all the PVA strands are broken, and the forces are absorbed solely by the polyester strands.

The portion OA of the curve C corresponds to the normal operation of the geosynthetic material in a structure. The portion AB corresponds to an alarm situation, and the portion BD corresponds to the use of the geosynthetic material in the parachute mode, for example in the event of a collapse of earth below a structure equipped with the geosynthetic material according to the invention.

Figures 2 and 3 show a geosynthetic material produced by weave-and-knit technology, in combination with non-woven, which comprises, in its transverse direction, a plurality of parallel strands or cords 11, 12 distributed in a first group of strands 11 which are produced from PVA fibre and a second group of strands 12 which are produced from polyester or polypropylene fibres.

The strands 11 and 12 are integrated, during the manufacture of the geosynthetic material 10, in a perfectly straight arrangement which does not cause any undulation or shearing effect, as in other textile surfaces.

In Figures 2 and 3, the PVA strands 11 and the polyester or polypropylene strands 12 are arranged

- 5 -

alternately. It is clear that the density of the two types of strands may differ and be calculated according to the use of the geosynthetic material 10.

Figures 4 and 5 show an advantageous use of the geosynthetic material 10 in a civil engineering structure 20 arranged on a ground 21 comprising internal cavities 22 which are separated from the surface 23 of the ground 21 by vaults 24. Arranged above the surface 23 is a first geosynthetic material 25 which comprises filaments capable of breaking when the coefficient of elongation of the first geosynthetic material 25 is, for example, 4%, in order to signal a first alarm level, and filaments capable of breaking when the coefficient of elongation of the first geosynthetic material is, for example, 8%, in order to provide a second alarm level.

Between the geosynthetic material 10 according to the invention and the first geosynthetic material 25 described above, is arranged an earth layer H which is calculated in such a way that the first geosynthetic material 25 experiences deformation above 4% under the weight of this layer H.

When a collapse occurs below the first geosynthetic material 25, the weight of the layer H causes the filaments having a low coefficient of breaking elongation to break and results in the provision of a first alarm level.

Under this condition, the geosynthetic material 10 according to the invention alone supports the weight of the structure 20. Beyond a particular deformation of the geosynthetic material 10 (5-6%), the latter will transmit additional forces to the first geosynthetic material 25 which are capable of causing the filaments having a high coefficient of breaking elongation of the first geosynthetic material 25 to break and resulting in the provision of the second alarm level. This second alarm level will be reached at a deformation of the geosynthetic material 10 of the order of 6 or 7%, which

- 6 -

is well below the level of breaking deformation of the polyester strands of the geosynthetic material 10.

- 7 -

CLAIMS

1. Geosynthetic material of the type comprising at least one lap of parallel reinforcing strands, characterized in that it is produced from weave-and-knit in combination with non-woven and that the said reinforcing strands are distributed in a first group of strands, produced with a fibre having a high tension modulus and a breaking elongation value close to 5%, and in a second group of strands, produced with a fibre having a tension modulus below the tension modulus of the fibre of the first group of strands and a breaking elongation value at least equal to 12%.
2. Geosynthetic material according to Claim 1, characterized in that the fibre of the strands of the first group is made of polyvinyl acetate.
3. Geosynthetic material according to either one of Claims 1 or 2, characterized in that the fibre of the strands of the second group is made of polyester or polypropylene.