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(54) **Artificial turf for landscape and sports**

Kunstrasen für Landschaft und Sport

Gazon artificiel pour paysage et sport

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Description

Field of the Invention

[0001] The present invention relates to surfaces simulating natural grass and, more specifically, to artificial turf imitating the volume effect and density of natural grass and manufacturing such turf.

Background of the Invention

[0002] Artificial turf, also often referred to as synthetic grass, is a surface of synthetic fibers made to look like natural grass. It is most often used in sports applications. However, it is now being used on residential lawns and landscaping as well. Artificial turf stands up to heavy use and requires no irrigation or trimming. Domed, covered, and partially covered stadiums may require artificial turf because of the difficulty of getting grass enough sunlight to stay healthy. But, artificial turfs currently available still fail to provide the excellent shock absorbing properties of natural grass surfaces and also fall short in mimicking the volume effect of natural grass.

[0003] Today's generation artificial turfs are typically made from UV-enhanced polypropylene fiber or polyethylene fiber that is tufted into a woven synthetic primary backing that receives a secondary backing in form of a coating or laminate on the opposite side of the face fibers to give the turf dimensional stability and to aid fiber binding.

[0004] When installed, the turf's face (i.e., the grass "blades") is generally given a layer of sand to augment water drainage and/or a layer of cryogenic rubber granules to help keeping the tufts more vertically oriented and to provide shock-absorbency. The infill typically provides ballast and structure for the artificial turf, helping the fibers to stand and to provide a "cushion" effect when stepping over the turf. This protects the roots of the tuft fibers.

[0005] Currently, non-infill artificial turf refers to those artificial turf models with short pile height, narrow gauge (distance between rows), and high stitch rate. Artificial turfs that are used without such infill are typically made from shorter, denser polyethylene fibers that include even shorter crimped fibers to keep the tufts resembling grass blades upright. Some non-infill systems provide an underlay under the turf to provide cushioning.

[0006] Due to an ever increasing number of residential and commercial applications of artificial turf, artificial turf with improved properties that more and more resemble natural grass is sought after, as illustrated in the following examples.

[0007] GB 1,154,842 discloses raised tufted, bonded fibrous structures. A fibrous web of desired weight and structure was placed on top of another such web and the assembled fibrous structure then needle punched in a conventional single bed needle loom. On passage through the needle loom, fibres from one fibrous web are carried by the needles through the other fibrous web as the foundation layer and the needle penetration is controlled so as to ensure that the aligned fibres pass through the foundation layer and project beyond its surface as fibre tufts.

[0008] WO 2001/37657 A1 discloses a vertically draining, rubber filled synthetic turf. The vertically draining synthetic turf comprises a porous geotextile membrane positioned between an open graded aggregate layer and a sand layer. The synthetic turf also includes a pile fabric comprising a plurality of pile elements tufted to a woven or non-woven backing above the open graded aggregate layer. An infill layer consisting of resilient particles, preferably a mixture of high and low density rubber, is interspersed among the pile elements of the pile fabric. The backing layer may be solely a non-woven, in a single layer or in multiple layers. A suitable non-woven, dimensionally stable material is a polyester/nylon blend, spunbound, non-woven material.

[0009] WO 2012/125513 A1 discloses a synthetic ground cover system for erosion control to be placed atop the ground, which includes a synthetic grass comprising a composite of one or more geo- textiles tufted with synthetic yarns. The synthetic ground cover also includes a sand/soil infill ballast applied to the synthetic grass and a binding agent applied to the sand/soil infill to stabilize the sand/soil infill against high velocity water shear forces. The system includes a synthetic turf which includes a backing and synthetic turf blades secured to the backing. The synthetic grass blades are tufted into the substrate or backing comprising a synthetic woven or non-woven fabric. The backing can be a single ply backing or can be a multi-ply backing, as desired. A filter can be secured to the substrate to reinforce the substrate and better secure the synthetic grass blades. Preferably, the at least one filter fabric may also comprise non-woven synthetic fabric.

[0010] As more artificial turf and less natural grass is used to cover the ground for an increasing number of applications, it is increasingly important to provide artificial turf that is eco-friendly.

Summary of the Invention

[0011] From the foregoing, it can be seen that there is a need for artificial turf that resembles more closely natural grass.

[0012] The present invention seeks to provide artificial turf for landscape and sports applications that imitates more closely the root zone, the volume effect, and density of natural grass and that has an improved wear and drainage property.

[0013] It is an advantage of embodiments of the present invention to provide the artificial turf with a mechanically bounded layer of fibers functioning as the root zone of natural grass that assists the pile yarn of the tufts to stand and that protects the bending points of the tufts such that the application of an infill can be eliminated. The mechanically bounded layer of fibers allows moving of the fiber so that compaction of the surface, thus hardening of the surface will be extensively be reduced.

[0014] It is another advantage of embodiments of the present invention that the artificial turf can be made from materials that are entirely recyclable thereby reducing the amount of waste that presently has to be disposed of in landfills.

[0015] It is still another advantage of embodiments of the present invention to enable surface water to drain easily in all directions to the ground underneath the installed artificial turf.

[0016] It is yet another advantage of embodiments of the present invention to provide artificial turf with a mechanically bounded layer of fibers for equalizing for uneven/rocky soils.

[0017] It is yet another advantage of embodiments of the present invention to provide artificial turf with a mechanically bounded layer of fibers that has shock absorbing properties and, thus, contributes to a more natural feeling of the artificial turf.

[0018] According to an aspect of the present invention, an artificial turf adapted for use in landscape and sports applications comprises a mechanically bounded layer of fibers made of one or more natural and/or synthetic fibers. Pile yarn is inserted through the mechanically bounded layer of fibers, the pile yarn being anchored to the mechanically bounded layer of fibers. The mechanically bounded layer of fibers has a density that decreases from the bottom to the top of the mechanically bounded layer of fibers.

