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(54) **Artificial Turf**

(57) The present invention pertains to a tufted artificial turf comprising a flexible, water-permeable support fabric provided with tufts, wherein the tufts comprise parts of straight monofilament yarn and parts of curly monofilament yarn, characterized in that said tufts are manufactured from a compound yarn formed by twining together said straight monofilament yarn with the curly monofilament yarn.

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Description

[0001] The present invention pertains to an artificial turf and to the yarns required therefore.

[0002] The object of the present invention is to provide a new type of artificial turf comprising a combination of straight and curly monofilament yarns. The thus obtained artificial turf provides, on the one hand, the look of natural grass, and on the other hand, the known use of a well-known infill layer by filling for example sand and/or rubber particles for enhancing the elasticity of the surface of the artificial turf becomes superfluous.

[0003] Many patent applications describe yarns for the manufacture of synthetic turfs made of a variety of materials and combinations thereof. Often, combinations are presented of polyethylene, polypropylene, or block copolymers thereof. Further to the use of these materials, the use of polyamide 6 (nylon) is also known, for instance from the Japanese patent application JP-A-3.279.419.

[0004] Apart from the choice of material, many structural shapes of yarns are known, among others straight monofill, fibrillated or monofill curled yarns.

[0005] The present invention provides a specific combination of structural shape and material for the yarns as a result of which tufts are formed which do not need infill material. Therefore, especially the application and the maintenance of such synthetic turfs is simplified. Also, recycling possibilities are strongly increased as a result of which these synthetic turfs are more environment-friendly.

[0006] The present invention is related to yarns, tufted on a carrier material. It is generally known that several yarns twisted or twined together are tufted in a carrier material. In this way standing tufts are formed, wherein each individual tuft is composed of a multiple of filaments.

[0007] The invention relates mainly to a tufted artificial turf comprising a flexible, water-permeable support fabric, provided with tufts, wherein each tuft comprises partly of straight monofilament yarn and partly of curly monofilament yarn, characterised in that said tufts are manufactured from a compound yarn composed from said straight monofilament yarn twined together with the curly monofilament yarn.

[0008] According to the invention the support fabric comprises a flexible way water-permeable plastic material, preferably a laminate of a UV-stabilised tuft fabric from polypropylene, provided with a latex backing. The specific weight of this laminate amounts preferably between 800 and 1500 g/m^2, and more preferably between 1100 and 1400 g/m^2.

[0009] The artificial turf according to the invention comprises tufts, manufactured from a compound yarn, i.e. from straight monofilament yarn and curly monofilament yarn, wherein the straight and curly monofilament yarns are twined together such that the curly monofilament yarn is nested around the straight monofilament yarn, wherein the curly monofilament yarn provides partly stability and partly elasticity to the straight monofilament yarn. Because of this, an infill with for example sand or rubber particles is superfluous.

[0010] In a preferred embodiment of the artificial turf according to the invention, the curly and straight monofilament yarns of said composed yarn are extruded from polyamide, for example polyamide 6, polyamide 6.6 and polyamide 6.12, and more preferably polyamide 6.

[0011] In a further preferred embodiment, both the straight monofilament yarn and the curly monofilament yarn of said composed yarn each comprise preferably of 4 to 12 individual filaments, more preferably of 6 to 10 individual filaments, and most preferably of 8 individual filaments.

[0012] The thickness and width of the filaments are such that they resemble individual blades of grass; the width of the individual filaments preferably ranges between 0.5 and 2 millimetre, more preferably between 0.75 and 1.5 millimetre, and is most preferably equal to approximately 0.9 millimetre.

[0013] The thickness of the individual filaments is not only important to achieve the look of natural grass, but also to achieve the desired properties of elasticity. The individual filaments usually have a thickness between 50 μm and 200 μm, more preferably between 100 μm and 150 μm and most preferably, it amount to approximately 140 μm.

