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(54) **PROCESS FOR RECYCLING SYNTHETIC SPORTS SURFACES USING POWDERED STABILIZING AGENTS**

PROZESS ZUM RECYCLING VON SYNTHETISCHEN SPORTBELÄGEN UNTER BEIMISCHUNG VON PULVERFÖRMIGEN STABILISIERUNGSMITTELN

PROCÉDÉ DE RECYCLAGE DE REVÊTEMENTS SYNTHÉTIQUES DE SPORT EN UTILISANT UN AGENT STABILISANT EN POUDRE

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- **MALTESE, Cristiano**
I-20158 Milano (IT)
- **PORTIGLIATTI, Elisa**
I-20158 Milano (IT)
- **PISTOLESI, Carlo**
I-20158 Milano (IT)

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(74) Representative: **Minoja, Fabrizio**
Bianchetti Bracco Minoja S.r.l.
Via Plinio, 63
20129 Milano (IT)

(73) Proprietor: **Mapei S.p.A.**
I-20158 Milano (IT)

(72) Inventors:
• **SQUINZI, Marco**
I-20158 Milano (IT)

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Description

Field of the invention

[0001] The present invention relates to a method for recycling built in synthetic sports surfaces, in particular for sports facilities, by recovering the crushed surface with a powdered stabilizing agent designed to be used in combination with soil to produce a new underlay *in situ* which constitutes the most suitable support for laying the new sports surface.

Prior art

[0002] The use of synthetic turf to make sports fields (for football, tennis, hockey, etc.) has grown enormously since 2001. The synthetic surface usually lasts for eight to ten years, because the wear caused by being trodden on and by atmospheric agents leads to constant deterioration over the years.

[0003] After about 10 years, the synthetic surface needs to be replaced, after being removed and sent for landfill, entailing an inevitable economic outlay which increases the running costs of the sports facility. This operation inevitably also involves the installation or stabilization of the underlay soil.

[0004] The synthetic surface generally consists of a number of components which are combined according to the requirements laid down by the sports federations concerned (e.g. FIFA). There are multiple possible permutations in terms of underlay, type of synthetic surface, and optionally, the product used for the stabilizing infill.

[0005] The following are some examples of construction of synthetic sports surfaces:

- Synthetic turf/Sand
- Synthetic turf/Recycled rubber
- Synthetic turf/Thermoplastic rubber (TPU)
- Synthetic turf, Sand, Rubber recycled from tyres (SBR,NR)
- Synthetic turf, Sand, Recycled EPDM rubber
- Synthetic turf, Sand, Thermoplastic rubber (TPU)
- Synthetic turf, Sand, recycled rubber (SBR)
- Synthetic turf, Sand, Natural infill made of vegetable fibre/High-grade

[0006] Rubber

- Synthetic turf, Sand, Thermoplastic/Cork
- Synthetic turf, Sand, High-grade Rubber
- Synthetic surface made of prefabricated vulcanized rubber
- Synthetic surface cast *in situ*.

[0007] To date, attempts to recycle synthetic turf with other products (e.g. conventional hydraulic binders - lime and cement) have been unsuccessful, and above all involve crushing of the turf in specialized units, not *in situ*.

[0008] Disclosed are methods designed to improve the engineering properties of soil which are based on scari-fying/pulverizing the soil followed by treatment with an additive based on pozzolan, calcium sulphate and calcium oxide (EP 1 089 950). It is further known from JP2008 025284A to recycle and stabilize installed synthetic sports surface by crushing them.

Description of the invention

[0009] It has now been found that the synthetic flooring of sports facilities can be directly *recycled in situ*, thus avoiding sending it to landfill, by mixing the ground material in suitable proportions with the underlay soil, water and a stabilizing agent.

[0010] "Stabilizing agent" means a binder as defined, for example, in Italian standard CNR_UNI 10006 (cement, lime, asphalt and tar), published in June 2002. CNR UNI 10006 reports geotechnical classification of soils mostly used for pavements. The classification is based on particle size composition as well as the plasticity characteristics of the soils and it divides the soils into 7 primary groups designed as A-1, A-2.... A-7.

[0011] The classification of soils was developed by HRB (Highway Research Board) and was then adopted also by AASHTO (American Association of State Highway and Transportation Officials).