[0019] By providing a mechanically bounded layer of fibers formed as a non-woven matting, surface water can drain easily to the soil underneath the artificial turf once installed. As a result, the artificial turf in accordance with advantageous embodiments of the present invention dries quickly provided drainage of the subsoil. By using a mixture of natural and, therefore, moisture absorbent fibers and synthetic fibers, the water holding capacity of the artificial turf can be improved compared to known prior art products.

[0020] According to preferred embodiments of the present invention, decrease in density occurs at a constant rate. As a result, the layer provides structural support for the tufts and shock-absorbance to contribute to a more natural feeling of the artificial turf.

[0021] According to preferred embodiments of the present invention, the mechanically bounded layer of fibers includes a lower layer and a upper layer, the lower layer being positioned at the bottom of the mechanically bounded layer of fibers and the upper layer being positioned on top of the lower layer, and the upper layer having a higher fiber coarseness than the lower layer.

[0022] The terms "upper" and "top", on the one hand, and "lower" and "bottom", on the other hand, are used herein to designate sides or portions of the artificial turf with reference to their relative positioning when the turf is deployed for normal use on a ground surface. Thus, "upper" and "top" refer to portions at or near the side from which free ends of the tufts stick out; and "lower" and "bottom" refer to portions at or near the opposite side.

[0023] This embodiment also provides structural support for the tufts and shock-absorbance to contribute to a natural feeling of the artificial turf, while allowing an efficient manufacturing process starting from two homogeneous non-woven mats having different fiber coarseness.

[0024] According to preferred embodiments of the present invention, the lower layer provides structural support for the pile yarn.

[0025] According to preferred embodiments of the present invention, the upper layer acts as a shock-absorbing layer and contributes to a natural feeling of the artificial turf.

[0026] According to preferred embodiments of the present invention, the lower layer is formed by fibers that are more flexible and form a denser structure than fibers forming the upper layer, the fibers of the lower layer having a smaller linear mass density than fibers forming the upper layer.

[0027] According to preferred embodiments of the present invention, the fibers of the lower layer have a linear mass density in the range of about 3,3 dtex to about 110 dtex.

[0028] According to preferred embodiments of the present invention, wherein the fibers of the upper layer have a linear mass density in the range of about 11 dtex to about 600 dtex.

[0029] According to preferred embodiments of the present invention, the upper layer is thicker and has a higher fiber coarseness than the lower layer.

[0030] According to preferred embodiments of the present invention, fill yarn is created on the upper surface of the upper layer through velour needle-punching, the fill yarn giving the upper surface of the upper layer a velour-like appearance, thereby imitating the root zone of natural grass, providing cushioning, and assisting the pile yarn of the tufts to stand. By velour-needle punching the upper surface of the upper layer, the surface is given a fluffy structure that provides cushioning. Since the fill yarn assists the pile yarn to stand, no infill, as often used in the known prior art is needed with the artificial turf in accordance with advantageous embodiments of the present invention.

[0031] According to preferred embodiments of the present invention, the mechanically bounded layer of fibers is manufactured as a single fabric or as two separate fabrics that are joined together.

[0032] According to preferred embodiments of the present invention, the mechanically bounded layer of fibers is formed by needle-punching.

[0033] According to preferred embodiments of the present invention, the mechanically bounded layer of fibers consists of up to eight different types of fibers.

[0034] According to preferred embodiments of the present invention, the mechanically bounded layer of fibers, the pile yarn, and a backing anchoring the pile yarn to the mechanically bounded layer of fibers are made of eco-friendly materials that are 100% recyclable by being mechanically deconstructable. It is furthermore advantageous to choose a homogenous polymer composition for all elements of the inventive artificial turf to support the recyclability.

[0035] According to an aspect of the present invention, a method for manufacturing artificial turf for use in landscape and sports applications comprises the steps of:

> forming by needle-punching a mechanically bounded layer of fibers having a density that decreases from the bottom to the top of the mechanically bounded layer of fibers; creating fill yarn extending from the upper surface of the mechanically bounded layer of fibers through velour needle-punching, thereby giving the upper surface of the mechanically bounded layer of fibers a velour-like appearance; inserting pile yarn through the mechanically bounded layer of fibers; and anchoring the pile yarn at the backside of the mechanically bounded layer of fibers.

[0036] According to an aspect of the present invention, a method for manufacturing artificial turf for use in landscape and sports applications comprises the steps of: forming by needle-punching a lower layer from a plurality of natural and/or synthetic fibers; forming by needle-punching an upper layer from a plurality of natural and/or synthetic fibers that have a higher linear mass density than the fibers of the lower layer, the upper layer having a less dense structure than the lower layer; placing the upper layer on top of the lower layer to form a mechanically bounded layer of fibers; creating fill yarn on the upper surface of the upper layer through velour needle-punching thereby giving the upper surface of the upper layer a velour-like appearance; inserting pile yarn through the mechanically bounded layer of fibers; and anchoring the pile yarn at the backside of the mechanically bounded layer of fibers.

Brief Description of the Drawings

[0037] The above and other characteristics, features, and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention. The reference figures quoted below refer to the attached drawings.

> Fig. 1 is a schematic cross-sectional view of the artificial turf in accordance with a first preferred embodiment of the present invention; and
> Fig. 2 is a schematic cross-sectional view of the artificial turf in accordance with a second preferred embodiment of the present invention.

Detailed Description of the Invention

[0038] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. Any reference signs in the claims shall not be construed as limiting the scope. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes.

[0039] Where the term "comprising" is used in the present description and claims, it does not exclude other elements or steps. Where an indefinite or definite article is used when referring to a singular noun e.g. "a" or "an", "the", this includes a plural of that noun unless something else is specifically stated.

[0040] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment, but may. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments.

[0041] Similarly it should be appreciated that in the description of exemplary embodiments of the invention, various features of the invention are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the claims following the detailed description are hereby expressly incorporated into this detailed description, with each claim standing on its own as a separate embodiment of this invention.