[0014] The yarn number of the individual filaments of the straight monofilament yarn usually ranges between 500 and 2000 dtex, more preferably between 750 and 1500 dtex, and is most preferably equal to approximately 1000 dtex. Whereas the yarn number of the individual filaments of the curly monofilament yarn usually ranges between 300 and 1500 dtex, more preferably between 500 and 1000 dtex, and most preferably is equal to approximately 750 dtex. The total dtex value per tuft preferably ranges between 12,000 and 16,000, and more preferably between approximately 13,000 and 15,000, and is most preferably equal to approximately 14,000 dtex.

[0015] In a further preferred embodiment of the invention, the individual filaments are manufactured in several shades, wherein the straight monofilament yarn preferably comprises 2 to 6 dark green and 2 to 6 olive green filaments, more preferably 3 to 5 dark green and 3 to 5 olive green, and most preferably 4 dark green and 4 olive green filaments. The curly monofilament yarn preferably comprises 1 to 3 beige and 3 to 9 light green filaments, more preferably 1.5 to 4.5 beige and 2.5 to 7.5 light green, and most preferably 2 beige and 6 light green filaments.

[0016] The curly monofilament yarn is generally manufactured from a straight monofilament yarn that is subjected to one or more heat treatments. This treatment may take place as from the extrusion of the yarn and/or during the processing step and/or on the finished carpet. Preferably, the final curling and crimping is obtained after a heat treatment during

the coating of the tuft fabric with a stabilizing agent, such as for example latex, as a result of which also the tufts become firmly attached in the tuft fabric. In its finished form the support fabric comprises a laminate of a tuft fabric with an additional layer of a stabilizing agent, preferably a latex, applied onto it.

[0017] According to present the invention, the manufacturing of curly monofilament yarn by means of a heat treatment can be performed in 3 different ways, i.e. by means of a heat treatment of the monofilament yarn directly after extrusion and before the tufting process, by means of a heat treatment during the application of the adhesion material (latex) on the tuft fabric, or by means of a combination of both aforementioned heat treatments. In a preferred embodiment the straight monofilament yarn is subjected to a first heat treatment which takes place before the tufting process such that an initial curling arises. Subsequently, the straight and partly curly monofilament yarn is tufted in line on a tuft fabric, after which a latex backing is applied to the back of aforementioned tuft fabric by means of a second heat treatment. The application of the latex backing and the associated heat treatment completes on the one hand the curling and ensures on the other hand an optimum fixing of the tufts in the tuft fabric. After aforementioned heat treatment(s), the curly monofilament has a shrinkage of at least 60 % and more preferably of at least 50 %. Therefore, the rest height of the curly yarn ranges between 1/5 to 3/5, preferably 1/3 to 3/5 and most preferably approximately 1/2 of the length of the straight monofilament yarn in the tuft. This height ratio on the support fabric ensures that a good elasticity and bonding strength to the artificial turf are obtained such that an infill becomes superfluous.

[0018] Both aforementioned monofilament yarns are subsequently twined together to form one yarn and this with a speed of approximately 30 turns per running meter wherein the curly monofilament yarn is nested around the straight monofilament yarn. The finally obtained composed yarn has a yarn number which usually ranges between 10,000 dtex and 20,000 dtex, preferably between 12,000 and 16,000, more preferably between 13,000 and 15,000 and is most preferably approximately 14,000 dtex.

[0019] Preferably, the filaments in a tuft all have the same length between 3 and 5 cm, more preferably between 3.5 cm and 4.5 cm and most preferably approximately between 3.7 and 3.9 cm. The curly filaments in their curly state have a length ranging between 40 and 60 % with respect to the initial length. In general, the shrinkage is obtained by a heat treatment.

[0020] The invention is further illustrated by means of the examples below which illustrate some preferred embodiments of the invention.

Example 1.

