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(54) **A waterproof membrane**

Wasserdichte Membran

Membrane étanche à l'eau

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Description

THE PRESENT INVENTION relates to a method of forming a waterproof membrane.

There has, for a long time, been a requirement for a resilient and durable waterproof membrane which is economic and straightforward to manufacture to form a coating on a roof, lining for a tunnel, a tank, a swimming pool, a basement, or to form a protective coating for machinery.

EP-A-73564 discloses a roofing system which incorporates a waterproof membrane.

US-A-3937640 discloses a self-adhesive multi-layer laminated bituminous roofing membrane. The membrane is produced by uniting a bitumen-coated base sheet and a release sheet. The membrane can be applied over a substrate in a simple manner without melting or liquifying bitumen.

FR-A-2608549 relates to a protective coating of fibre reinforced elastomeric material intended for use on ship hulls and for marine structures. The Specification discloses coating a surface to be protected with an elastomeric skin made up of layers of textile fibres chosen for mechanical properties and an elastomeric coating the vulcanisation of which is done in situ. The Specification teaches that organic elastomers, polyurethanes, acrylics or other materials may be used for the coating.

FR-A-2433497 discloses a waterproof and non-slip/skid coating for a roadway. The Specification teaches that a non-woven material made from synthetic fibres may be stuck to a roadway by an epoxy resin emulsion. The Specification teaches that the epoxy resin may incorporate coal tar.

According to this invention there is provided a method of forming a waterproof membrane which forms a coating on a roof, a lining in a tunnel, a tank, a swimming pool or a basement, or which forms a protective coating on machinery, the method comprising the steps of initially taking a first mixture of silicone polymer, plasticiser and solvent, and a separate mixture of an accelerator, a cross-linking agent and solvent, admixing the two mixtures to form a curable composition, the curable composition comprising between 35 and 50% by weight silicone polymer, between 15 and 25% by weight plasticiser, between 1 and 3% by weight cross-linker and between 0.015 and 0.03% accelerator, with solvent making the composition up to 100%, and immediately after the admixing step coating a surface where the membrane is to be provided with the curable composition, applying, to the coated surface, a matrix which consists of a body formed from a plurality of fibres, the body being adapted to absorb the curable composition in a liquid state, and applying more of the curable composition to the exposed areas of the matrix so that the matrix is fully impregnated with the curable composition, the method comprising the further step of permitting the curable composition to cure to form a silicone rubber material to provide said waterproof membrane.

The method comprises the step of initially admixing two mixtures to form a curable composition. The curable composition is then immediately used to form the waterproof membrane. In the method of the invention, a specific curable composition is utilised.

Conveniently said matrix consists of a non-biodegradable material.

Advantageously the matrix consists of a material made from polyester fibres.

Preferably the matrix is a non-woven matrix.

Conveniently the matrix has an initial thickness of 3 millimetres prior to impregnation.

Preferably the silicone polymer comprises a hydroxyl ended dimethyl polysiloxane.

Preferably the accelerator comprises an organo-tin compound.

Preferably the cross-linker is an acetoxy-silane, a modified ketoximosilane, or methyl ethyl ketoxine.

Alternatively the cross-linker is a mixture of methyl tris (methyl ethyl ketoxamino) silane with an amino silane.

The plasticiser may comprise an alpha-w-dimethyl poly dimethyl siloxane.

Advantageously the accelerator is dibutyl-tin dilaurate.

Conveniently the solvent comprises 1,1,1,-trichloroethane.

Alternatively the solvent comprises a mixture of 1,1,1,-trichloroethane and white spirit.

Preferably the solvent comprises 50% or more trichloroethane.

In some embodiments the solvent comprises 25% or more trichloroethane.

Conveniently the mixture consists of 40 to 44% by weight polymer.

Advantageously the mixture consists of between 18 to 22% by weight plasticiser.

Preferably the mixture consists of between 2 to 2.5% by weight cross-linker.

Conveniently the mixture comprises 0.02 to 0.025% accelerator.

Conveniently the curable composition is initially sprayed on to the surface to be protected to form a coating of the curable composition and is finally sprayed on to the matrix when the matrix is in position.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example.

The invention provides a method of forming a waterproof membrane which consists of a matrix which is impregnated with a curable silicone rubber material.

The matrix may be of any convenient form, provided it can absorb the silicone rubber material in the uncured state.