[0012] The process according to the invention comprises the following stages:

- a) Crushing and grinding the existing *surface in situ*;
- b) Homogenizing the ground surface and incorporating it in soil of a class between A1 and A6 according to CNR UNI 10006 for the entire thickness of treatment, namely 5-20 cm;
- c) Spreading a powdered stabilizing agent in the quantity of between 2 and 10% by weight of the weight of the soil;
- d) Mixing the existing soil, the ground surface and the stabilizing agent;
- e) Wetting and compacting the stabilized soil.

[0013] The invention also relates to a novel stabilizing agent which is particularly effective for application in the process described above, comprising a hydraulic binder and/or mixtures of hydraulic binders complying with standards EN197 and EN459, or an air binder complying with standard EN459, optionally mixed with minerals with latent hydraulic activity complying with standard EN15167, and/or minerals with pozzolanic activity complying with standards EN13263 and EN450.

[0014] Examples of hydraulic binders include Portland cement and hydraulic lime. Binders with latent hydraulic activity are typically blast furnace slag, while minerals with pozzolanic activity are fly ash and microsilica.

[0015] The stages of the method according to the invention are described in detail below.

1. Crushing and grinding of the existing surface *in situ*, taking care to standardize the size of the ground surface which will subsequently be incorporated in the existing underlay by the stabilization process using the formulation according to the invention. The synthetic surface, crushed with suitable equipment, together with infill material, will be deposited on the surface of the current underlay.

2. Homogenization of the ground surface (including stabilizing infill) and incorporation in the existing underlay for a minimum thickness of 5 cm; this operation will be performed with equipment suitable to disintegrate the whole thickness of the existing underlay and to disperse the ground material uniformly into the aggregate forming the subject of the treatment. This equipment may be rotating horizontal shaft machines, disc harrows, graders, harrows, rotavator cutters or equivalent equipment selected according to the required degree of consolidation of the existing underlay and the humidity level at the time of the operation.

3. Spreading of powdered stabilizing agent with suitable spreading machines. The dose of the formulation according to the invention, to be established by suitable preliminary laboratory tests, will range between a minimum of 2% and a maximum of 10% by weight of the weight of the soil.

The spreading operation must only be performed on the portion of soil to be treated the same day; it is advisable to prevent all vehicles, apart from mixing equipment, from crossing the portion of soil on which the stabilizing agent has been spread, until it has been thoroughly mixed.

4. Mixing of existing soil and the ground (incorporated) surface with the formulation according to the invention using rotating horizontal shaft machines, disc harrows, graders, harrows, rotavator cutters or equivalent equipment which allows homogenous mixing of the stabilizing agent and the soil throughout the required thickness. The number of runs depends on the choice of equipment, the nature of the soil /aggregate treated, and its degree of humidity. Mixing must be as uniform as possible, taking care to mix the stabilizer to the depth established at the time of planning and at the same time distribute the ground turf evenly through the mixture.

5. Wetting. Wetting is then performed to reach the Optimum Moisture Content (OMC) determined by the Proctor compaction test, assuming that the aggregate is only partly saturated and can therefore presumably absorb some of the water. The minimum quantity of water can vary as the work proceeds, depending on the weather conditions and/or the humidity present in the material treated. The stabilizing agent according to the invention has a content of fine particles with a high specific surface area which increase the amount of water needed to make the mixture; the optimum moisture content (OMC) can there-

fore undergo variations (e.g. additions) which are directly established as the work proceeds, especially on the basis of meteorological conditions during the work. Wetting of the aggregate must be performed evenly, and only on the area where all stages of application of the formulation according to the invention, namely spreading of stabilizing powder, mixing, wetting and compacting, are expected to be completed within approximately 6 hours. The extent of said area will be established as the work proceeds, according to different variables, such as the dimensions of the mixing machine used, the type of equipment used to distribute the water, the time taken to position the stabilizer on the surface, the time needed for homogenous mixing of the aggregate with the stabilizer, the time devoted to compacting, and last but not least, the atmospheric conditions during the application.

6. Compacting of stabilized soil. The mixture thus obtained must be suitably compacted with a vibrating roller (minimum 3 t) until an *in situ* density is reached which must be $\geq 98\%$ of the reference value obtained from mod. AASHTO laboratory compaction tests. Compacting stabilized soil requires a more moderate compacting roller speed than that generally used to compact other bases (e.g. bituminous conglomerates).

[0016] Said process can be advantageously applied to all types of material used to lay synthetic turf, such as those listed in the Prior Art section above.