[0021] The compound yarn comprises 8 filaments curly monofilament yarn of polyamide 6 (nylon) with a compound dtex value of 6000 (8 filaments of each 750 dtex per filament) with a width of 0.9 mm, a thickness of 140 μm and a height of 38 mm in elongated form and a height of approximately 24 mm in curly form with 8 filaments straight monofilament (diamond structure) with a dtex value of 8000, a width of 0.9 mm and also a thickness of 140 μm. These yarns are twined together and subsequently this composed yarn is linearly tufted with approximately 140 stitches per running meter with a needle distance of 5/16", and a pile height of 38 mm such that a pile weight was obtained of approximately 2200 g/m^2. The support material comprises a polypropylene tuft fabric which is UV-stabilised with a specific weight of approximately 164 g/m^2 provided with a latex backing with 1000 g/m^2.

[0022] The obtained artificial turf have the following properties:

Colour stability	Scale 7 (DIN 54004)
UV-Stability	> 6,000 u (DIN 53387)
Water permeability	6.10^{-4} m/sec
Flame retardancy	Class 1 (DIN 51960)
Pile anchoring	> 30 N
Chlorine resistance	4 - 5 (DIN 54019)
Resistance to seawater	4 - 5 (DIN 54007)

Example 2

[0023] In a similar manner a number of other artificial turfs were tufted. Table I below gives the individual data for each type of filament.

Curly PA monofilament	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9
number	8	10	6	6	6	4	8	8
dtex (per fil)	740	600	1300	1100	1200	1500	800	750
length straight (mm)	40	42	38	39	45	40	38	46
length (curly)	25	20	18	17	21	16	15	19
width (mm)	0.6	0.8	1.4	0.9	1	0.95	0.85	0.6
thickness (μm)	150	85	100	140	130	175	100	140
Straight PA monofilament								
number	8	6	10	8	12	12	10	8
dtex (by fil)	1000	1200	600	1500	1100	1000	1300	1200
length	40	42	38	42	48	38	38	46
width (mm)	0.8	0.9	0.5	1	0.9	0.8	1	0.7
thickness (μm)	140	140	150	170	130	135	140	180

[0024] The thus obtained composed yarns are tufted on a tuft fabric and provided with a water permeable backing, for example made of latex.

Example 3

a) Taber abrasion test 4000cycli

[0025] Tests were conducted to determine an optimal yarn construction for use in grass turfs according to the invention.

[0026] A first test consisted of a determination of the resistance to abrasion of yarns. By means of the known Taber test resistance to abrasion of yarns is determined. The test method consists of placing a sample of yarn on a rotating disk whereby two roughened wheels are placed on top of the sample with a defined force. The loss of weight is determined, in this example after 4000 rotations and presented as promille loss of the original sample weight. Hereby the loss of weight is determined on a sample of 10 cm diameter. The yarns used in this are the following (TABLE II):

TABLE II

Yarn sample	Loss of weight
Straith monofilament yarn	
PA monofil straigth, 8 filaments X 500 dtex, thickness 50μm	61 promille
PA monofil straigth, 8 filaments X 1000 dtex, thickness 100μm	42 promille
PA monofil straigth, 8 filaments X 1000 dtex, thickness 150μm	22 promille
PA monofil straigth, 8 filaments X 1500 dtex, thickness 150 μm	16 promille
Curly monofilament yarns	
PA monofil curly, 8 filaments X 350 dtex, thickness 50μm	63 promille
PA monofil curly, 8 filaments X 500 dtex, thickness 50μm	60 promille
PA monofil curly, 8 filaments X 500 dtex, thickness 150μm	43 promille
PA monofil curly, 8 filaments X 750 dtex, thickness 50μm	58 promille
PA monofil curly, 8 filaments x 750 dtex, thickness 150μm	24 promille
PA monofil curly, 8 filaments X 1000 dtex, thickness 200μm	21 promille

b) Lisport test 5000 cycli (5 years in practice)

[0027] This test is conducted with a device that consists of two rolling mills of each 28kg that are each provided with 150 studs. These make 5000 tours back and forth over a grass turf. The last rolling mill turns at half of the speed of the first mill to cause friction. After 5000 cycli one obtains an idea of the wear pattern and the resilience of the yarns. Following samples were hereby tested (TABLE III).

