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(54) **HIGH FLEXIBILITY BENTONITE PANEL, IN PARTICULAR FOR THE WATERPROOFING OF TERRAIN, AND ITS PRODUCTION PROCESS**

HOCHFLEXIBILITÄTSELEMENT AUS BENTONIT, SPEZIELL FÜR DIE ABDICHTUNG DES BODENS, UND DESSEN HERSTELLUNGSVERFAHREN

PANNEAU EN BENTONITE TRES SOUPLE, NOTAMMENT POUR IMPERMEABILISER UN TERRAIN, ET SON PROCEDE DE FABRICATION

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Description

Technical Field

The present invention relates to a high flexibility bentonite panel, in particular for the waterproofing of terrain and for hydraulic and construction works.

The invention also relates to a process for the production of said panel.

Background Art

Waterproofing panels of the above-mentioned type are already known and have in common the characteristic of comprising a layer of bentonite, in particular sodium bentonite, which in the presence of humidity becomes hydrated, swelling greatly and forming an impermeable barrier. In US-A-4048373 a panel of the above-mentioned type is disclosed in which the layer of bentonite is incorporated between two faces of a sheet of corrugated paperboard in the spaces delimitated by the intermediate corrugated sheet of said paperboard. The bentonite is in a granular form and preferably has thickening substances added to it such as salts of polyacrylic acid with a molecular weight compressed between 500,000 and 2,000,000 and higher, polyacrylonitrile, polyvinyl acetate and polyvinyl alcohol. In the waterproofing panel according to US-A-4501788, the layer of bentonite, in granules, is placed between a permeable flexible support of preferably synthetic fabric, to which it is glued, and a protective covering which prevents the loss of granules and allows for the stocking of the panel in rolls.

In the waterproofing panel according to EP-A-278 419, the layer of bentonite is placed between two synthetic fabrics sewn to one another with transverse stitches every 10-15 cm.

One of the principle inconveniences encountered in the use of known waterproofing panels consists in the fact that they are not well-suited to the waterproofing of inclined or vertical walls, such as the sides of tanks, on one hand because of the scarce friction between the panel and the ground and on the other hand because of the tendency of the granules of bentonite to slide downwards due to their weight thus forming pockets of bentonite in some areas and consequent reduction of the thickness of the waterproofing agent in others. This occurs in particular in panels in which the layer of bentonite is held by means of stitches, but it is also present in those in which the layer of bentonite is glued to a support. In regard to this, it is important to note that in an improved version of the waterproofing panel according to above-mentioned US-A-4501788, recently put on the market, besides having provided for the gluing of the bentonite layer to the support, the layer of bentonite is also placed between two sheets of fabric in heavy polypropylene needled with nylon wool, to increase the adhesion of the granules, and united by transversal stitches to limit the formation of pockets. It is worth noting on the other hand that the adhesives used up to this time have provided no sufficient results because some are limitedly soluble in water and therefore impede the process of swelling, others were found to be at least potentially pollutive, and still others formed structures that were excessively rigid and fragile.

Another inconvenience of the known waterproofing panels is their relative fragility and limited flexibility. This makes the waterproofing of surfaces with complicated geometry (corners, ducts, small cisterns, etcetera) particularly difficult and complicates the operations of manipulation of the panels which, once unrolled, must be positioned without being able to be rerolled and cannot be moved in order to avoid local fractures or breaking of the bentonite layer.

A further inconvenience of the known waterproofing panels is their scarce resistance to atmospheric agents, in particular to rain, given that the binder solubilizes very rapidly, with the consequent necessity of completing the work in a short time or in proper atmospheric conditions.

The object of the present invention is to provide a waterproofing panel for terrain and for hydraulic and construction works, which comprises a layer of bentonite and allows for the obviation of the above-mentioned inconveniences encountered in waterproofing panels of a traditional type.

It is therefore a particular object of the present invention to provide a waterproofing panel that is flexible and elastic enough to not present problems of manipulation, especially losses of bentonite, and to be able to be used for the waterproofing of surfaces of complex geometry.

A further object of the present invention is to provide a waterproofing panel in which the adhesion of the bentonite granules to one another and to the layers of external covering is sufficient to allow for its use also on vertical surfaces without producing variations in thickness of the waterproofing layer.

Another object of the present invention is to provide a waterproofing panel of the above-mentioned type that possesses a greater resistance to atmospheric agents, in particular rain.