[0017] The invention is illustrated in greater detail in the following example, which relates to treatment with the formulation according to the invention of a natural stabilized material (called Stabilized Vitali) having a particle size of between 0 and 30 mm, which can be described as sandy gravel and belongs to Class A1-a according to standard CNR UNI 10006. The stabilized material underwent a Proctor compaction test (according to CNR B.U. no. 69), and the Optimum Moisture Content (OMC) was thus determined as 9% by weight.

[0018] The California bearing ratio (CBR) (according to CNR UNI 10009) of the natural stabilized material tested, with the addition of 5% by weight of the formulation according to the invention, was then determined. The results demonstrate that the addition of the formulation according to the invention significantly improves the geomechanical properties of the material tested, giving it a bearing ratio exceeding 250%. According to reference standard CNR UNI 10006 (Construction and maintenance of roads - soil use techniques), the California bearing ratio must be greater than 80 for the base layer in the case of protected roads with a medium and high traffic intensity, and the unprotected surface wear layer of roads with limited traffic intensity.

[0019] The California bearing ratio of the mixture of stabilized material and ground synthetic turf was also determined, the dose by weight of the formulation according

to the invention remaining unchanged. The California bearing ratio of said mixture is also greater than 250%: this means that despite the introduction of ground turf into the mixture, the geomechanical properties of the treated material significantly improved. Moreover, the compression resistance of the mixture with the turf granulate remains unchanged compared with the mixture only containing stabilized material and the formulation according to the invention.

[0020] The formulation according to the invention therefore significantly improves the geomechanical properties of the treated material and allows the granulate deriving from grinding and crushing of the worn synthetic surface to be used in the mixture.

Applicable standards and legislation

EN 197-1: 2011

[0021] Cement - Part 1: Composition, specifications and conformity criteria for common cements.

EN459-1:2010

[0022] Building lime - Part 1: Definitions, specifications and conformity criteria.

EN15167-1:2006

[0023] Ground granulated blast furnace slag for use in concrete, mortar and grout - Part 1: Definitions, specifications and conformity criteria.

EN13263-1:2005 + A1:2009

[0024] Silica fume for concrete - Part 1: Definitions, requirements and conformity criteria.

EN450-1:2005 + A1:2007

[0025] Fly ash for concrete - Part 1: Definition, specifications and conformity criteria.

EN934-2:2009

[0026] Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions, requirements, conformity, marking and labelling.

EN934-3:2009

[0027] Admixtures for concrete, mortar and grout - Part 3: Admixtures for masonry mortar - Definitions, requirements, conformity and marking and labelling.

EN934-4:2009

[0028] Admixtures for concrete, mortar and grout - Part

4: Admixtures for grout for prestressing tendons - Definitions, requirements, conformity, marking and labelling.

5 Claims

1. Process for recycling built in synthetic sports surfaces by:

- a) Crushing and grinding the existing synthetic sports surface *in situ*;
- b) Homogenizing the crushed and ground surface and incorporating it in the existing underlay soil of a class between A1 and A6 according to CNR UNI 10006) for the entire thickness of treatment, namely 5-20 cm;
- c) Spreading a powdered stabilizing agent in the quantity of between 2 and 10% by weight of the weight of the treated soil;
- d) Mixing the existing soil, the crushed and ground surface and the stabilizing agent;
- e) Wetting and compacting the stabilized soil.

2. Process as claimed in claim 1, wherein the stabilizing agent is a hydraulic binder and/or mixtures of hydraulic binders complying with standards EN197 and EN459.

3. Process as claimed in claim 1, wherein the stabilizing agent is an air binder complying with standard EN459.

4. Process as claimed in claim 1, wherein the stabilizing agent is a hydraulic binder and/or air binder mixed with added minerals with latent hydraulic activity complying with standard EN15167.

5. Process as claimed in claim 1, wherein the stabilizing agent is a hydraulic binder and/or air binder mixed with added minerals with latent hydraulic activity complying with standard EN15167, and/or added minerals with pozzolanic activity complying with standards EN13263 and EN450.

6. Process as claimed in claim 1, wherein the stabilizing agent can be modified with additions of admixtures complying with standard EN934 and/or synthetic fibers and/or minerals.