TABLE III

Sample of artificial grass turf consisting of	Result	Remarks
PA straight monofilament yarn: 8 filaments X1000dtex, thickness 150μm + PA curly monofilament yarn: 8 filaments X 500 dtex, thickness 150μm; twined together	±	
PA straight monofilament yarn: 8 filaments X1000dtex, thickness 150μm + PA curly monofilament yarn: 8 filaments X 750 dtex, thickness 150μm; twined together	+	Yarn remains intact and stays nicely upright
PA straight monofilament yarn: 8 filaments X1000dtex, thickness 150μm + PA curly monofilament yarn: 8 filaments X 1000 dtex, thickness 150μm; twined together	±	
PA straight monofilament yarn: 8 filaments X1000dtex, thickness 150μm sepearatly tufted in A/B position with PA curly monofilament yarn: 8 filaments X 750 dtex, thickness 150μm	-	Carpet shows line pattern and is not usable

c) determination of resilience

[0028] In this example, the ball/grass turf interaction was determined that is obtained with grass turfs according to the invention. This test involves measuring of ball roll. FIFA applies amongst other things following criteria for ball roll of between 4m-8m. Table IV gives a number of results of ball roll in function of the pile height of yarns used in the grass turf.

Table IV

Pile height of Straight monofilament yarn	Free pile (height above the curly yarn)	Ball roll
25mm	10mm	12m
35mm	15mm	7m
40mm	20mm	5m
45mm	25mm	8m

[0029] A pile height (straight monofilament yarn) of 40mm with 20mm free pile gives amongst other things a good result.

d) determination of friction coefficient

[0030] In this test the friction coefficient of different samples of artificial grass turfs according to the invention were tested (Table V), with indication of used yarns, tuft gauge (= i.e. distance between 2 yarns) height of the tufts, friction coefficient and general condition of the artificial grass turf.

Table V

yarn	Tuft gauge	Pile height	Friction coefficient	artificial grass turf
4X1000dtex PA straight monofil + 4X750dtex PA curly monofil	3/16"	25mm	0,58	±
8X1000dtex PA straight monofil + 8X750dtex PA curly monofil	5/16"	38mm	0,26	+ (*)

(continued)

yarn	Tuft gauge	Pile height	Friction coefficient	artificial grass turf
8X1000dtex PA straight monofil + 8X750dtex PA curly monofil	5/8"	40mm	0,33	±
(*) less danger for burn injuries during sliding, provides a more natural aspect, yarns easier to cut on a tufting device				

Example 4

[0031] In a preferred embodiment the invention provides a tufted artificial turf having following specifications:

- The straight monofilament yarn is made of polyamide 6, and comprises 8 individual filaments, whereby the individual filaments each have a yarn number of 1000 dtex and a thickness of 150μm,
- The curly monofilament yarn is made of polyamide 6, comprises 8 individual filaments, whereby the individual filaments each have a yarn number of 750dtex and a thickness of 150μm,
- The straight monofilament yarn is twined together with the curly monofilament yarn,
- Pile height of the tufts = 38mm
- tuft gauge of 5/16"
- no infill layer.

[0032] It is obvious that above given examples are not limiting for the invention.

Claims

1. Tufted artificial turf comprising a flexible, water-permeable support fabric provided with tufts, wherein the tufts comprise parts of straight monofilament yarn and parts of curly monofilament yarn, **characterized in that** said tufts are manufactured from a compound yarn composed by twining together said straight monofilament yarn with the curly monofilament yarn.

2. Artificial turf according to claim 1, **characterized in that** said straight monofilament yarn and said curly monofilament yarn are manufactured from polyamide 6, polyamide 6.6 or polyamide 6.12, and preferably from polyamide 6.

3. Artificial turf according to claims 1 or 2, **characterized in that** the resting height of the curly yarn is between 1/5 to 3/5, preferably 1/3 to 2/3 of the length of the straight monofilament yarn in the tufts and still more preferably amounts to approximately 1/2 thereof.