An additional object of the present invention is to provide a process for the production of a waterproofing panel of the above-mentioned type having high flexibility and elasticity, as well as having good properties of adherence to the ground even when steeply inclined.

Disclosure of the invention

The waterproofing panel according to the present invention is of the type comprising a layer of granular bentonite glued between two pieces of permeable synthetic fabric. One of the fundamental characteristics of the waterproofing panel according to the present invention is that as a binder for holding together the granules of bentonite, and to make them adhere stably to the cov-

ering fabrics, a copolymer of acrylic esters is used, formed by acrylic acid and alcohols such as methyl and isobutyl alcohol. Thanks to the use of this adhesive, the effects of breakaway are limited in cases of particularly difficult utilisation (inclined or vertical) or inaccurate manipulation of the product in the yard which currently, as a result of the use of binders that are too rigid, are the cause of breakaway and breaking of the product with losses of bentonite. This binder gives the panel durable flexibility and contemporaneously has the characteristic that it rehydrates in the presence of water favouring the absorption in a greater measure on the part of the bentonite after the installation has been completed. Furthermore the solubilization of this binder in the presence of water is relatively slower than other known binders, thus the installation can be carried ahead without problems even in atmospheric conditions that are not optimal, for instance in case of rain.

A further important characteristic of the panel according to the present invention is that it has impressions uniformly distributed on one of its faces, realized by means of pressing at the time of production. This pressing is advantageous both in terms of a more uniform distribution of the binder between the granules of bentonite with consequent attainment of a more compact structure, as well as in terms of giving the panel good adherence to the ground even if steeply inclined. The combined effect of the presence of said impressions and the use of binder composed of acrylic esters provides a product of high flexibility that proves particularly suited for installations in non flat areas having complex geometry. Moreover it allows for a consequent reduction in costs as a result of less scrap and less overlapping as well as greater reliability of the execution of the work due to fewer junctions of the product.

An additional important characteristic of the waterproofing panel according to the present invention consists in the fact that the granules of bentonite are uniformly covered by the binder thanks to the methods with which the binder is incorporated in the bentonite layer.

The waterproofing panel according to the present invention comprises therefore a layer of granular bentonite contained between two layers of permeable synthetic fabric agglomerated and fixed to said layers by means of a binder, characterized by the fact that said binder is a copolymer of acrylic esters of low grade alcohols having such properties that it rehydrates and relatively slowly solubilitates in the presence of water.

The process for producing the waterproofing panel according to the present invention provides for the distribution of said binder in the form of a foam on the first flexible permeable support, deposition on said foamed support of the layer of granular bentonite, the spraying on top of said layer of an aqueous solution of said binder, the covering of the layer of bentonite with a second flexible permeable support, the heat drying of the manufactured item thus obtained and finally the heat pressing of the dried manufactured item in order to realize said impressions on one of its faces.

Best Made of carrying out the Invention

The waterproofing panel according to the present invention contains between 4 and 6 kg/m2 of bentonite, preferably sodium bentonite, in a granular form of granulometry comprised between 0.5 and 5 mm; calcium bentonite or a mixture of sodium bentonite and calcium bentonite can also be used to resist percolates rich with heavy metals contained for example in solid industrial residues. Modified bentonites can also be used, that is bentonites made to react with organic substances such as polyacrylates and/or quaternary ammonium salts for special uses.

The adhesive used is composed of a copolymer of acrylic esters formed by acrylic acid and low-grade alcohols such as methyl alcohol and isobutyl alcohol. A product on the market that has proved particularly suited to the purposes of the present invention is POLICRIL 305/RB produced by the firm FAR. Obviously equivalent products having the same composition, such as the resin BAYER 678 produced by the firm BAYER, can be used in alternative.

The flexible and permeable elements and the covering of the layer of granular bentonite of the panel according to the present invention are preferably realized in synthetic fabrics. In particular, the first support is composed of polypropylene fabric internally needled with a non-woven fabric of nylon weighing 150 g/m2, whereas the covering support is a fabric of polyester weighing 40 g/m2. Obviously fabrics having equivalent characteristics can be used in alternative.

In practice, for the production of the waterproofing panel according to the present invention one can proceed as follows.

The binder in the form of a foam with 40% additive of a surface-active agent, of the anionic type for example, is spread on a propylene fabric internally needled with a non-woven fabric of nylon. A layer of several millimeters of uniformly distributed granular bentonite is thus formed on the foamed fabric, upon which a solution of binder at 50% is sprayed. The total quantity of binder used is comprised between 500 and 1500 g/m2 and is preferably between 700 and 1000 g/m2.