The matrix may consist of many alternate materials. The matrix may, for example consist of a bio=degradable woven material, such as hessian, or may preferably

consist of a non-biodegradable material, that is to say a material made from a synthetic or man-made fibre such as polyester. It has been found that very good results are obtained using a non-woven material as the matrix, in the form of a fleece formed from a polyester fibres. The fleece is needled, but is not a woven fabric. Such a matrix presents a large number of randomly oriented fibres, defining a large number of interstices which can absorb the silicone rubber material in the uncured state. Of course, matrices of other particular forms may provide a similar effect. Thus a fabric woven from strands or filaments of polyester which present a large number of protruding fibres may well be found to be satisfactory, as may a material having a formation similar to that of velvet.

The preferred polyester fleece has a thickness, before impregnation, of approximately 3 millimetres.

In forming the waterproof membrane by the method of the invention, the matrix is impregnated with a composition which cures or sets to form a silicone rubber. The composition with which the matrix is impregnated consists of a mixture of a silicone polymer, a cross-linker, a plasticiser, an accelerator and a solvent.

The composition may be provided as two mixtures in two separate drums to be admixed on site to form the curable composition. One drum may contain the silicone polymer, the plasticiser and some solvent, and the other drum may contain the accelerator and cross-linking agent together with some solvent. It is to be understood that in such a situation the contents of the two drums would be mixed immediately before the impregnating step.

The silicone polymer may be a hydroxyl ended dymethyl polysiloxane. It is preferred to utilise a silicone polymer having a viscosity of approximately 50,000 c.p.s., although polymers having a greater or lower viscosity may be utilised. The viscosity is, of course, a measure of the molecular weight of the polymer. The typical formula for the silicone polymer would be $HO-(Si(CH_3)_2-O)_n-H$.

The cross-linking agent may be a silane. In some cases it may be appropriate to use an acetoxysilane of the type having the formula $(R)_4$-N-Si-$(O.CO.CH_3)_n$ where R is one of the radicals $-CH_3$; $-CH_2.CH_3$; or -O-C-$(CH_3)_3$. One disadvantage of such cross-linking agents is that during the curing or setting stage acetic acid fumes are generated, which in certain circumstances can be very disadvantageous, especially if the setting or curing reaction is being carried out within a confined space. Thus, it is preferred to use as a cross-linking agent a modified ketoximosilane or a methylethylketoxine. The preferred cross-linking agent is a mixture of methyl tris (methyl ethyl ketoxamino) silane with amino silane. Such a mixture is sold by ICI under the trade designation Silcane Sealant Cross-Linking Agent Number 8.

The plasticiser utilised may be a silicone oil such as an alpha-w-dimethyl poly dimethyl siloxane, as sold by IUCI under the trade designation F 111.

The accelerator utilised may be an organo-tin compound and is preferably dibutyl-tin dilaurate, but other materials may be utilised such as stannous octoate or a platinum salt.

Whilst any appropriate solvent may be utilised it is preferred to use 1,1,1,-trichloroethane, or a mixture of 1,1,1,-trichloroethane and white spirit. In such a mixture preferably there is 50 per cent or more trichloroethane. If the trichloroethane concentration is reduced to 25% the resultant mix is, at ordinary temperatures, very viscous.

The preferred mixture of these components, consists of between 35 and 50% by weight polymer, preferably 40 to 44% by weight polymer, between 15 and 25% by weight plasticiser, preferably 18 to 22% by weight plasticiser, between 1 and 3% by weight cross-linker, preferably 2 to 2.5% by weight cross-linker, and between 0.015 and 0.03% accelerator, preferably 0.02 to 0.025% accelerator. Solvent is used to bring the mixture up to 100%.

During the curing process the silicone polymer molecules cross-link, thus forming a rubber having a very high molecular weight.

It may be found that less accelerator is necessary in hot weather.

The silicone rubber material is flexible but has significant strength, the strength being enhanced by the matrix which is fully embedded therein. The silicone rubber is resistant to ultra-violet light and maintains flexibility over a very wide range of temperatures between at least -60°C and + 150°C. The membrane thus created is waterproof, but is gas permeable.

In the method of the invention the matrix is impregnated with the mixture that sets to form the silicone rubber in situ. Thus, if a flat surface is to be provided with a waterproof membrane it is envisaged that after the surface has been prepared, the surface would be sprayed or otherwise coated with a preliminary layer of the mixture which sets to form the silicone rubber as described above. This mixture will therefore enter all the nooks and crannies present on the surface. Subsequently the matrix, in the form of the polyester fleece described above will be located in position on top of the initial layer of curable material. The fleece will be cut to size so that, as far as is practicable, the entire surface of the initial layer of the curing composition is covered with at least one layer of the fleece. At the edges of the discrete elements of fleece, the fleece may overlap itself. Subsequently a further layer of the curable material is applied to the top surface of the fleece, this layer fully impregnating the fleece. The curable composition is then left to cure. The end result is that since the fleece is fully impregnated, all the curable composition sets to form effectively an integral layer or element of silicone rubber in which the fleece is fully embedded. The layer of silicone rubber is firmly adhered to the surface sub-structure, thus providing a durable waterproof coating. Since

the silicone rubber material is inherently flexible, even if the sub-structure of the surface should move, due to settlement, or due to thermal expansion and contraction, the silicone rubber will be able to accommodate such movement without tearing and without otherwise being damaged. Even if the surface is exposed to direct sunlight, which contains ultra-violet light, the silicone rubber material will not deteriorate.