[0042] Furthermore, while some embodiments described herein include some but not other features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form different embodiments, as would be understood by those in the art. For example, in the following claims, any of the claimed embodiments can be used in any combination.

[0043] In the description provided herein, numerous specific details are set forth. However, it is understood that embodiments of the invention may be practiced without these specific details. In other instances, well-known methods, structures, and techniques have not been shown in detail in order not to obscure an understanding of this description.

[0044] The following terms or definitions are provided solely to aid in the understanding of the invention.

[0045] The term "backside" is used herein to denote the side of the mechanically bounded layer of fibers which faces away from the side from which free edges of the tufts stick out.

[0046] As employed herein, the term "fiber coarseness" is defined as weight per fiber length and is normally expressed in units of mg/m or g/m. The fiber coarseness depends on fiber diameter, cell wall thickness, cell wall density, and fiber cross section. A high coarseness value indicates a thick fiber wall, giving stiff fibers unable to collapse. Thin walled fibers with low coarseness value give flexible fibers and a denser structure. The coarser the fibers, the stronger they will be.

[0047] As employed herein, the term "tex" refers to a unit of measure for the linear mass density of fibers and is defined as the mass in grams per 1000 meters. The most commonly used unit is the decitex, abbreviated dtex, which is the mass in grams per 10,000 meters. When measuring objects that consist of multiple fibers the term "filament tex" is sometimes used, referring to the mass in grams per 1000 meters of a single filament.

[0048] As employed herein, the term "tufting" refers to a type of textile process in which a thread is inserted on a carrier base. Tufted carpets are manufactured by insertion of tufts (a short cluster of elongates strands of yarn attached at the base) through a backing fabric, creating a pile surface of cut and/or loop ends.

[0049] As employed herein, the term "filament" refers to a single continuous strand of natural or synthetic fiber.

[0050] As employed herein, the term "yarn" refers to a continuous strand of twisted or untwisted threads of natural or synthetic material.

[0051] As employed herein, the term "pile" refers to the visible surface (wearing surface) of carpet consisting of upright ends of yarn or yarn tufts in loop and/or cut configuration. Sometimes it is called "face" or "nap".

[0052] As employed herein, the term "backing" refers to a substrate applied to the back of the carpet to increase dimensional stability and enhances the anchoring of the pile yarn.

[0053] As employed herein, the term "non-woven" refers to engineered fabric (sheet or web structure) bonded together by entangling fibers mechanically, thermally, or chemically.

[0054] As employed herein, the term "needle-punch" refers to a mechanical process involving thousands of needles that orient and interlock fibers to create nonwoven fabric.

[0055] Referring to **Fig. 1,** the schematic cross-section of an artificial turf 10 is illustrated in accordance with preferred embodiments of the present invention. The artificial turf 10 includes a mechanically bounded layer of fibers 20, a backing 30, and a plurality of tufts 40.

[0056] The mechanically bounded layer of fibers 20 is formed as a non-woven matting made of one or more natural and/or synthetic fibers or yarns. The mechanically bounded layer of fibers 20 serves as a carrier for the tufts 40.

[0057] As illustrated in Fig. 1, the mechanically bounded layer of fibers 20 can be a single layer containing a mixture of fibers. According to preferred embodiments of the present invention, the coarseness of the fibers forming the mechanically bounded layer of fibers 20 may increase from the bottom to the top of the layer 20. For example, the coarseness may gradually increase at a constant rate.

[0058] Alternatively, as illustrated in **Fig. 2,** the mechanically bounded layer of fibers 20 can include visually two or more layers, such as, a structural layer 21 and a volume simulating layer 22. The structural layer 21 is positioned at the bottom of the mechanically bounded layer of fibers 20 facing away from the pile yarn 41. The volume simulating layer 22 is positioned on top of the structural layer 21 facing the pile yarn 41. In case of multiple layers of fibers, the mechanically bounded layer of fibers is divided into multiple functionalities, such as, for example, structural enhancements (layer 21) and volume simulating (layer 22).

[0059] The mechanically bounded layer of fibers 20 can be manufactured as a single fabric or as two separate fabrics that are joined together. In accordance with preferred embodiment of the present invention, the mechanically bounded layer of fibers 20 is formed by needle-punching. During this mechanical bonding method, fibers are transported with felting needles and interlocked in the non-woven structure. This procedure increases the friction between the fibers, which reinforces the non-woven fabric. To differentiate the structure of the non-woven fabric, the web can be further structured using special machines equipped with structuring fork or crown needles. The surface can be structured as a velour or rib, or with geometrical or linear patterns. Needle-punching is an ecologically friendly technology, as it permits the use of recycled material including that from polyethylene terephthalate bottles and regenerated fibers from apparel, as well as natural fibers. It may be possible to use other technologies to form non-woven fabrics to obtain the mechanically bounded layer of fibers 20.

[0060] The mechanically bounded layer of fibers 20 may consist of up to eight different types of fibers. Each of the fibers can have a different color, if desired. The types of fibers can include moisture absorbent fibers, such as coco, cotton, jute, wool, rayon or other natural or synthetic fibers. The types of fibers can further include synthetic fibers, such as polypropylene (PP), polyethylene (PE), polyamides (PA), and polyester (PES) or a combination thereof. The fibers can be treated, for example, with anti-algae, with herbicide, UV-stabilizer, or to be anti-static. The fibers can be melt fibers. The fibers can among others further include mineral based fibers, animal based fibers, or plant based fibers.

[0061] If the mechanically bounded layer of fibers 20 is formed as a single layer, as shown in **Fig. 1,** a mixture of relatively thin walled fibers that are flexible and form a relatively dense structure and, thus, having a relatively low coarseness value and relatively thick walled fibers that are stiff and form a relatively sparse structure and, thus, having a relatively low coarseness value is used in combination. In an exemplary embodiment of the invention, the density of the mechanically bounded layer of fibers 20 can gradually decrease from the bottom to the top of the layer 20. Accordingly, the coarseness of the fibers will gradually increase from the bottom to the top of the layer 20. By designing the mechanically bounded layer of fibers 20 that way, structural support for the tufts 40 and protection for bending points 42 of the tufts 40 is provided as well as shock-absorbance to contribute to a more natural feeling of the artificial turf 10.