Known plasticizing additives with a base of cellulose (CMC, methyl-ethylcellulose, etc.), polyvinyl alcohol, polyacrylates, etcetera, in an amount varying from 0.5 to 3 % with respect to the weight of the bentonite, are added to the adhesive. These additives improve the flexibility, the swellability and in general the hydrophilic properties of the bentonite. Sodium hydroxide is also added to the binding solution to bring it to a weakly alkaline value (pH=8).

The panel thus obtained is heat dried in a special oven. Its initial content of humidity is equal to about 25-28% resulting from the bentonite's own humidity and from that introduced with the binder on a solution or a

foam. After drying in the oven the residual humidity is at most 20%.

When the panel is still hot, it is pressed to favor the compactness of the bentonite layer when the binder still has not hardened. For this purpose, the panel is passed through a calendering machine in which one of the pressure rollers has a worked surface so as to print impressions on the face of the panel that will be used for contact with the ground, that is the one formed in polyester. The impressions left on the face of the panel are clearly visible intersecting grooves forming designs in the shape of lozenges. This localized pressing operation, besides making the layer markedly more compact and its adhesion to the external fabrics in correspondence with said impressions considerably more intimate, allows also for the reduction, even if limitatedly, of the amount of binder and possible additives necessary. Moreover the presence of these uniformly distributed impressions on the face of the panel in contact with the ground prevents sliding even when the ground is steeply inclined.

The waterproofing panel according to the present invention, once cooled is cut into pieces or strips for example of 25 meters by 4 meters and collected in rolls that are then put into plastic bags, or in smaller pieces, for example sheets of about 5 by 5 meters (weighing 25 kg) to be installed by hand, for instance in the construction field. Obviously the panel according to the invention can be put on the market even in other cut down sizes according to the specific needs of various fields of use.

The panel according to the present invention can be advantageously used in many applications in the hydraulic and construction fields. In particular it is suited for the waterproofing of the walls of dumps and the grounds chosen for dump preparation, for the preparation of drainage basins, created to collect rain water or drainage water, as well as for canalization of water towards large deposits. In construction, it can be used for the waterproofing of terraces, cellars, basements, pools, etcetera. In agriculture it can be used for the forming of lakes for irrigation and other uses; in the transportation field, it can be used of the waterproofing of railroad embankments in high-velocity tracts made in crushed stone.

Variations and/or modifications can be brought to the waterproofing panel according to the present invention and to the relative production process without departing from the scope of the appended claims.

Claims

1. Waterproofing panel for terrain and hydraulic and construction works, comprising a layer of granular bentonite glued between two permeable synthetic fabrics, characterized by the fact that it comprises a copolymer of acrylic esters of low-grade alcohols as an adhesive, having such properties that it rehydrates and relatively slowly solubilitates in the presence of water.

2. Waterproofing panel according to claim 1, wherein said layer of bentonite is comprised between a first sheet comprising a polypropylene fabric internally needled with a non-woven fabric of nylon and a second sheet made of a fabric of polyester.

3. Waterproofing panel according to the previous claims, wherein the face of said panel formed by said polyester fabric has a plurality of uniformly distributed impressions.

4. Waterproofing panel according to the previous claims, wherein the content of bentonite per square meter is comprised between 4 and 6 kg.

5. Waterproofing panel according to the previous claims, wherein the granulometry of the bentonite is comprised between 0.5 and 5 mm.

6. Waterproofing panel according to the previous claims, wherein said adhesive is the commercial product known as POLICRIL 305 RB.

7. A process for producing a waterproofing panel for terrain and for hydraulic and construction works, comprising a layer of granular bentonite characterized by the fact that it comprises the following steps:

   - distributing in the form of a foam an adhesive formed by a copolymer of acrylic esters of low-grade alcohols, having such properties that it rehydrates and relatively slowly solubilitates in the presence of water, on a first flexible permeable support;
   - placing said layer of granular bentonite on said foam covered support;
   - spraying an aqueous solution of said adhesive over said layer;
   - covering said bentonite layer with a second flexible permeable support;
   - heat drying the manufactured product thus obtained;
   - submitting the manufactured product to heat pressing realizing a plurality of uniformly distributed impressions on one of the supports.

8. Process according to claim 7, wherein said first support is formed by a synthetic fabric in polypropylene internally needled with a non-woven fabric nylon, said second permeable support being formed by a polyester fabric.

