Abstract: A method for the construction of an artificial grass sports pitch, such as a football or five-a-side pitch, comprising the stage of construction of a bed area defined as a free surface of a stratified sub-base (5) of inert granular material and a stage of provision of an homogeneous stabilised layer (12) below the stratified sub-base, obtained in situ by mixing natural soils with a binder (lime or cement).
A METHOD FOR THE CONSTRUCTION OF AN ARTIFICIAL GRASS SPORTS PITCH AND A SPORTS PITCH THUS OBTAINED

DESCRIPTION

The present invention relates to a method for the construction of an artificial grass sports pitch, of the type including the features set out in the preamble of the main claim, and a sports pitch thus obtained.

The invention is of particular, although not exclusive, application in the specific sector of the construction of bases for artificial grass football pitches.

In this technical field, a known method is defined by the regulation "I Campi di Calcio in Erba Artificiale" (Artificial Grass Football Pitches), in force since 5 June 2006, of the Lega Nazionale Dilettanti (LND - National Amateur League), affiliated to the Federazione Italiana Gioco Calcio (Italian Football Federation).

According to this method, the sequence of operations to be carried out prior to the laying of the artificial grass carpet is as described below.

a) Preparation of the bed surface, by removal of the soil on site to a depth of between approximately 45 and 50 cm with respect to ground level and subsequent rolling of the surface obtained. Provision is also made for checking by means of laser-controlled machinery, and any necessary correction of the depth. The purpose of this first stage is to obtain a foundation with an appropriately hard and planar surface.

b) Laying of a geotextile of a weight of 250 g/m² on the surface of the foundation defined in the preceding point.

c) Provision of drainage and irrigation systems, using the
diagrams set out in Tables 2, 3, 4 and 7 of the above-mentioned regulation as a reference.

d) Laying of a plurality of layers of inert materials, of progressively decreasing granular size:

- aggregate of a granular size of between 4 and 7 cm, to a thickness of 30 cm;
- chippings of a granular size of between 2.8 and 3.2 cm, to a thickness of 7 cm;
- gravel of a granular size of between 1.2 and 1.8 cm, to thickness of 4 cm;
- sand of a granular size of between 0.2 and 0.8 cm, to a thickness of 3 cm.

e) Possible laying of a layer of resilient drainage matting (only in the case of pitches subject to FIFA STAR 2 certification).

The above-mentioned regulation defines the technical constructional requirements which have to be satisfied by the sub-base and tested, by carrying out appropriate tests, to obtain the go-ahead for laying of the artificial grass carpet.

The solution described above has up to now made it possible to satisfy the performance characteristics of artificial grass carpets laid down by international standards bodies, and in particular as regards their specific application to football pitches, by LND, FIFA and UEFA.

The main drawback of this method of construction of the beds for artificial grass sports pitches is the need to deal with huge quantities of inert materials which raises environmental and transport problems, both
from the point of view of the disposal of the soil removed, and the supply, transport and laying of the inert materials. These problems are particularly substantial as regards the procurement of inert granular material for the aggregate which represents the thickest layer.

The problem that the present invention seeks to resolve is that of providing a method which makes it possible to improve, in terms of construction, performance and cost, artificial grass sports pitches, in order to satisfy the above-mentioned requirements and at the same time to remedy the drawbacks of the cited prior art.

This problem, as well as others which will be examined in detail in the following description, is addressed and resolved by the invention by a method for the construction of an artificial grass sports pitch embodied in accordance with the appended claims.

The features and advantages of the invention will become clear from the following detailed description of a preferred, but not exclusive, embodiment, given purely by way of non-limiting example with reference to the appended drawings, in which:

Fig. 1 is a general block diagram of the main stages of a method for the construction of an artificial grass sports pitch of the present invention;

Fig. 2 is a particular block diagram of the stages of construction of a stabilised layer of the present invention;

Fig. 3 is a view in section of a sports pitch obtained using the method of Figs. 1 and 2;

Fig. 4 is a view in section of a constructional variant of a sports pitch according to the method of the present invention;
Fig. 5 is a plan view of a football pitch, showing the points of measurement of the modulus of deformation according to the method of Figs. 1 and 2;

Fig. 6 is a plan view of a five-a-side football pitch, showing the points of measurement of the modulus of deformation according to the method of Figs. 1 and 2.