[0062] If, according to preferred embodiments of the present invention, the mechanically bounded layer of fibers 20 is formed as a single layer, as shown in **Fig. 2,** the structural layer 21 is formed by relatively thin walled fibers that are flexible and form a relatively dense structure. Accordingly, fibers with the relatively low linear mass density (dtex value) are selected for the structural layer 21. The structural layer 21 is utilized for anchoring the tufts 40. The structural layer 21 provides dimensional stability for the artificial turf 10 and protection for the bending points 42 of the tufts 40. The fibers of the structural layer 21 have preferably a linear mass density in the range of about 3,3 dtex to about 110 dtex, and more preferably of about 11 dtex.

[0063] The volume simulating layer 22 is formed by fibers having a larger linear mass density than the fibers of the structural layer 21. The fibers of the volume simulating layer 22 have preferably a linear mass density in the range of about 11 dtex to about 600 dtex, and more preferably of about 110 dtex. Consequently, the volume simulating layer 22 has also a higher fiber coarseness (weight per fiber length) than the structural layer 21. A high coarseness value indicates a thick fiber wall, giving stiff fibers unable to collapse. Therefore, the volume simulating layer 22 of the mechanically bounded layer of fibers 20 is thicker and coarser than the structural layer 21. Fibers with a higher dtex value are selected for the volume simulating layer 22 so that the mechanically bounded layer of fibers 20 can act as a shock-absorbing layer and contribute to a natural feeling of the artificial turf 10.

[0064] In addition, the fibers of the mechanically bounded layer of fibers 20 can be given a velour effect by needling to mimic the root zone volume effect of natural grass. Due to a mechanical needling process, fiber is pushed out of the upper surface of the layer 20. Velour needle-punched non-woven material can be produced by placing an non-woven material on a brush-like stitch base and needling of the non-woven material on this stitch base. Since with this method the fibers seized by the needles are needled into the bristles or lamellas of the needle stitch base, the non-woven material needled in this way is given a velour-like appearance where the fiber stands out above the surface.

[0065] By velour needle-punching the mechanically bounded layer of fibers 20, fill yarn 23 is created. The fill yarn 23 is punched out of the non-woven fibrous matting of the mechanically bounded layer of fibers 20 creating a natural grass like root zone . The fill yarn 23 gives the upper surface of the mechanically bounded layer of fibers 20 (facing the pile yarn 41) a fluffy appearance and provide cushioning. The fill yarn 23 also assists the pile yarn 41 of the tufts 40 to stand. Thus, no infill, as often used with prior art artificial turf, is needed with the artificial turf 10 in accordance with preferred embodiments of the present invention.

[0066] Strands of pile yarn 41 form each tuft 40. A tuft 40 is a short cluster of elongates strands of pile yarn 41 attached at the base, the bending point 42. The tufts 40 are inserted through the mechanically bounded layer of fibers 20. Tufting usually is accomplished by inserting reciprocating needles threaded with pile yarn 41 into the mechanically bounded layer of fibers 20 to form tufts 40 of yarn. Loopers or hooks, typically working in timed relationship with the needles, are located such that the loopers are positioned just above the needle eye when the needles are at an extreme point in their stroke through the mechanically bounded layer of fibers 20. When the needles reach that point, pile yarn 41 is picked up from the needles by the loopers and held briefly. Loops or tufts 40 of yarn result from passage of the needles back through the mechanically bounded layer of fibers 20. This process typically is repeated as the loops move away from the loopers due to advancement of the backing through the needling apparatus. Subsequent, the loops can be cut to form a cut pile, for example, by using a looper and knife combination in the tufting process to cut the loops.

[0067] The pile yarn 41 can consist of up to four different types of yarns. Each yarn can have a different color, if desired. The pile yarn 41 can be monofilament, tape or a combination thereof. The pile yarn 41 has preferably a linear mass density of about 400 dtex to about 3000 dtex and, more preferably of about 1600 dtex. The number of strands of pile yarn 41 in a tuft 40 is between 2 and 10, and preferably 6. The tuft gauge (distance between rows) is between 1/2" and 1/16" and typical 3/8" or 3/16" or 1/8". The stitch rate of the tufting is between 8/10 cm and 30/10 cm and preferably 12/10 cm.

[0068] In accordance with preferred embodiments of the invention and as shown in Fig. 2, the mechanically bounded layer of fibers 20 may have a height H3 of about 3 mm to about 15 mm, and more preferably about 8 mm. The fill yarn 23 may extend from the upper surface of the mechanically bounded layer of fibers 20 for a height H2 of about 1 mm to about 20 mm, and more preferably of about 10 mm. The pile yarns 41 may extend from the fill yarn 23 for about 1 mm to about 20 mm, and more preferably 10 mm (height H1). The total height H4 of the artificial turf 10 may be about 10 mm to about 60 mm, and more preferably about 28 mm.

[0069] The backing 30 is applied to the mechanically bounded layer of fibers 20 as a last finishing step to enhance the anchoring of the tufts to the mechanically bounded layer of fibers 20. In accordance with preferred embodiments of the present invention the backing 30 can be a coated backing such as, for example, a polyethylene (PE) backing that is applied by means of powder or hot melt coating. The backing 30 can further be a calander backing or latex backing.

[0070] In the finishing operation, the backside or stitched surface of the mechanically bounded layer of fibers 20 is coated with an adhesive, such as a natural or synthetic rubber or resin latex or emulsion or a powder or hot melt adhesive, to enhance locking or anchoring of tufts 40 to the mechanically bounded layer of fibers 20. Use of such further improves dimensional stability of the tufted turf 10, resulting in more durable turf. Further stabilization can be provided in the finishing operation by laminating, for example, a thermoplastic film or a woven or nonwoven fabric made from polypropylene, polyethylene, or ethylene-propylene copolymers or natural fibers such as jute, to the tufted mechanically bounded layer of fibers 20.

