

(19)



(11)

EP 4 826 159 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.10.2026 Bulletin 2026/43

(51) International Patent Classification (IPC):
E01C 13/08^(2006.01)

(21) Application number: **25170670.1**

(52) Cooperative Patent Classification (CPC):
E01C 13/08

(22) Date of filing: **15.04.2025**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
GE KH LA MA MD TN

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(54) **MATERIAL AS INFILL MATERIAL FOR AN ARTIFICIAL TURF**

(57) The present application pertains to a material as infill material for an artificial turf comprising Coconut fibers, Particles of cork, particles of ground almond

shells. Furthermore, it pertains to an artificial turf provided with an infill material according to the present application.

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Description

[0001] The present application pertains to a material which is suitable as infill material for an artificial turf.

[0002] Artificial turf has become more and more important during recent years, especially for the coverage of sporting courts, such as football courts, soccer courts, tennis courts or courts for other kinds of sports which are traditionally carried out on grass. The advantage of artificial turf is a higher resistance to environmental influences, such as dryness during summer or cold conditions during winter. For this reason, artificial turf is an option especially in polar regions with short vegetation periods where damages in the grass cannot be compensated by natural growth in due time, but also in very dry regions where artificial turf may help to save water resources and is e.g. not destroyed by locust swarms. But also, in regions with less extreme climate, artificial turf becomes more and more popular as it provides homogeneous and reproducible mechanical properties and requires less care than natural grass as it is e.g. not necessary to cut and fertilize artificial turf.

[0003] Apart from coverings for sports courts, artificial turf has also become very popular as ground covering e.g. in private gardens instead of natural grass for the same reasons.

[0004] Artificial turf typically comprises a sheet-like fabric forming the so-called primary backing with pile yarns tufted therein with the pile yarns simulating stems of natural grass. Furthermore, the artificial turf may comprise further layers of sheet-like material and/or fillings which may influence the areal weight and thus the stability against wrinkles but also the damping effect of the artificial turf.

[0005] The pile yarns (also called "tufting yarns") tufted into the primary backing are so-called "artificial turf yarns" which are typically monofilaments, or fibrillated tape, which are also called "artificial turf monofilaments" or "artificial grass tape yarn". To provide the same mechanical properties as a natural turf field, artificial turf fields are often provided with so-called infill material. Infill material is typically a particulate material, which is deposited between the tufting yarns of the artificial turf field. The infill material provides a certain amount of softness by its movable character, by providing better player-field interaction or stability, which aims to avoid injuries, and it contributes to keeping the tufting yarns, which have the same character and function as the stems of natural grass, in an upright position. Depending on the purpose of the artificial turf, be it for decorative purposes or for the use with a certain kind of sports, different infill materials may be used to provide different characteristics. Typical materials for artificial turf infill are sand, ground brick, shredded tires or particles of different kinds of polymers, such as rubber or other elastomers. Also, different kinds of composite particles comprising nuclei and coatings of different materials are used.

[0006] The more complex the particles are, the better their properties can be tailor-made for a certain purpose. Particles of rubber or other elastomers are e.g. typically quite soft and do not provide much abrasion to the artificial turf yarns between which they are deposited and to the skin of players falling on an artificial turf field provided with such infill.

[0007] In general, a small percentage of the infill material is discharged from the artificial turf field during use, e.g. by particles being clamped in the sole profile of player's shoes and carried off the artificial turf field. Thus, the infill load of an artificial turf field must be partly refilled from time to time. The interval for the refill depends on both the characteristics of the artificial turf and the characteristics of the infill material.

[0008] A common disadvantage of all materials named so far is their low biodegradability and - apart from sand or brick - their bad effect on the environment. Polymer particles may adsorb poisonous substances or be eaten by animals as they are confused with food. As polymer infill particles are discharged from artificial turfs upon use as mentioned above, they contribute to an increase in the amount of plastics in the environment.

[0009] For this reason, the use of polymeric infills will be banned by the EU as of 2031. Thus, effort has been put into developing infill materials which are of biological origin and/or biodegradable. Materials that have been identified as possible infill materials are cork granules, coconut fibers or different kinds of cereal husks. Also ground walnut shells and olive pits have been used as infill materials.