The method of the present invention may be applied to soil of clay or clay-loam type or of sandy loam type.

With reference first to Fig. 1, the block diagram shows the sequence of the main stages of a method for the construction of an artificial grass sports pitch embodied in accordance with the present invention. The individual main stages of the method are described below in chronological order of performance, with reference to the reference numeral that they bear in Fig. 1. Each stage is followed by the following stage in the list given below, unless otherwise specified.

1. Removal of the organic material nearest to the surface to a thickness of approximately 10 cm in order to remove vegetation or any other extraneous material. According to a variant of the present invention, where the organic material is reasonably contained or otherwise removed or treated, this stage is omitted and the method starts with the following stage 2.

2. Creation of a stabilised layer 12 of a thickness of between 20 and 30 cm, above a layer 11 of natural soil comprising sandy loam or loamy sand and/or clay or loam, present in situ. The stabilised layer 12 is obtained by means of the sequence of secondary stages described in the block
Maturation of the treatment for a period of approximately 4 or 5 days. During this stage, the chemical reactions which determine the physical and mechanical properties of the sub-base take place in the mixture of soil and binder.

Possible checking by measuring the modulus of deformation, using the plate test set out in standard SNV 670317 or, as an alternative, by measuring the dynamic modulus of deformation set out in standard DIN 18196. In both cases, the test must be carried out at a plurality of points of the bed surface as shown in Fig. 5 and Fig. 6, for a football pitch and a five-a-side pitch respectively. In the case of a football pitch 21 with dimensions of 105 x 68 m, provision is made for 15 tests to be carried out, each at a point 23 corresponding to the centre of a rectangular portion 22 of pitch of an area of approximately 500 m²; in the case of a five-a-side pitch 31 with dimensions of 50 x 30 m, provision is made for 6 tests to be carried out, each at a point 33 corresponding to the centre of a rectangular portion 32 of pitch of an area of approximately 250 m².

Positioning of drainage pipes 13 on the surface 14. In a variant of the invention, as will be explained in detail below, stage 5 is omitted and stage 4 is followed directly by stage 6.

Laying of a layer 15 of inert granular material, for instance chippings, of a granular size of between 1.8 and 2.2 cm to a thickness of between 5 and 20 cm, typically 14 cm.

Laying of a layer of sand 17 of a granular size of between 0.2 and 0.8 cm to a thickness of approximately 3 cm.
8. Laying of a layer of resilient drainage matting. According to a structural variant of the invention, stage 8 is omitted and stage 7 is followed directly by stage 9.


With reference to the block diagram of Fig. 2, the main stage 2 comprises a sequence of secondary stages to be carried out for the provision of a stabilised layer 12 according to the present invention. The individual secondary stages are described below with reference to the reference numeral which they bear in Fig. 2. When each stage is complete, it is followed by the stage following it in the list given below, unless otherwise specified.

101. Sampling and laboratory analysis of soil samples in order to establish the type and quantity of binder to be used and to determine the optimum moisture level for compacting of the mixture of soil and binder to be used in situ. The binder to be mixed with the soil is slaked lime or quicklime or cement or a mixture of lime and cement. Quicklime or slaked lime is used for clay-loam or clay soils. Slaked lime is to be preferred to quicklime, because of its drying effect, in the treatment of soils having a high moisture value with respect to the optimum value determined by the laboratory analyses, in order to obtain optimum compacting of the soil. A maximum tolerance of +/-2% with respect to the optimum value is admissible. Cement is used for sandy loam or loamy sand soils. The quantities by weight of binder to be used are, by way of example, between 2% and 3% of the dry weight of the soil to be treated.

102. Possible prior stage of milling of the soil to be stabilised by
means of a conventional agricultural milling machine, generally available locally for hire from plant hire firms, or a like agricultural machine. According to a structural variant of the invention, stage 102 is omitted, and stage 101 is followed directly by stage 103.

103. Regularisation of a free working surface 14 of the stabilised layer 12. The surface 14 is inclined at a gradient from the centre to the peripheral edges of the stabilised layer 12. The value of the gradient is between 0.3% and 0.5%, as is also prescribed in the above-mentioned Regulation. According to a variant of the present method, the surface 14 has a greater gradient (Fig. 4) of between 0.6% and 1.0% to enable the water to run off without installing the drainage pipes 13.