[0071] The adhesive bonds the mechanically bounded layer of fibers 20 to the backing 30.

[0072] To provide an eco-friendly artificial turf 10 in accordance with preferred embodiments of the present invention the mechanically bounded layer of fibers 20, the tufts 40, and the backing 30 may all be made of materials that are recyclable, such as, for example, 100% polyolefin.

[0073] Other arrangements for accomplishing the objectives of embodiments of the present invention will be obvious for those skilled in the art. It is to be understood that although preferred embodiments, specific constructions and configurations, as well as materials, have been discussed herein for devices according to the present invention, various changes or modifications in form and detail may be made without departing from the scope of this invention.

Claims

1. An artificial turf (10) adapted for use in landscape and sports applications, comprising:

a mechanically bounded layer of fibers (20) made of one or more natural and/or synthetic fibers, and
pile yarn (41) inserted through the mechanically bounded layer of fibers (20), the pile yarn (41) being anchored to the mechanically bounded layer of fibers (20),
wherein the mechanically bounded layer of fibers (20) has a density that decreases from the bottom to the top of the mechanically bounded layer of fibers (20).

2. The artificial turf (10) according to claim 1, wherein fill yarn (23) extending from the upper surface of the mechanically bounded layer of fibers (20) is created through velour needle-punching, the fill yarn (23) giving the upper surface of the mechanically bounded layer of fibers (20) a velour-like appearance, thereby providing structural support for the pile yarn (41) by assisting the pile yarn (41) to stand, imitating the root zone of natural grass, and providing cushioning.

3. The artificial turf (10) according to claim 1, wherein the mechanically bounded layer of fibers (20) includes a lower layer (21) and an upper layer (22), the lower layer (21) being positioned at the bottom of the mechanically bounded layer of fibers (20) and the upper layer (22) being positioned on top of the lower layer (21), and the upper layer (22) having a higher fiber coarseness than the lower layer (21).

4. The artificial turf (10) according to claim 3, wherein the lower layer (21) is a structural layer that is utilized for anchoring the pile yarn (41) and that provides dimensional stability.

5. The artificial turf (10) according to claim 3, wherein the upper layer (22) is a volume simulating layer that acts as a shock-absorbing layer and contributes to a natural feeling of the artificial turf (10).

6. The artificial turf (10) according to any of claims 3 to 5, wherein the lower layer (21) is formed by fibers that are more flexible and form a denser structure than fibers forming the upper layer (22), the fibers of the lower layer (21) having a smaller linear mass density than the fibers forming the upper layer (22).

7. The artificial turf (10) according to claim 6, wherein the fibers of the lower layer (21) have a linear mass density in the range of about 3,3 dtex to about 110 dtex.

8. The artificial turf (10) according to claim 6, wherein the fibers of the upper layer (22) have a linear mass density in the range of about 11 dtex to about 600 dtex.

9. The artificial turf (10) according to any of claims 1 to 8, wherein the mechanically bounded layer of fibers (20) is manufactured as a single fabric or as two separate fabrics that are joined together.

10. The artificial turf (10) according to any of claims 1 to 9, wherein the mechanically bounded layer of fibers (20) is formed by needle-punching.

11. The artificial turf (10) according to any of claims 1 to

10, wherein the mechanically bounded layer of fibers (20) consists of up to eight different types of fibers.

12. The artificial turf (10) according to any of claims 1 to 11, wherein the mechanically bounded layer of fibers (20), the pile yarn (41), and a backing (30) enhancing the anchoring the pile yarn (41) to the mechanically bounded layer of fibers (20) are made of eco-friendly materials that are 100% recyclable by being mechanically deconstructable.

13. The artificial turf (10) according to any of claims 1 to 12, wherein the mechanically bounded layer of fibers (20), the pile yarn (41), and the backing (30) are made of 100% polyolefin.

14. A method for manufacturing artificial turf (10) for use in landscape and sports applications, comprising the steps of:

forming by needle-punching a mechanically bounded layer of fibers (20) having a density that decreases from the bottom to the top of the mechanically bounded layer of fibers (20);
creating fill yarn (23) extending from the upper surface of the mechanically bounded layer of fibers (20) through velour needle-punching, thereby giving the upper surface of the mechanically bounded layer of fibers (20) a velour-like appearance;
inserting pile yarn (41) through the mechanically bounded layer of fibers (20); and
anchoring the pile yarn (41) at the backside of the mechanically bounded layer of fibers (20).

15. A method for manufacturing artificial turf (10) for use in landscape and sports applications, comprising the steps of:

forming by needle-punching a lower layer (21) from a plurality of natural and/or synthetic fibers;
forming by needle-punching an upper layer (22) from a plurality of natural and/or synthetic fibers that have a higher linear mass density than the fibers of the lower layer (21), the upper layer (22) having a less dense structure than the lower layer (21);
placing the upper layer (22) on top of the lower layer (21) to form a mechanically bounded layer of fibers (20);
creating fill yarn (23) extending from the upper surface of the upper layer (22) through velour needle-punching thereby giving the upper surface of the upper layer (22) a velour-like appearance;
inserting pile yarn (41) through the mechanically bounded layer of fibers (20); and
anchoring the pile yarn (41) at the backside of the mechanically bounded layer of fibers (20).

Patentansprüche

1. Kunstrasen (10), geeignet zur Verwendung in Landschaftsgärtnerei und Sportanwendungen, umfassend:

eine mechanisch gebundene Faserschicht (20) aus einer oder mehreren Natur- und/oder Synthetikfaser(n) und
Polgarn (41), das durch die mechanisch gebundene Faserschicht (20) eingesetzt ist, wobei das Polgarn (41) an der mechanisch gebundenen Faserschicht (20) verankert ist,
wobei die mechanisch gebundene Faserschicht (20) eine Dichte aufweist, die vom Boden zur Oberseite der mechanisch gebundenen Faserschicht (20) hin abnimmt.