9. Process according to claims 7 and 8, wherein the adhesive in the form of a foam is an aqueous solution of said adhesive containing from 0.2 to 3% of a surface-active agent.

10. Process according to claims 7 to 9, wherein the amount of adhesive used is comprised between 500 and 1500 g/m2.

11. Process according to claim 10, wherein the amount of adhesive used is comprised between 700 and 1000 g/m2.

12. Process according to claims 7 to 11, wherein sodium hydroxide is added to said adhesive to reach a pH of 8.

13. Process according to claims 7 to 12, wherein plasticizing additives chosen from among compositions of a base of cellulose, polyvinyl alcohol, polyacrylates in an amount comprised between 0.5 and 3% on the weight of the bentonite are added to said adhesive.

14. Process according to claims 7 to 13, wherein the bentonite used has a granulometry comprised between 0.5 and 5 mm.

Patentansprüche

1. Wasserdichte Platte für Boden, hydraulische Anlagen sowie Konstruktionsbauwerke mit einer Schicht aus körnigem Betonit, der zwischen zwei durchlässigen synthetischen Gewebeauflagen eingeklebt ist, **gekennzeichnet durch** den Umstand, daß als Klebstoff ein Kopolymer eines Acrylesters aus niedriggradigen Alkoholen Verwendung findet.

2. Wasserdichte Platte nach Anspruch 1, bei der die Betonitschicht zwischen einer ersten und einer zweiten Auflage angeordnet ist, wobei die erste Auflage ein Polypropylengewebe ist, mit dem eine nicht gewebte Einlage aus Nylon vernadelt ist und die zweite Auflage ein Gewebe aus Polyester ist.

3. Wasserdichte Platte nach den vorstehenden Ansprüchen, bei der die Außenfläche der Platte aus dem Polyestergewebe eine Vielzahl von gleichmäßig verteilten Eindrückungen aufweist.

4. Wasserdichte Platte nach den vorstehenden Ansprüchen, bei der der Betonitgehalt je m^2 zwischen 4 und 6 kg liegt.

5. Wasserdichte Platte, nach den vorstehenden Ansprüchen, bei der die Korngröße des Betonit zwischen 0,5 und 5 mm liegt.

6. Wasserdichte Platte nach den vorstehenden Ansprüchen, bei der der Klebstoff ein unter der Bezeichnung POLICRIL 305/RB kommerziell verfügbares Produkt ist.

7. Verfahren für die Herstellung einer wasserdichten Platte für den Boden, hydraulische Anlagen sowie Konstruktionsbauwerke mit einer Schicht aus körnigem Betonit, **dadurch gekennzeichnet,** daß das Verfahren folgende Verfahrensschritte einschließt

- Ablagern in der Form eines Schaumes und eines Klebstoffes aus einem Kopolymer aus Acrylestern aus niedriggebundenen Alkoholen mit solcher Eigenschaften, daß Rehydrodierung und in Gegenwart von Wasser relativ langsame Solubilisierung erfolgen, auf einen ersten flexiblen, durchlässigen Träger;
- Auftragen der Schicht aus körnigem Betonit auf den schaumbedeckten Träger;
- Aufsprühen des Klebstoffes als eine wässrige Lösung auf die vorgenannte Schicht;
- Bedecken der Betonischicht mit einem zweiten flexiblen, durchlässigen Träger;
- Trocknen des auf diese Weise erhaltenen Produkts unter Wärmezufuhr;
- Pressen des auf diese Weise hergestellten Produkts unter Wärmezufuhr, um so die Vielzahl der gleichmäßig auf einen der Träger verteilten Eindrückungen herzustellen.

8. Verfahren nach Anspruch 7, bei dem ein erster Träger aus einem synthetischen Polypropylengewebe Anwendung findet, mit dem eine nicht gewebte Einlage aus Nylon vernadelt ist, sowie ein zweiter, durchlässiger Träger aus einem Polyestergewebe.

9. Vorrichtung nach Anspruch 7 und Anspruch 8, bei dem als Klebstoff ein Schaum aus einer wässrigen Klebstofflösung mit einem oberflächenaktiven Wirkstoffanteil von 0,2 bis 3% Verwendung findet.

10. Verfahren nach den An;prüchen 7 bis 9, bei dem die Menge des verwendeten Klebstoffes zwischen 500 und 1500 g/m^2 beträgt.

