DRAIN ROLL PACKAGE

TECHNICAL FIELD

The present invention relates to a drain roll package. In particular, the present invention relates to a drain roll package suitable for providing continuous drain band for use in ground treatment operations.

BACKGROUND

Ground treatment such as land reclamation has been carrying out in many places around the world. Various solutions are developed for areas with water-saturated soil, to shorten the soil consolidation period and with low cost. Amongst these solutions, prefabricated vertical drain (PVD) is one of the widely used technologies for such purpose. PVD technology uses band-form, continuous wick drain material inserted vertically into the soil to facilitate water escape from compressible soils, and to accelerate soil consolidation.

Such drain material is typically supplied in a roll form, i.e. a continuous drain band wound around a reel in a single column, with the width of the roll the same as the width of the band. In operation, a rig carries an end of the drain band and inserted into a predetermined depth of the ground. During the drain band insertion process, the drain roll is unwound to release the drain band which follows the insertion of the drain band into the ground. When reached the predetermined depth in the ground, the leading end of the drain band is fixed inside the ground. The rig is then retracted from the ground, leaving a segment of drain band inside the ground with a length the same as the predetermined depth. The drain band is cut off at a point a certain length above the ground surface to complete the insertion process of this drain band segment. This insertion process is repeated by attaching the end of the next segment of the drain roll to the rig tip and inserting the rig tip into the ground at an adjacent location. When the current drain roll reaches the end, or with a remaining drain band segment of a length shorter than the predetermined depth, the current drain roll will be replaced with a new one and the operation resumed.

With the currently available drain roll package supply, the drain band insertion operation will be frequently interrupted for drain roll replacement, each time a current drain roll reaches its end of drain band length segment. In some applications, placement of drain bands in the ground at relatively greater depth is required, e.g. about 60 meters as is the case of land reclamation in some areas. Under such situation, the currently available drain roll package in the market, which contains a drain band of about 300 meters, can only last for several insertion operations before a new drain roll is replaced. Frequent replacements of drain rolls are therefore required during which, the insertion option is interrupted which greatly reduces the production efficiency. In addition, as any remaining segment of a drain band is still wound on the drain roll, it is not always easy, if not impossible, to determine the length of any remaining drain band segment. If a remaining drain band segment has insufficient length, it will not be discovered until the final end of the segment is unwound from the roll while before the leading end reaches the predetermined depth. When this happens, the last insertion operation is unsuccessful. A rectification operation may become necessary, e.g. by either retrieving the drain band of insufficient length from the ground and replace the drain roll with a new one, or to insert a new drain segment at the same location. This last segment of drain band of insufficient length will have to be discarded resulting in material wastage and cost increase.

Under the current drain roll package structure, increase of the length of the drain band will also increase the external diameter of the drain roll. However, it is impractical to increase the capacity of the drain roll package by winding with longer drain bands. This is because a drain roll package with longer drain bands wound will form a drain roll package of a larger external diameter. Such larger diameter drain roll packages will require larger space and greater capacity for both storage and transportation which may not be economical to either a drain roll supplier or a user.

It is therefore desirable to provide a drain roll package which is capable of supplying drain band in longer length but without increasing the external diameter of the drain roll package. Such a drain roll package is currently unavailable.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide drain roll packages which are capable of supplying a continuous drain band for soil consolidation operation based on the prefabricated vertical drain technology. By maintaining the same external diameter of the drain roll package, drain roll packages structured according to embodiments of the present invention provide continuous drain band with a much longer length compared to the conventional drain roll packages. According to one aspect of the present invention, a drain roll package includes a drain band and a reel around which the drain band is wound to form a plurality of windings. The drain band has a core and a shield surrounding the core. A cross section of the drain bans is defined by a width and a thickness. At least one of the windings is progressively shifted along a first axial direction of the reel such that a tail end of said at least one of the windings is offset from a head end of said at least one of the windings along the first axial direction.

In one embodiment, the tail end is offset from the head end by a distance which is the same as the width, and a first subsequent winding of said at least one of the windings lies in a same layer around the reel as said at least one of the windings.

In another embodiment, the tail end of said at least one of the windings is offset from the head end by a distance which is less than the width, and a first subsequent winding of said at least one of the windings partially overlaps over said at least one of the windings.

Other aspects and advantages of the present invention will become apparent from the following detailed description, illustrating by way of example the inventive concept of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the present invention will be described in detail with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view showing a drain roll package according to one embodiment of the present invention;

Fig. 2 is an enlarged perspective view showing an inner-most winding layer of the drain roll package of Fig. 1;

Fig. 3 is an enlarged perspective view showing the cross-sectional structure of a drain band forming the drain roll package of Fig. 1;

Fig. 4 is a partial front view of Fig. 1;

Fig. 5 is a cross-sectional view of Fig. 4;

Fig. 6 is a partial cross sectional view of Fig. 1 along A-A;

Fig. 7 is a cross-sectional partial view of a drain roll package according to another embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

According to one embodiment of the present invention, as shown in Fig. 1 to 6, a drain roll package 100 for use in soil consolidation operation includes a continuous drain band 130 wound around a reel 110. Drain band 130 has a core 137 and a textile filter fabric shield 139 surrounding core 137. Core 137 and shield 139 may be made of plastic, e.g. polypropylene, such that the drain band can be resiliently deformed within a predetermined range without being damaged or broken. Core 137 is of a corrugated form with hollow channels 138 which serve as water paths to allow water from the soil to pass through. Shield 139 permits water to pass into core 137 from the surrounding soil, while restricting the soil particles from entering into core 137 which might clog channels 138. Drain band 130 has a generally rectangular cross section (Fig. 3), with a width 130W and a height/thickness 130H defining the profile.