2. Kunstrasen (10) nach Anspruch 1, wobei Füllgarn (23), das sich an der oberen Oberfläche der mechanisch gebundenen Faserschicht (20) erstreckt, durch Velours-Vernadeln gebildet wird, wobei das Füllgarn (23) der oberen Oberfläche der mechanisch gebundenen Faserschicht (20) ein veloursartiges Aussehen verleiht, wodurch eine strukturelle Halterung für das Polgarn (41) bereitgestellt wird, indem ein Stehen des Polgarns (41) unterstützt wird, wodurch der Wurzelbereich von natürlichem Gras imitiert und eine Dämpfung bereitgestellt wird.

3. Kunstrasen (10) nach Anspruch 1, wobei die mechanisch gebundene Faserschicht (20) eine untere Schicht (21) und eine obere Schicht (22) enthält, wobei die untere Schicht (21) am Boden der mechanisch gebundenen Faserschicht (20) positioniert ist und die obere Schicht (22) auf der unteren Schicht (21) positioniert ist und die obere Schicht (22) eine höhere Fasergrobheit als die untere Schicht (21) aufweist.

4. Kunstrasen (10) nach Anspruch 3, wobei die untere Schicht (21) eine Strukturschicht ist, die zum Verankern des Polgarns (41) verwendet wird und dimensionale Stabilität bereitstellt.

5. Kunstrasen (10) nach Anspruch 3, wobei die obere Schicht (22) eine Volumen simulierende Schicht ist, die als stoßdämpfende Schicht dient und zu einer natürlichen Wirkung des Kunstrasens (10) beiträgt.

6. Kunstrasen (10) nach einem der Ansprüche 3 bis 5, wobei die untere Schicht (21) durch Fasern gebildet ist, die flexibler sind und eine dichtere Struktur als Fasern bilden, die die obere Schicht (22) bilden, wobei die Fasern der unteren Schicht (21) eine geringere lineare Massendichte als die Fasern haben, die die obere Schicht (22) bilden.

7. Kunstrasen (10) nach Anspruch 6, wobei die Fasern der unteren Schicht (21) eine lineare Massendichte im Bereich von etwa 3,3 dtex bis etwa 110 dtex haben.

8. Kunstrasen (10) nach Anspruch 6, wobei die Fasern der oberen Schicht (22) eine lineare Massendichte im Bereich von etwa 11 dtex bis etwa 600 dtex haben.

9. Kunstrasen (10) nach einem der Ansprüche 1 bis 8, wobei die mechanisch gebundene Faserschicht (20) als einzelner Stoff oder als zwei separate Stoffe, die miteinander verbunden sind, gebildet ist.

10. Kunstrasen (10) nach einem der Ansprüche 1 bis 9, wobei die mechanisch gebundene Faserschicht (20) durch Vernadeln gebildet wird.

11. Kunstrasen (10) nach einem der Ansprüche 1 bis 11, wobei die mechanisch gebundene Faserschicht (20) aus bis zu acht verschiedenen Arten von Fasern besteht.

12. Kunstrasen (10) nach einem der Ansprüche 1 bis 11, wobei die mechanisch gebundene Faserschicht (20), das Polgarn (41) und eine Unterlage (30), die die Verankerung des Polgarns (41) an der mechanisch gebundenen Faserschicht (20) verstärkt, aus umweltfreundlichen Materialien hergestellt sind, die 100% wiederverwertbar sind, da sie mechanisch dekonstruierbar sind.

13. Kunstrasen (10) nach einem der Ansprüche 1 bis 12, wobei die mechanisch gebundene Faserschicht (20), das Polgarn (41) und die Unterlage (30) aus 100% Polyolefin bestehen.

14. Verfahren zur Herstellung eines Kunstrasens (10), geeignet zur Verwendung in Landschaftsgärtnerei und Sportanwendungen, umfassend die folgenden Schritte:

Bilden einer mechanisch gebundenen Faserschicht (20) mit einer Dichte, die vom Boden zur Oberseite der mechanisch gebundenen Faserschicht (20) hin abnimmt, durch Vernadeln;
Erzeugen eines Füllgarns (23), das sich an der oberen Oberfläche der mechanisch gebundenen Faserschicht (20) erstreckt, durch Velours-Vernadeln, wodurch der oberen Oberfläche der mechanisch gebundenen Faserschicht (20) ein veloursartiges Aussehen verliehen wird;
Einsetzen von Polgarn (41) durch die mechanisch gebundene Faserschicht (20); und
Verankern des Polgarns (41) an der Rückseite der mechanisch gebundenen Faserschicht (20).

15. Verfahren zur Herstellung eines Kunstrasens (10), geeignet zur Verwendung in Landschaftsgärtnerei und Sportanwendungen, umfassend die folgenden Schritte:

Bilden einer unteren Schicht (21) aus mehreren Natur- und/oder Synthetikfasern durch Vernadeln;
Bilden einer oberen Schicht (22) aus mehreren Natur- und/oder Synthetikfasern durch Vernadeln, die eine höhere lineare Massendichte als die Fasern der unteren Schicht (21) haben, wobei die obere Schicht (22) eine weniger dichte Struktur als die untere Schicht (21) hat;
Anordnen der oberen Schicht (22) auf der unteren Schicht (21) zum Bilden einer mechanisch gebundenen Faserschicht (20);
Erzeugen eines Füllgarns (23), das sich an der oberen Oberfläche der oberen Schicht (22) erstreckt, durch Verlours-Vernadeln, wodurch der oberen Oberfläche der oberen Schicht (22) ein veloursartiges Aussehen verliehen wird;
Einsetzen von Polgarn (41) durch die mechanisch gebundene Faserschicht (20); und
Verankern des Polgarns (41) an der Rückseite der mechanisch gebundenen Faserschicht (20).