104. Spreading of a layer of the binder selected on the basis of the analyses carried out during stage 101 on the surface of the layer to be treated, which may also be carried out by conventional agricultural machinery (spreaders), preferably with volumetric metering, periodically monitoring the quantity, in terms of kg/m², spread on the soil.

105. Mixing of the soil with the chosen binder by one of more passes of an agricultural milling machine on the layer to be treated, until all the material has been reduced to pieces of a maximum dimension of approximately 25 mm.

106. Visual inspection of homogeneity by inspection of the uniform surface colouring of the mixture obtained by applying the stage of the method bearing reference numeral 105. If this inspection has a positive outcome, the following stage, bearing reference numeral 107, is carried out; otherwise, the stage bearing reference numeral 105 is carried out
107. Checking by rapid methods, applied directly in situ, according to standard ASTM D 4643-93, of the moisture content of the mixture. If this value is equal to the value determining optimum compacting, the next stage of the method is the stage bearing reference numeral 109; otherwise, the method includes the performance of the stage bearing reference numeral 108.

108. Moisture correction, by adding water if the moisture level is below the optimum value, or by further milling if the moisture level is above the optimum value. The water to be added if the moisture level is below the optimum value should contain small quantities of organic and inorganic substances such as oils, sulphates, chlorides and the like, which could interfere with the chemical reactions on which the present treatment is based. On completion of this stage, the method includes the performance of the stage bearing reference numeral 107.

109. Compacting of the stabilised layer obtained by applying the preceding stages, by repeated passes by an appropriate machine (compressor roller or fully loaded tyre means).

The stabilised layer 12 obtained by means of the method described above is substantially impermeable to water. For that reason, the variant of Fig. 4, in which the gradient of the surface 14 enables the water to run off towards the perimetral edges of the stabilised layer 12, means that the installation of the drainage pipes 13 on the surface 14 can be avoided. In both the cases of Figs. 3 and 4, the water which runs off in the pipes 13 or on the surface 14 is collected in perimetral drainage tubes 20 housed in a
chamber 19 which runs along the whole perimetral edge of the stabilised layer 12.

National and international studies and applications have borne out experience known from ancient times, showing that chemical reactions take place in mixtures of soils comprising clay and lime or comprising sandy loams or loamy sands and cement, bringing about an improvement of the physical and mechanical properties of these soils, such as increased shear strength and reduced deformability. These properties are not influenced by any water which may be present or by thermal variations.

The method of the present invention makes it possible to apply these concepts to sub-bases for artificial grass sports pitches.

The method of construction of the bed areas for artificial grass carpets of the present invention achieves the proposed objects and offers, with respect to the prior art, an improvement of the bed area in terms of physical and mechanical properties such as shear strength and deformability, while at the same time containing the environmental impact that this construction entails and substantially reducing construction costs.
CLAIMS

1. A method for the construction of an artificial grass sports pitch, such as a football or five-a-side pitch, comprising the stage of construction of a bed area defined as a free surface of a stratified sub-base of inert granular material, characterized in that the method comprises a stage of provision of an homogeneous stabilised layer below the stratified sub-base, the stabilised layer being obtained in situ by mixing natural soils with a binder.

2. A method according to claim 1, wherein the natural soils are of the clay-loam or clay type and the binder comprises quicklime or slaked lime.

3. A method according to claim 1, wherein the natural soils are of the sandy loam or loamy sand type and the binder comprises cement.

4. A method according to one of claims 1 to 3, wherein the free surface is inclined with a gradient from a central zone of the sports pitch to a perimetral edge zone of the sports pitch.

5. A method according to claim 4, wherein the gradient of the free surface is between 0.6% and 1.0%.

6. A method according to one of the preceding claims, wherein a drainage network of drainage pipes is laid on the free surface.

7. A method according to one of the preceding claims, wherein the quantity by weight of the binder is between 2% and 3% of the weight of the natural soil to be mixed with the binder, these weights referring to the dry weight of the natural soil.

8. A method according to one of the preceding claims, wherein the
thickness of this stabilised layer is between 20 and 30 cm.

9. A method according to one of the preceding claims, wherein the stratified sub-base comprises:
   - a layer of sand of a granular size of between 0.2 and 0.8 cm, on which the artificial grass carpet bears,
   - a layer of inert granular material of a granular size of between 2.2 and 2.8 cm, on which the layer of sand bears.