[0010] A disadvantage of such materials compared to non-biodegradable infill materials is their low specific weight which leads to problematic behavior in case of flooding and freezing in cold climates. Many materials of biological origin have a low specific weight and thus tend to float if water stands too high on an artificial turf field provided with such infill material. In such cases the infill material can be washed away with the draining water leading to loss of the expensive infill material. This is especially the case for cork which is very light and floats extremely well. Another disadvantage of cork is its limited availability as it is needed for multiple purposes.

[0011] Walnut shells as infill material have the further disadvantage of being allergenic which necessitates that they must be either heat-treated or rinsed thoroughly to either destroy or remove the allergens. Furthermore, walnut shells and pieces thereof have a strongly abrasive effect on the artificial turf yarns and thus contribute to high wear to the turf.

[0012] It is thus the object of the present invention to provide a material as artificial turf infill that is less abrasive, less allergenic and has a higher specific weight than materials of the prior art.

[0013] It has now surprisingly been found that these problems are solved by a material as infill material for

an artificial turf comprising coconut fibers, particles of cork and particles of ground almond shells.

[0014] A typical characteristic of the material according to the present application is that it may be poured, spread, scattered or strewed and thus be disposed between the artificial turf yarns. To fulfill this requirement, the material may be in a particulate form. "Particulate" according to the present invention means that the material comprises discrete particles (or granules which is a synonym for "particles") which are not or just loosely connected to each other.

[0015] Throughout the present application, the expression "cork" means a material that is obtained from the bark of trees, namely of the bark of botanical species *Quercus suber* or of the bark of *Phellodendron amurense* or other species of the *Phellodendron* genus.

[0016] Cork is a porous material with a low specific weight and a reasonable amount of elasticity. With these properties, cork particles can provide the artificial turf infill with resilient properties and thus allow to comfortably carry out sports games thereon. Furthermore, the elasticity and porosity of the cork prevents cork particles from developing sharp edges upon breaking and thus reduce the abrasive effect to both the artificial turf yarns as well as to the skin of players falling on a field that has been filled with cork granules. Furthermore, due to their porous character, cork particles have a high capacity for water.

[0017] Throughout the present application, the expression "coconut fibers" means the fibers obtained from the fruit of different palm species, namely from the mesocarp of the fruit of the palm *Cocos nucifera*. A common synonym for coconut fibers is "coir".

[0018] The natural functionality of the coconut fibers is to provide the fruit of *Cocos nucifera* with a floatable shell that allows the fruit to migrate through the Ocean and to be washed ashore. This requires that the fibers, despite being biodegradable, show slow biodegradation in moist conditions. Thus, also under the influence of moisture, coconut fibers are a long-lasting natural product.

[0019] Having fibrous character in contrast to the other components of the infill material, the coconut fibers can intermingle with each other or, when they are part of the artificial turf infill, with other components of the infill material and/or with the artificial turf yarns. Under the pressure of feet trampling the artificial turf, they can get into mechanical connection with each other and/or with other components of the material and form a network structure which is not a regular but a random network structure. This random network structure has two advantages. First, it slows down the process of discharge of the coconut fibers from the artificial turf and, second, this network can also keep the particulate components of the artificial turf infill within the artificial turf. Thus, the coconut fibers can keep the infill material together. Furthermore, they may be able

to bind it to the artificial turf as the fibers may also intermingle with the artificial turf yarns.

[0020] Throughout the present application, the expression "almond shells" means the endocarp of the fruits of plants of botanical genus *Prunus*, in an embodiment of botanical species *Prunus amygdalis* (almond), *Prunus persica* (peach) or *Prunus armenicana* (abricot).

[0021] Throughout the present application, the expression "ground" means that a good has been processed into particles mechanically by e.g. cutting, breaking, tearing, grinding, milling, beating, crushing or any other method known to the person skilled in the art.

[0022] Almond shells according to the present application are a common waste product obtained in the production of any kind of products, namely food products, that contain almonds such as e.g. marzipan or the cheaper surrogate product persipan which is made of apricot or peach seeds. In all these products, only the seed of the almond, the peach or the apricot is used while the shell which surrounds the seed is a waste product. Thus, almond shells are widely available and are cheap material.