4. Artificial turf according to any one of claims 1 to 3, **characterized in that** said straight and curly monofilament yarn each comprises 4 to 12 individual filaments, preferably 6 to 10 individual filaments, and more preferably 8 individual filaments.

5. Artificial turf according to any one of claims 1 to 4, **characterized in that** said individual filaments of the straight monofilament yarn each have a yarn number of between 500 and 2000 dtex, preferably of between 750 and 1500 dtex, and most preferably of 1000 dtex.

6. Artificial turf according to any one of claims 1 to 5, **characterized in that** said individual filaments of the curly monofilament yarn each have a yarn number of between 300 and 1500 dtex, preferably of between 500 and 1000 dtex, and most preferably of 750 dtex.

7. Artificial turf according to any one of claims 1 to 6, **characterized in that** said individual filaments have a width of between 0.5 and 2 millimetre, preferably of between 0.75 and 1.5 millimetre, and most preferably of 0.9 millimetre.

8. Artificial turf according to any one of claims 1 to 7, **characterized in that** said individual filaments have a thickness of between 50 μm and 200 μm, preferably of between 100 μm and 150 μm, and most preferably of 140 μm.

9. Artificial turf according to any one of claims 1 to 8, **characterized in that** said composed yarn has a yarn number

of between 10,000 and 20,000 dtex, preferably of between 12,000 and 16,000 dtex, more preferably of between 13,000 and 15,000 dtex, and most preferably of 14,000 dtex.

10. Artificial turf according to any one of claims 1 to 9, **characterized in that** said tufts are arranged in rows which are located on mutual distances of between 4/16" and 6/16".

11. Artificial turf according to any one of claims 1 to 10, **characterized in that** said tufts have an average height of between 30 to 50 mm, preferably of between 35 to 40 mm and most preferably of 38 mm.

12. Artificial turf according to any one of claims 1 to 11, **characterized in that** it lacks an infill layer.

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EUROPEAN SEARCH REPORT

Application Number
EP 08 15 1177

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 940 522 A (WESSELLS JOHN HUMPHREY) 24 February 1976 (1976-02-24) * column 1, line 14 - line 18; claims 1,2,12,13; figures; examples 1,2,7; table I * * column 2, line 47 - line 49 * * column 6, line 33 - line 36 * * column 8, line 19 - line 29 *	1-12	INV. E01C13/08 D05C17/02 D06N7/00 D02G3/44
X	US 2003/099787 A1 (FINK WILBERT E [US]) 29 May 2003 (2003-05-29) * page 2, paragraph 23; claims 1,3,6,9; figures 3-6 * * page 3, right-hand column, line 1 - line 13 *	1-12	
A	FR 2 719 619 A (LEVASSEUR SOMMER [FR]) 10 November 1995 (1995-11-10) * column 5, line 23 - line 26; claims 1-4; figures * * page 6, line 16 - line 18 *	1-12	TECHNICAL FIELDS SEARCHED (IPC)
A	BE 1 014 936 A6 (DOMO CABRITA NV [BE]) 1 June 2004 (2004-06-01) * claims 1,4-9,13,14; figures *	1-12	D06N E01C D05C D02G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 May 2008	Pamies Olle, Silvia

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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09-05-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3940522 A	24-02-1976	NONE	
US 2003099787 A1	29-05-2003	NONE	
FR 2719619 A	10-11-1995	NONE	
BE 1014936 A6	01-06-2004	BR PI0408071 A	14-02-2006
		CA 2517506 A1	16-09-2004
		CN 1723320 A	18-01-2006
		EP 1457600 A1	15-09-2004
		WO 2004077914 A2	16-09-2004
		IS 8043 A	23-09-2005
		KR 20050105253 A	03-11-2005
		MA 27819 A1	03-04-2006
		MX PA05009311 A	22-05-2006
		NL 1025399 C1	16-04-2004
		US 2006093783 A1	04-05-2006
		ZA 200507081 A	28-06-2006

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3279419 A **[0003]**