Patentansprüche

1. Verfahren zum Recyceln verlegter synthetischer Sportbeläge mittels:

- a) Zerkleinern und Mahlen der vorhandenen synthetischen Sportbeläge *in situ*;
- b) Homogenisieren des zerkleinerten und ge-

- mahlenen Belags und Einarbeiten desselben in die vorhandene Bettungsschicht (Erdboden einer Klasse zwischen A1 und A6 gemäß CNR UNI 10006) über die gesamte Tiefe der Behandlung, nämlich 5-20 cm; 5
- c) Verteilen eines pulverisierten Stabilisierungsmittels in der Menge zwischen 2 und 10 Gewichtsprozent bezogen auf das Gewicht des behandelten Erdbodens;
- d) Mischen des vorhandenen Erdbodens, des zerkleinerten und gemahlenen Belags und des Stabilisierungsmittels; 10
- e) Befeuchten und Verdichten des stabilisierten Erdbodens.
2. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel ein hydraulisches Bindemittel und/oder Mischungen hydraulischer Bindemittel ist/sind, das/die den Standards EN197 und EN459 entspricht/entsprechen. 15
3. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel ein Luftbindemittel ist, das dem Standard EN459 entspricht. 20
4. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel ein hydraulisches Bindemittel und/oder ein Luftbindemittel ist, welches mit hinzugefügten Mineralien mit latenter hydraulischer Aktivität vermischt ist, die Standard EN15167 entsprechen. 25
5. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel ein hydraulisches Bindemittel und/oder ein Luftbindemittel ist, welches mit hinzugefügten Mineralien mit latenter hydraulischer Aktivität vermischt ist, die Standard EN15167 entsprechen, und/oder mit hinzugefügten Mineralien mit puzzolanischer Aktivität vermischt ist, die Standards EN13263 und EN450 entsprechen. 30
6. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel durch Zugaben von Beimengungen, die Standard EN934 entsprechen, und/oder von synthetischen Fasern und/oder von Mineralien modifiziert werden kann. 35
7. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel ein hydraulisches Bindemittel und/oder ein Luftbindemittel ist, welches mit hinzugefügten Mineralien mit latenter hydraulischer Aktivität vermischt ist, die Standard EN15167 entsprechen, und/oder mit hinzugefügten Mineralien mit puzzolanischer Aktivität vermischt ist, die Standards EN13263 und EN450 entsprechen. 40
8. Verfahren wie in Anspruch 1 beansprucht, wobei das Stabilisierungsmittel ein hydraulisches Bindemittel und/oder ein Luftbindemittel ist, welches mit hinzugefügten Mineralien mit latenter hydraulischer Aktivität vermischt ist, die Standard EN15167 entsprechen, und/oder mit hinzugefügten Mineralien mit puzzolanischer Aktivität vermischt ist, die Standards EN13263 und EN450 entsprechen. 45

Revendications

1. Procédé pour le recyclage de surfaces synthétiques de sports intégrées par: 50
- a) concassage et broyage de la surface synthétique de sports existante *in situ*; 55
- b) homogénéisation de la surface concassée et broyée et son incorporation dans la thibaude existante (un sol d'une classe comprise entre

A1 et A6 selon CNR UNI 10006) pour toute l'épaisseur de traitement, à savoir 5 à 20 cm ;
 c) étalement d'un agent stabilisant en poudre dans une quantité comprise entre 2 et 10 % en poids du poids du sol traité ;
 d) mélange du sol existant, de la surface concassée et broyée et de l'agent stabilisant ;
 e) mouillage et compactage du sol stabilisé.

2. Procédé selon la revendication 1, dans lequel l'agent stabilisant est un liant hydraulique et/ou des mélanges de liants hydrauliques conformes aux normes EN 197 et EN459.

3. Procédé selon la revendication 1, dans lequel l'agent stabilisant est un liant aérien conforme à la norme EN459.

4. Procédé selon la revendication 1, dans lequel l'agent stabilisant est un liant hydraulique et/ou un liant aérien mélangé à des minéraux ajoutés ayant une activité hydraulique latente conforme à la norme EN15167.

5. Procédé selon la revendication 1, dans lequel l'agent stabilisant est un liant hydraulique et/ou un liant aérien mélangé avec des minéraux ajoutés ayant une activité hydraulique latente conforme à la norme EN15167, et/ou des minéraux ajoutés ayant une activité pouzzolanique conforme aux normes EN13263 et EN450.

6. Procédé selon la revendication 1, dans lequel l'agent stabilisant peut être modifié par des ajouts de mélanges conformes à la norme EN934 et/ou de fibres synthétiques et/ou de minéraux.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 2008025284 A [0008]

Non-patent literature cited in the description

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