Revendications

1. Gazon artificiel (10) conçu pour une utilisation dans des applications de paysage et sportives, comprenant :

une couche mécaniquement liée de fibres (20) faite d'une ou plusieurs fibres naturelles et/ou synthétiques, et
un fil de poil (41) inséré à travers la couche mécaniquement liée de fibres (20), le fil de poil (41) étant ancré à la couche mécaniquement liée de fibres (20),
dans lequel la couche mécaniquement liée de fibres (20) a une densité qui diminue du bas vers le haut de la couche mécaniquement liée de fibres (20).

2. Gazon artificiel (10) selon la revendication 1, dans lequel un fil de remplissage (23) s'étendant de la surface supérieure de la couche mécaniquement liée de fibres (20) est créé par aiguilletage feutre, le fil de remplissage (23) donnant à la surface supérieure de la couche mécaniquement liée de fibres (20) une apparence semblable à du feutre, fournissant de ce fait un support structurel pour le fil de poil (41) en aidant le fil de poil (41) à être debout, imitant la zone de racine de l'herbe naturelle et fournissant un amortissement.

3. Gazon artificiel (10) selon la revendication 1, dans lequel la couche mécaniquement liée de fibres (20) inclut une couche inférieure (21) et une couche supérieure (22), la couche inférieure (21) étant positionnée au fond de la couche mécaniquement liée de fibres (20) et la couche supérieure (22) étant positionnée sur le dessus de la couche inférieure (21), et la couche supérieure (22) ayant une rusticité de fibre plus élevée que la couche inférieure (21).

4. Gazon artificiel (10) selon la revendication 3, dans lequel la couche inférieure (21) est une couche structurelle qui est utilisée pour ancrer le fil de poil (41) et qui procure une stabilité dimensionnelle.

5. Gazon artificiel (10) selon la revendication 3, dans lequel la couche supérieure (22) est une couche simulant un volume qui agit comme une couche absorbant les chocs et qui contribue à un sentiment naturel du gazon artificiel (10).

6. Gazon artificiel (10) selon n'importe laquelle des revendications 3 à 5, dans lequel la couche inférieure (21) est formée par des fibres qui sont plus souples et qui forment une structure plus dense que les fibres formant la couche supérieure (22), les fibres de la couche inférieure (21) ayant une densité de masse linéaire plus petite que les fibres formant la couche supérieure (22).

7. Gazon artificiel (10) selon la revendication 6, dans lequel les fibres de la couche inférieure (22) ont une densité de masse linéaire dans la plage d'environ 3,3 dtex à environ 110 dtex.

8. Gazon artificiel (10) selon la revendication 6, dans lequel les fibres de la couche supérieure (22) ont une densité de masse linéaire dans la plage d'environ 11 dtex à environ 600 dtex.

9. Gazon artificiel (10) selon n'importe laquelle des revendications 1 à 8, dans lequel la couche mécaniquement liée de fibres (20) est fabriquée comme un tissu unique ou comme deux tissus distincts qui sont joints ensemble.

10. Gazon artificiel (10) selon n'importe laquelle des revendications 1 à 9, dans lequel la couche mécaniquement liée de fibres (20) est formée par aiguilletage.

11. Gazon artificiel (10) selon n'importe laquelle des revendications 1 à 10, dans lequel la couche mécaniquement liée de fibres (20) consiste en jusqu'à huit types différents de fibres.

12. Gazon artificiel (10) selon n'importe laquelle des revendications 1 à 11, dans lequel la couche mécaniquement liée de fibres (20), le fil de poil (41) et un support (30) améliorant l'ancrage du fil de poil (41) à la couche mécaniquement liée de fibres (20) sont faits de matières écologiques qui sont 100 % recyclables en pouvant être mécaniquement déconstruites.

13. Gazon artificiel (10) selon n'importe laquelle des revendications 1 à 12, dans lequel la couche mécaniquement liée de fibres (20), le fil de poil (41) et le support (30) sont faits de polyoléfine à 100 %.

14. Procédé pour fabriquer du gazon artificiel (10) pour une utilisation dans des applications de paysage et sportives, comprenant les étapes de :

formation par aiguilletage d'une couche mécaniquement liée de fibres (20) ayant une masse volumique qui diminue du bas vers le haut de la couche mécaniquement liée de fibres (20) ;
création d'un fil de remplissage (23) s'étendant de la surface supérieure de la couche mécaniquement liée de fibres (20) par aiguilletage feutre,, donnant de ce fait à la surface supérieure de la couche mécaniquement liée de fibres (20) une apparence semblable à du feutre ;
insertion de fil de poil (41) à travers la couche mécaniquement liée de fibres (20) ; et
ancrage du fil de poil (41) au côté arrière de la couche mécaniquement liée de fibres (20).

15. Procédé pour fabriquer du gazon artificiel (10) pour une utilisation dans des applications de paysage et sportives, comprenant les étapes de :

formation par aiguilletage d'une couche inférieure (21) à partir d'une pluralité de fibres naturelles et/ou synthétiques ;
formation par aiguilletage d'une couche supérieure (22) à partir d'une pluralité de fibres naturelles et/ou synthétiques qui ont une densité de masse linéaire plus élevée que les fibres de la couche inférieure (21), la couche supérieure (22) ayant une structure moins dense que la couche inférieure (21) ;
placement de la couche supérieure (22) sur le dessus de la couche inférieure (21) pour former une couche mécaniquement liée de fibres (20) ;
création de fil de remplissage (23) s'étendant de la surface supérieure de la couche supérieure (22) aiguilletage feutre donnant de ce fait à la surface supérieure de la couche supérieure (22) une apparence semblable à du feutre ;
insertion de fil de poil (41) à travers la couche mécaniquement liée de fibres (20) ; et
ancrage du fil de poil (41) au niveau du côté

arrière de la couche mécaniquement liée de fibres (20).