[0023] In contrast to other infill materials such as walnut shells, almond shells do not comprise allergens which would have to be removed or destroyed prior to use as an artificial turf infill. In addition, almond shell particles are mechanically more durable than walnut shells. Furthermore, although fully biodegradable, biodegradation of almond shells is slower compared to e.g. walnut shells. Furthermore, if almond shells are ground, the edges or the particles obtained are less sharp thus having less abrasive effect to both the artificial turf yarns and the skin of players who fall on artificial turf fields that comprise particles of ground almond shells as an infill material. A further advantage of almond shells compared to e.g. walnut shells is their higher specific weight and their higher durability. Thus, particles of ground almond shells can serve as kind of a high-weight filler for the infill material.

[0024] As has been found by the inventors, the specific properties of the three components combine in a synergistic manner to form an artificial turf infill which has unexpected advantageous properties. The different components surprisingly do not show any tendency to separate forming different layers. On the contrary, they remain in a mixture where they combine their positive properties. The cork particles contribute to the material's resilience and water holding capacity. The coconut fibers form a framework which keeps the infill material within the artificial turf and the ground almond shells to the material's weight to keep it in place by its own gravity.

[0025] The length of the coconut fibers is not particularly limited. However, in an embodiment, the coconut fibers have a length of at least 0.5 mm, 1 mm, 2 mm, 3 mm, 5 mm or 10 mm and a length of at most 30 mm, 20 mm, 10 mm, 5 mm or 3 mm.

[0026] The length of the coconut fibers is determined by microscopical inspection of a sample comprising at least 200 coconut fibers which are elongated without tension and measured. If a value according to the application has the attribute "at least", this means that the sample does not comprise more than 5% of fibers which have a length below that value. If a value according to the present application has the attribute "at most", this means that not more than 5% of the fibers of the same sample have a length higher than that value. As a consequence, in a sample of 200 fibers, not more than 10 fibers may be shorter than the value attributed "at least" and not more than 10 fibers may be longer than the value attributed "at most".

[0027] If the coconut fibers are longer than 30 mm, it becomes difficult to deposit them between the artificial turf yarns. However, if the coconut fibers are shorter than 0.5 mm, they fail to form a random network that can entangle the material and protect it from being discharged from the artificial turf.

[0028] Throughout the present application, the term "particle size distribution" means that the size distribution of the material is determined according to FIFA Test Method 2024-18. According to this norm, a stack of sieves with decreasing mesh size is used through which a sample of the material is passed. The lower value of the size distribution is then, starting from the smallest sieve, the largest mesh size through which 10 wt.-% or less of the sample is passing. The higher value of the size distribution is, starting from the largest, the smallest mesh size through which 10 wt.-% or less of the sample is retained. For being a particle size distribution in accordance with the present application, at least 60 wt.-% of the sample must be within the range between the lower and the higher value. The sieves have mesh sizes of 0.00 mm, 200 μ m, 315 μ m, 0.5 mm, 0.63 mm, 0.80 mm, 1.00 mm, 1.25 mm, 1.60 mm, 2.00 mm, 2.50 mm, 3.15 mm, and 4.00 mm. Throughout this application, these mesh sizes are also called "sieve steps".

[0029] The term "a particle size distribution smaller than x" means that the lower boundary of the particle size distribution as discussed above is at least one sieve step smaller than x. The term "a particle size distribution larger than x" means that the upper boundary of the particle size distribution is at least one sieve step higher than x. The term "a particle size distribution of at least x" means that the value of x is the lower value of the size distribution as explained above. The term "a particle size distribution of at most x" means that the value of x is the higher value of the size distribution as explained above.

[0030] It is understood that any lower boundary values and upper boundary values mentioned in the present application may be combined with each other to give a particle size distribution according to the present application. It is further understood that any particle size distribution according to the present application

must fulfill the criterion that at least 60 wt.-% of the sample must be within the range between the lower and the higher value

[0031] The size of the particles of cork is not particularly limited. However, in an embodiment, the particles of cork have a particle size distribution of at least 0.5 mm, 0.63 mm, 0.8 mm, 1 mm, 1.25 mm or 1.6 mm and at most 1.25 mm, 1.6 mm, 2 mm or 2.5 mm or 3.15 mm measured according to FIFA Test Method 2024-18.