It is envisaged that waterproof membranes as described above may find many different applications. It will readily be appreciated that such a waterproof membrane may be utilised as a tank lining, or as a lining for a swimming pool, or as a lining for a basement or other parts of a building subjected to damp. Such a membrane may be incorporated within the foundations of a building, particularly if the building is of the type which is formed with an integral concrete floor slab. However, it is also envisaged that a waterproof membrane as described may find other applications. For example, such a waterproof membrane may be provided on the exterior of items of machinery which operate within a hostile environment, such as pumps as used in water-works, sewage farms or the like. At the present point in time any such pumps have to be fabricated from corrosion-resistant material, such as stainless steel, which means that such pumps are very expensive. However, it is envisaged that the exterior of such a pump may be provided with a protective coating effectively formed from a waterproof membrane as described above, thus enabling the pump to be manufactured initially of a much cheaper material.

It is envisaged that the curable mixture may, if desired, contain appropriate dyes or colourants, so that the membrane, when manufactured, has a desired colour.

Claims

1. A method of forming a waterproof membrane which forms a coating on a roof, a lining in a tunnel, a tank, a swimming pool or a basement, or which forms a protective coating on machinery, the method comprising the steps of initially taking a first mixture of silicone polymer, plasticiser and solvent, and a separate mixture of an accelerator, a cross-linking agent and solvent, admixing the two mixtures to form a curable composition, the curable composition comprising between 35 and 50% by weight silicone polymer, between 15 and 25% by weight plasticiser, between 1 and 3% by weight cross-linker and between 0.015 and 0.03% accelerator, with solvent making the composition up to 100%, and immediately after the admixing step coating a surface where the membrane is to be provided with the curable composition, applying, to the coated surface, a matrix which consists of a body formed from a plurality of fibres, the body being adapted to absorb the curable composition in a liquid state, and applying more of the curable composition to the exposed areas of the matrix so that the matrix is fully impregnated with the curable composition, the method comprising the further step of permitting the curable composition to cure to form a silicone rubber material to provide said waterproof membrane.

2. A method according to Claim 1 wherein said matrix consists of a non-biodegradable material.

3. A method according to Claim 3 wherein the matrix consists of a material made from polyester fibres.

4. A method according to any one of the preceding Claims wherein the matrix is a non-woven matrix.

5. A method according to any one of the preceding Claims wherein the matrix has an initial thickness of 3 millimetres prior to impregnation.

6. A method according to any one of the preceding Claims wherein the silicone polymer comprises a hydroxyl ended dimethyl poly siloxane.

7. A method according to any one of the preceding Claims wherein the accelerator comprises an organo-tin compound.

8. A method according to any one of the preceding Claims wherein the cross-linker comprises acetoxysilane, modified ketoximosilane or methyl ethyl ketoxine.

9. A method according to any one of Claims 1 to 7 wherein the cross-linker is a mixture of methyl tris (methyl ethyl ketoxamino) silane with an amino silane.

10. A method according to any one of the preceding Claims wherein the plasticiser is alpha-w-dimethyl poly dimethyl siloxane.

Patentansprüche

1. Ein Verfahren zur Herstellung einer wasserdichten Membran, die eine Abdeckung auf einem Dach, eine Auskleidung in einem Tunnel, einem Tank, einem Swimmingpool oder einem Keller bildet oder die einen Schutzüberzug auf Maschinen bildet, wobei das Verfahren die Schritte umfaßt, daß zunächst eine erste Mischung aus Silikonpolymer, Weichmacher und Lösungsmittel und eine getrennte Mischung aus einem Beschleuniger, einem Vernetzungsmittel und Lösungsmittel genommen wird, daß die zwei Mischungen vermischt werden, um eine aushärtbare Zusammensetzung zu bilden, wobei die aushärtbare Zusammensetzung zwischen