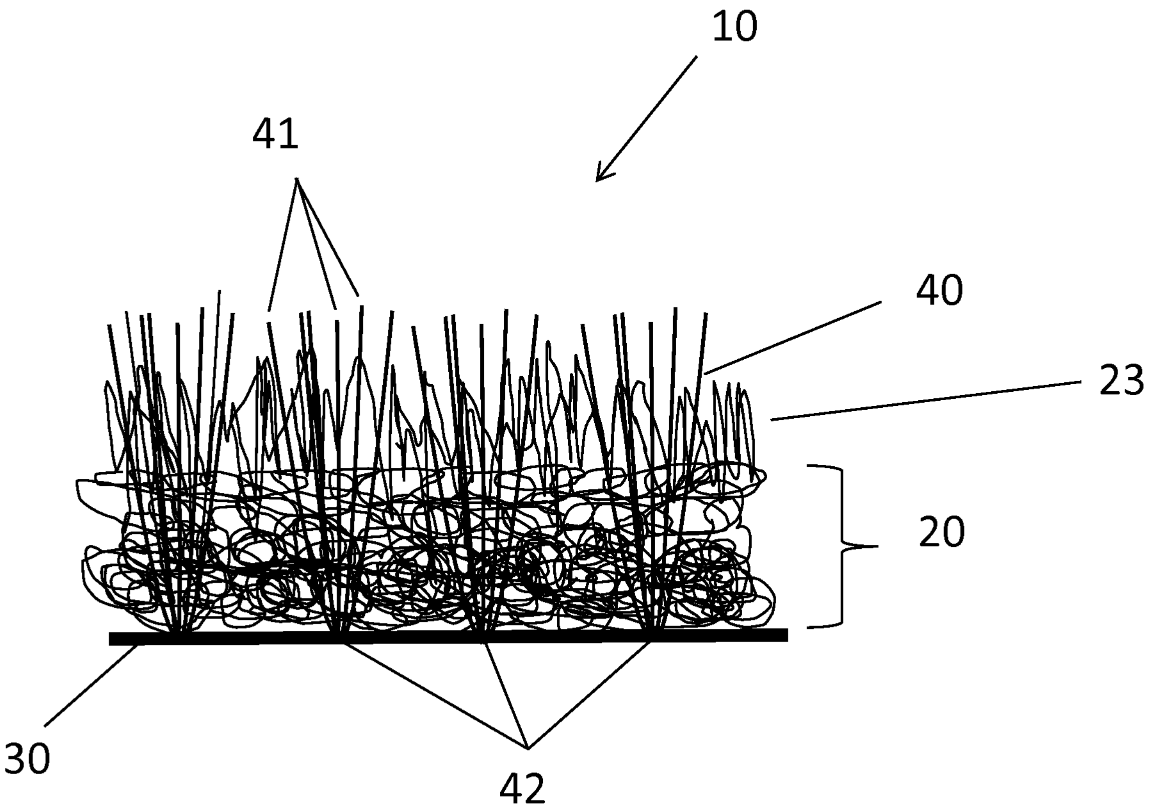

Fig. 1

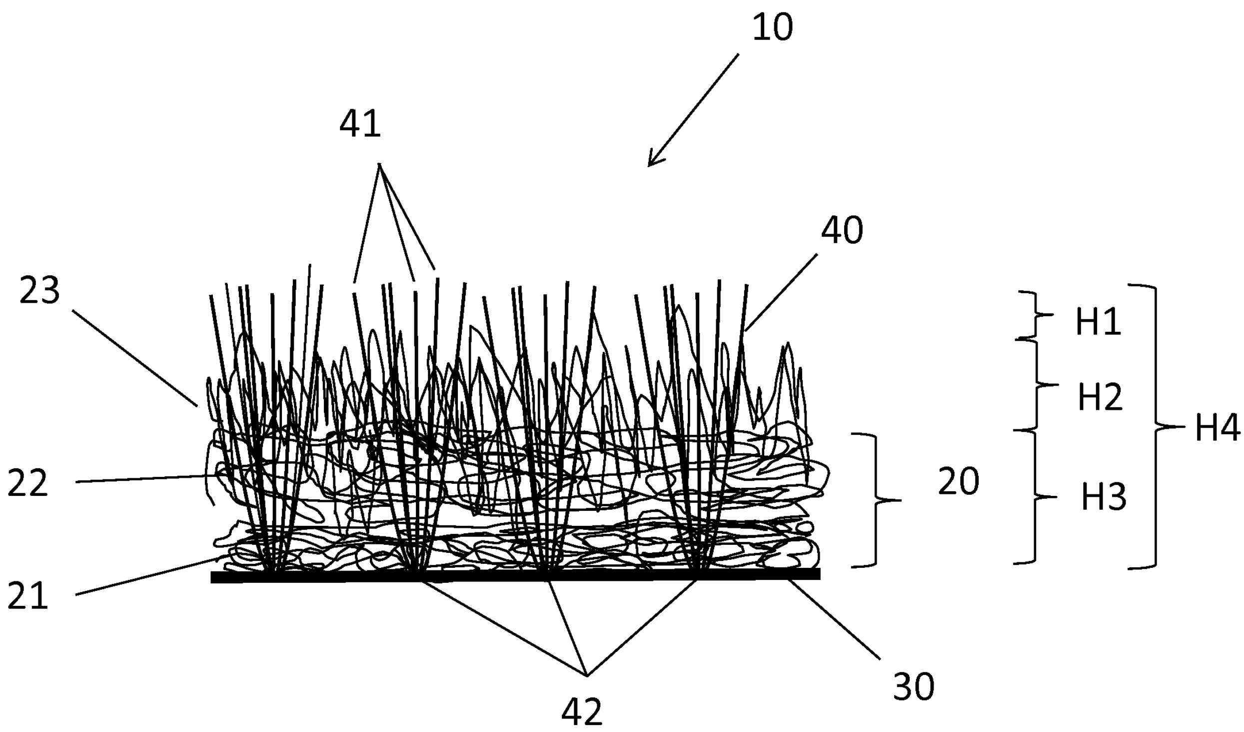

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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