[0032] If the particles of cork have a particle size distribution smaller than 0.5 mm, they may not develop the resilient effect that cork particles have for both their elasticity and porous character. If the particles of cork have a particle size distribution larger than 2.5 mm, they may not efficiently be entangled in the framework formed by the coconut fibres.

[0033] The size of the particles of ground almond shells is not particularly limited. However, in an embodiment, the particles of ground almond shells have a particle size distribution of at least 0.5 mm, 0.63 mm, 0.8 mm, 1 mm, 1.25 mm or 1.6 mm and at most 1.25 mm, 1.6 mm, 2 mm or 2.5 mm or 3.15 mm measured according to FIFA Test Method 2024-18.

[0034] If the particles of ground almond shells have a particle size distribution smaller than 0.5 mm, this may have two disadvantageous effects: First, the biodegradation rate of the particles is increased by their increased surface area and second, the small particles may not fulfil the function as a heavy filler in the infill material according to the present application as for their small diameter, they cannot efficiently be entangled by the framework formed by the coconut fibers, would fall through that network and form a separate layer where they would no longer be able to contribute to the properties of the infill layer. On the other hand, if the particles of ground almond shells are too large, entanglement in the fiber network would also not work.

[0035] In an embodiment, the particle size distribution of the particles of cork is smaller than the particle size distribution of the particles of ground almond shells. According to the present application, a "smaller particle size distribution" compared to another particle size distribution means that at least either the lower value of the particle size distribution of the particles of cork or the higher value of the particle size distribution of the particles of cork is at least one sieve step lower than the corresponding value for the particles of ground almond shells.

[0036] E.g. in case the particle size distribution of the cork particles is at least 0.8 mm and at most 2.5 mm, then the particle size distribution of the particles of ground almond shells may be at least 1 mm and at most 2.5 mm or at least 0.8 mm and at most 3.15 mm. If the particles of ground almond shells have a larger size distribution than the particles of cork, they show less tendency to separate from the other components of the material.

[0037] In an embodiment, in the material according to

the present application the amount of coconut fibres is at least 1, 5, 10 or 20 wt.-% and at most 30, 40, 50 or 70 wt.-%.

[0038] The coconut fibres can intermingle with each other and form a random network which is able to also entangle the cork particles and the particles of ground almond shells of the material.

[0039] In an embodiment, in the material according to the present application, the amount of particles of cork is at least 1, 5, 10 or 15 wt.-% and at most 25, 40, 50 or 70 wt.-%.

[0040] Due to the presence of cork, the material according to the present application can provide improved resilience properties.

[0041] In an embodiment, in the material according to the present application, the amount of particles of ground almond shells is at least 1, 20, 30 or 40 wt.-% and at most 60, 70, 75 or 80 wt.-%.

[0042] As almond shells are the only waste material contributing to the material according to the present application, it is also the cheapest component. Thus, a high content of particles of ground almond shells may contribute to a lower price of the material. Furthermore, it increases the specific weight of the material and thus allows for longer retention of the material within the artificial turf, especially as it prevents the material from floating and being washed out in heavier rains or in case of flooding. In an embodiment, the particles of ground almond shells have been tumble-finished or vibratory finished. In these finishing processes, the particles are filled into a rotatable drum or into a movable container and are then moved in the closed drum or the closed container, respectively, in such a manner that the particles get into mechanical interaction with each other. The particles collide and get in frictional contact with the consequence that sharp edges are rounded. To accelerate such a process, an abrasive agent such as sand may be added to the particles which can be removed by sieving after processing. Furthermore, particles that have turned too small under tumble-finishing or vibrational finishing may be removed, e.g. by sieving.

[0043] The advantage of these finishing processes is that the edges of the particles of ground almond are rounded which lowers their abrasive properties leading less damage to the artificial turf yarns as well as to less injuries by players falling on an artificial turf field being provided with the material as an infill.