35 und 50 Gew.-% Silikonpolymer, zwischen 15 und 25 Gew.-% Weichmacher, zwischen 1 und 3 Gew.-% Vernetzungsmittel und zwischen 0,015 und 0,03 % Beschleuniger umfaßt, wobei Lösungsmittel den Rest der Zusammensetzung auf 100 % ausmacht, und daß unmittelbar nach dem Vermischungsschritt eine Oberfläche, auf der die Membran bereitgestellt werden soll, mit der aushärtbaren Zusammensetzung beschichtet wird, auf die beschichtete Oberfläche eine Matrix aufgebracht wird, die aus einem Körper besteht, der aus einer Vielzahl von Fasern gebildet ist, wobei der Körper so ausgelegt ist, daß er die aushärtbare Zusammensetzung in einem flüssigen Zustand absorbiert, und mehr von der aushärtbaren Zusammensetzung auf die freien Flächen der Matrix aufgebracht wird, so daß die Matrix vollständig mit der aushärtbaren Zusammensetzung imprägniert wird, wobei das Verfahren den weiteren Schritt umfaßt, daß man die aushärtbare Zusammensetzung aushärten läßt, um ein Silikonkautschukmaterial zu bilden, um besagte wasserdichte Membran bereitzustellen.

2. Ein Verfahren nach Anspruch 1, wobei besagte Matrix aus einem biologisch nicht-abbaubaren Material besteht.

3. Ein Verfahren nach Anspruch 3, wobei die Matrix aus einem aus Polyesterfasern hergestellten Material besteht.

4. Ein Verfahren nach einem der vorangehenden Ansprüche, wobei die Matrix eine nicht-verwobene Matrix ist.

5. Ein Verfahren nach einem der vorangehenden Ansprüche, wobei die Matrix eine Anfangsdicke von 3 mm vor der Imprägnierung aufweist.

6. Ein Verfahren nach einem der vorangehenden Ansprüche, wobei das Silikonpolymer ein Dimethylpolysiloxan mit Hydroxyl-Endgruppen umfaßt.

7. Ein Verfahren nach einem der vorangehenden Ansprüche, wobei der Beschleuniger eine zinnorganische Verbindung umfaßt.

8. Ein Verfahren nach einem der vorangehenden Ansprüche, wobei das Vernetzungsmittel Acetoxysilan, modifiziertes Ketoximosilan oder Methylethylketoxin umfaßt.

9. Ein Verfahren nach einem der Ansprüche 1 bis 7, wobei das Vernetzungsmittel eine Mischung aus Methyl-tris(methylethyl-ketoxyamino)silan mit einem Aminosilan ist.

10. Ein Verfahren nach einem der vorangehenden Ansprüche, wobei der Weichmacher alpha-w-Dimethylpolydimethylsiloxan ist.

Revendications

1. Procédé de formation d'une membrane étanche à l'eau qui forme un revêtement sur un toit, un revêtement dans un tunnel, un réservoir, une piscine ou un sous-sol, ou qui forme un revêtement protecteur sur une machine, le procédé comprenant les étapes consistant à former initialement un premier mélange de polymère de silicone, de plastifiant et de solvant, et un mélange séparé constitué d'un accélérateur, d'un agent de réticulation et d'un solvant, à mélanger les deux mélanges pour former une composition durcissable, la composition durcissable comprenant entre 35 et 50 % en poids de polymère de silicone, entre 15 et 25 % en poids de plastifiant, entre 1 et 3 % en poids d'agent de réticulation et entre 0,015 et 0,03 % d'accélérateur, le solvant complétant la composition jusqu'à 100 % et, immédiatement après l'étape de mélange, les étapes consistant à revêtir, avec la composition durcissable, une surface où la membrane doit être appliquée, à appliquer, sur la surface revêtue, une matrice qui est constituée d'un corps formé de plusieurs fibres, le corps étant adapté pour absorber la composition durcissable à l'état liquide, et à appliquer encore de la composition durcissable sur les aires exposées de la matrice de façon que la matrice soit totalement imprégnée avec la composition durcissable, le procédé comprenant l'étape supplémentaire consistant à laisser la composition durcissable durcir pour former une matière de caoutchouc de silicone et fournir ladite membrane étanche à l'eau.

2. Procédé selon la revendication 1, dans lequel ladite matrice est constituée d'une matière non biodégradable.

3. Procédé selon la revendication 1, dans lequel la matrice est constituée d'une matière préparée à partir de fibres de polyester.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel la matrice est une matrice non tissée.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel la matrice a une épaisseur initiale de 3 mm avant l'imprégnation.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel le polymère de silicone comprend un diméthylpolysiloxane à extrémités hydroxyles.

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'accélérateur comprend un composé organoétain.

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'agent de réticulation comprend un acétoxysilane, un cétoximosilane modifié ou une méthyl-éthylcétoxine.

9. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel l'agent de réticulation est un mélange de méthyltris(méthyléthylcétoxamino)silane avec un amino-silane.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel le plastifiant est un alpha-W-diméthylpolydiméthylsiloxane.