10. A method according to claim 9, wherein the thickness of the homogeneous layer of inert granular material is between 5 and 20 cm.

11. A method according to one or more of the preceding claims, wherein the binder is distributed on the natural soils by means of a spreader device and is mixed with these soils, preferably by means of one or more passes of a milling machine.

12. A method according to one or more of the preceding claims, wherein the mixing of the binder and the natural soils comprises a plurality of successive passes of a milling machine, until mixed material of a granular size of between 20 and 30 mm is achieved.

13. A method according to one or more of the preceding claims, characterized in that it comprises a stage of correction of the moisture in the stabilised layer, until the optimum value established by laboratory analyses is achieved, a maximum tolerance of +/-2% with respect to this optimum value being admissible.

14. A method according to one or more of the preceding claims, comprising a stage of compacting of the stabilised layer.
15. An artificial grass sports pitch, such as a football or a five-a-side pitch, obtained using the method according to one or more of the preceding claims.

16. A bed area for a sports pitch, such as an artificial grass football or five-a-side pitch, defined as a free surface of a stratified sub-base of inert granular material, characterized in that, below the stratified sub-base, an homogeneous stabilised layer is provided and comprises a mixture of natural soils preferably present in situ and a binder selected from among quicklime and/or slaked lime and/or cement.
Removal of surface organic material

Construction of stabilised layer

Maturation of stabilised layer

Final inspection of stabilised layer

Positioning of drainage network

Laying of granular layer to a thickness of 14 cm

Laying of crushed sand layer to a thickness of 3 cm

Laying of resilient drainage matting

Laying of grass carpet

Fig. 1
Sampling and analysis of soil samples

Milling

Regularisation of bed in accordance with the gradients chosen

Spreading of binder

Mixing of soil with the binder

Visual inspection: is the mixture homogeneous?

NO

Measurement of moisture level of the mixture: is the moisture level optimum?

NO

Correction of moisture level

YES

Compacting

Fig. 2
A. CLASSIFICATION OF SUBJECT MATTER

INV. E01C 13/08
ADD. E01C 13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. RELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) E01C 13/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2002/132099 A1 (SQUIRES TROY [US]) 19 September 2002 (2002-09-19) paragraphs [0010], [0015], [0023], [0025]; figure 1</td>
<td>1,4-10, 13-16</td>
</tr>
<tr>
<td>A</td>
<td>US 4 462 184 A (CUNNINGHAM PERCY C [CA]) 31 July 1984 (1984-07-31) column 11, lines 10-23 column 12, lines 34-46 column 13, lines 6-22</td>
<td>1,4, 5</td>
</tr>
</tbody>
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Further documents are listed in the continuation of Box C

See patent family annex

Date of the actual completion of the international search

25 June 2008

Date of mailing of the international search report

09/07/2008

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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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</thead>
<tbody>
<tr>
<td>Y</td>
<td>WO 99/42665 A (ADELAIDE BRIGHTON LIMITED [AU]; MARTIN GUY KENNETH [AU]; BENSON STEPHE) 26 August 1999 (1999-08-26) page 3, lines 1-21 page 4, lines 9-16</td>
<td>2, 3, 11, 12</td>
</tr>
<tr>
<td>A</td>
<td>WO 95/28456 A (ARNLAND PTY LTD [AU]; ROBERTS MICHAEL STEPHEN [AU]; ATKINSON PETER [AU]) 26 October 1995 (1995-10-26) claims 1, 2, 4, 9, 10, 16</td>
<td>7, 13</td>
</tr>
<tr>
<td>A</td>
<td>LEGA NAZIONALE DILETTANTI: &quot;Regolamento per la realizzazione di un campo da calcio in erba artificiale di ultima generazione&quot; 6 January 2006 (2006-01-06), LEGA NAZIONALE DILETTANTI, ROME, XP002485694 cited in the application table 5</td>
<td>4-6, 8-10</td>
</tr>
<tr>
<td>Patent document cited in search report</td>
<td>Publication date</td>
<td>Patent family member(s)</td>
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<td>WO 02075055 A1</td>
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<tr>
<td>US 2005238433 A1</td>
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<td>US 4462184 A</td>
<td>31-07-1984</td>
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