[0044] In an embodiment, the material is biodegradable according to DIN EN 13432. This means that it can be turned into soil under conditions of industrial composting.

[0045] In an embodiment, the material according to the present application is biodegradable according to AS 5810 and/or NF T 51-800. This means that it can be turned into soil under conditions of home garden composting.

[0046] In an embodiment, the material according to the present application is a mixture. Thus, the particles

of cork, the particles of ground almond shells and the coconut fibres are present as a homogeneous mixture. This can be achieved by any kind of mixing technology known to the person skilled in the art such as mechanical mixing with suitable stirring means or pneumatic mixing by whirling with pressurized air. Furthermore, mixing can be carried out in rotating drums or vibrating containers and can thus be combined with rotatory finishing or vibrational finishing.

[0047] If the material is present as a mixture, the advantageous properties of all three components can be combined in the most efficient manner and can have the strongest synergistic effect when the material is used as an artificial turf infill.

[0048] In another aspect, the present application pertains to an artificial turf field which comprises a material according to the present application as infill material.

[0049] In an embodiment, the material is present in the artificial turf field as a single layer, thus the three components are homogeneously distributed in the infill layer. If provided in a single layer, the advantageous properties of the different components of the material can be combined in the most efficient manner and can have the strongest synergistic effect. Furthermore, providing the material as a single layer is technically simpler as the arrangement of several layers of infill material within the artificial turf.

[0050] In an embodiment, the coconut fibres of the material are intermingled with each other forming a random network such as a three-dimensional network. Said network may also entangle the particles of cork and the particles of ground almond shells.

Claims

1. Material as infill material for an artificial turf comprising
 - Coconut fibers,
 - Particles of cork,
 - particles of ground almond shells.
2. The material of claim 1 wherein the coconut fibers have a length of at least 0.5 mm, 1 mm, 2 mm, 3 mm, 5 mm or 10 mm and a length of at most 30 mm, 20 mm, 10 mm, 5 mm or 3 mm.
3. The material of claim 1 or 2 wherein the particles of cork have a particle size distribution of at least 0.5 mm, 0.63 mm, 0.8 mm, 1 mm, 1.25 mm or 1.6 mm and at most 1.25 mm, 1.6 mm, 2 mm or 2.5 mm or 3.15 mm measured according to FIFA Test Method 2024-18.
4. The material of any one or more of the previous claims wherein the particles of ground almond shells have a size distribution of at least 0.5 mm,

0.63 mm, 0.8 mm, 1 mm, 1.25 mm or 1.6 mm and at most 1.25 mm, 1.6 mm, 2 mm or 2.5 mm or 3.15 mm measured according to FIFA Test Method 2024-18.

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The material of any one or more of the previous claims wherein the particles of cork have a size distribution which is smaller than the average size of the particles of ground almond shells.
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The material of any one or more of the previous claims wherein the amount of coconut fibers is between 1 and 70 wt.-%, preferably between 5 and 50 wt.-% even more preferably between 10 and 40 wt.-% and most preferably between 20 and 30 wt.-%.
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The material of any one or more of the previous claims wherein the amount of particles of cork is between 1 and 70 wt.-%, preferably between 5 and 50 wt.-% even more preferably between 10 and 40 wt.-% and most preferably between 15 and 25 wt.-%.
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The material of any one or more of the previous claims wherein the amount of particles of ground almond shells is between 1 and 80 wt.-%, preferably between 20 and 75 wt.-% even more preferably between 30 and 70 wt.-% and most preferably between 40 and 60 wt.-%.
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The material of any one or more of the previous claims wherein the particles of almond shells have been tumble-finished or vibratory finished.
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The material according to any one or more of the previous claims wherein the material is biodegradable according to DIN EN 13432, preferably according to AS 5810 and/or NF T 51-800.
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The material according to any one or more of the previous claims wherein the material is a mixture.
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An artificial turf field comprising an infill material according to any one or more of the previous claims.
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The artificial turf field of claim 12, wherein the infill material is provided as one single layer.
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The artificial turf field of claim 13 wherein the coconut fibers of the infill are intermingled with each other.

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EUROPEAN SEARCH REPORT

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EP 25 17 0670

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