11. Verfahren nach Anspruch 10, bei dem die Menge des verwendeten Klebstoffes zwischen 700 und 1000 g/m^2 beträgt.

12. Verfahren nach den Ansprüchen 7 bis 11, bei dem ein Klebstoff Verwendung findet, dem Natriumhydroxid zugegeben ist, um einer pH-Wert von 8 zu erreichen.

13. Verfahren nach den Arsprüchen 7 bis 12, bei dem dem Klebstoff plastifizierende Additive in einer Menge zwischen 0,5 und 3% des Betonitgewichtes zugegeben sind, die aus Verbindungen auf der Basis von Zellulose, Polyvinylalkohol, Polyakryladen ausgewählt sind.

14. Verfahren nach den Ansprüchen 7 bis 13, bei dem

Betonit Verwendung findet, dessen Korngröße zwischen 0,5 und 5 mm liegt.

Revendications

1. Panneau pour imperméabiliser un terrain et des travaux hydrauliques et de constructive, comprenant une couche de bentonite granulaire collée entre deux structures synthétiques perméables, caractérisé par le fait qu'il comporte un copolymère d'esters acryliques d'alcools inférieurs comme une substance adhésive ayant de telles propriétés qu'elle se réhydrate et se dissout relativement lentement en présence d'eau.

2. Panneau pour imperméabiliser selon la revendication 1, dans lequel ladite couche de bentonite est comprise entre une première feuille comprenant une structure de polypropylène piquetée dans sa masse avec une structure de nylon non-tissée et une seconde feuille constituée d'une structure de polyester.

3. Panneau pour imperméabiliser selon les revendications précédentes, dans lequel la face dudit panneaux constituée par ladite structure de polyester présente une pluralité d'empreintes réparties de façon uniforme.

4. Panneau pour imperméabiliser selon les revendications précédentes, dans lequel la teneur en bentonite est comprise entre 4 et 6 kg par mètre carré.

5. Panneau pour imperméabiliser selon les revendications précédentes, dans lequel la granulométrie de la bentonite est comprise entre 0,5 et 5 mm.

6. Panneau pour imperméabiliser selon les revendications précédentes, dans lequel ladite substance adhésive est le produit commercialisé sous le nom: POLICRIL 305/RB.

7. Procédé pour réaliser un panneau pour imperméabiliser un terrain et des travaux hydrauliques et de construction, comprenant une couche de bentonite granulaire, caractér sé par le fait qu'il comprend les étapes suivantes:

   - répartir, sur un premier support perméable flexible, une mousse d'une substance adhésive formée d'un copolymère d'esters acryliques d'alcools inférieurs ayant de telles propriétés qu'elle se réhydrate et se dissout relativement lentement en présence d'eau;
   - disposer ladite couche de bentonite granulaire sur ledit support recouvert de mousse;
   - pulvériser une solution aqueuse de ladite substance adhésive sur ladite couche;
   - recouvrir ladite couche de bentonite d'un second support perméable flexible;
   - sécher, en le chauffant, le produit manufacturé ainsi obtenu;
   - presser à chaud le procuit manufacturé pour réaliser, sur l'un des supports, des empreintes réparties de façon uniforme.

8. Procédé selon la revendication 7, dans lequel ledit premier support est constitué d'une structure synthétique en polypropylène piquetée dans la masse avec une structure de nylon non-tissée, ledit second support perméable étant constitué d'une structure de polyester.

9. Procédé selon les revendications 7 et 8, dans lequel la substance adhésive sous la forme d'une mousse est une solution aqueuse de ladite substance adhésive contenant entre 0,2% et 3% d'un dérivé tensio-actif.

10. Procédé selon les revendications 7 à 9, dans lequel la quantité de substance adhésive utilisée est comprise entre 500 et 1500 g/m^2.

11. Procédé selon la revendication 10, dans lequel la quantité de substance adhésive utilisée est comprise entre 700 et 1000 g/m^2.

12. Procédé selon les revendications 7 à 11, dans lequel de l'hydroxyde de sodium est ajouté à la substance adhésive pour atteindre un pH de 8.

13. Procédé selon les revendications 7 à 17, dans lequel on ajoute à la substance adhésive une quantité d'additifs plastifiants choisis parmi des compositions à base de cellulose, d'alcool polyvinyl, de polyacrylates comprise entre 0,5% et 3% du poids de bentonite.

14. Procédé selon les revendications 7 à 13, dans lequel la bentonite utilisée a une granulométrie comprise entre 0,5 et 5mm.