Drain band 130 is wound around reel 110 to form a plurality of windings 131, 132, 133, etc. One or more of these windings, for instance winding 131, is wound around reel 110 starting at a head end 131a and ends at a tail end 131b to form a full round. Meanwhile, winding 131 is progressively shifted along a first axial direction 102 of reel 110. Wound in this manner, tail end 131b of winding 131 becomes offset from head end 131a along first axial direction 102. In the current embodiment, tail end 131b of winding 131 is offset from head end 131a along first axial direction 102 by a distance 106 which is the same as width 130W of drain band 130. Shifting the tail end of a given winding in this way allows a subsequent winding, e.g. winding 132, to be wound at a same radial layer as winding 131, instead of overlapping over winding 131. Reel 110 has a length 110L longer than width 130W of drain band 130 to accommodate at least two windings to be wound without overlapping. Taking an actual example for further illustration, a drain band of a width of about 10cm and a length of about 3000 meters, is wound on a reel of about 1.1 meter length. The drain band is wound around the reel in the above-illustrated manner, therefore it is possible to have 10 full windings wound around the reel at a same radial layer.

When the last winding of the first layer reaches the end of the reel, a further winding 141 is wound over the last winding of the first layer to start building the windings on the second layer, by progressively shifting the second layer of windings along a second axial direction 102' which is opposite to first axial direction 102. Further layers are built by repeating the same process, i.e. with windings of odd-numbered layers progressively shifted along first axial direction 102 and windings of even-numbered layers progressively shifted along second axial direction 102'. Upon reaching the predetermined external diameter 110D, the winding operation is completed and a drain roll package. Such a package will have a larger axial dimension 110L, which can be the same as the size of several conventional drain roll packages stacked together. The external diameter 110D can be controlled to be the same as that of a conventional drain roll package.

In another embodiment as shown in Fig. 7, a drain roll package 200 has drain band 230 wound on reel 210. Drain band 230 has the same structure as drain band 130 of the previous embodiment, i.e. formed of a core and a shield surrounding the core. Each of first layer windings 231, 232, etc. is shifted along first axial direction 202 of reel 210, by a distance 206. In the present embodiment, distance 206 is less than the width of drain band 230. As such, second winding 231 partially overlaps over first winding 231. Similarly, each subsequent winding in the first layer partially overlaps over a preceding winding.

When the last winding of the first layer reaches the end of the reel, a further winding 241, is wound over the last winding of the first layer to start building the windings on the second layer, by progressively shifting the second layer of windings along a second axial direction 202' which is opposite to first axial direction 202. Further layers are built by repeating the same process, i.e. with windings of odd-numbered layers progressively shifted along first axial direction 202 and windings of even-numbered layers progressively shifted along second axial direction 202'. Upon reaching the predetermined external diameter 210D, the winding operation is completed and a drain roll package formed.

According to the above illustration, that the present embodiment provides drain roll packages which contain and are capable of supplying a continuous drain band in a

much longer length, comparing to a conventional drain roll, but without increasing the external diameter of the drain roll package. Drain roll replacement frequency during the soil consolidation operation, and the material wastage due to a last drain band segment of a possible insufficient length, are greatly reduced. Additionally, storage and transportation requirements limited by the external diameter of the drain roll package are complied with.

Although embodiments of the present invention have been illustrated in conjunction with the accompanying drawings and described in the foregoing detailed description, it should be appreciated that the present invention is not limited to the embodiments disclosed. Therefore, the present invention should be understood to be capable of numerous rearrangements, modifications, alternatives and substitutions without departing from the spirit of the invention as set forth and recited by the following claims.

CLAIMS

1. A drain roll package comprising:
a drain band having a core and a shield surrounding the core, a cross section of the drain band being defined by a width and a thickness,
a reel around which the drain band is wound forming a plurality of windings,
wherein at least one of the windings being progressively shifted along a first axial direction of the reel such that a tail end of said at least one of the windings is offset from a head end of said at least one of the windings along the first axial direction.

2. The drain roll package of claim 1, wherein the tail end is offset from the head end by a distance the same as the width.

3. The drain roll package of claim 2, wherein a first subsequent winding of said at least one of the windings lies in a same layer around the reel as said at least one of the windings.

4. The drain roll package of claim 3, wherein a second subsequent winding of said at least one of the windings is wound over the first subsequent winding.

5. The drain roll package of claim 2, wherein the tail end of said at least one of the windings is offset from the head end by a distance less than the width.

6. The drain roll package of claim 5, wherein a first subsequent winding of said at least one of the windings partially overlaps over said at least one of the windings.