

Description

This invention relates to protective waterproofing membranes. More specifically the present invention is directed to a bituminous waterproofing sheet material having at least one major surface coated with a non-tacky polymeric coating composition. The polymeric coating composition is capable of adhering to freshly poured concrete surfaces and to the cured concrete substructure, and also provides a protective coating during storage and application of the sheet material.

It is known that concrete surfaces and the like can be sealed in a waterproof manner by forming or applying thereon a membrane of a bituminous composition such as asphalt, tar, pitch, or other material which is substantially impermeable to moisture and water vapor. Preformed rubberized asphalt sheet-like materials useful for this purpose are well known. Examples of these materials are disclosed in U.S. Patent Nos. 3,741,856; 3,853,682, 3,900,102 and 4,215,160. These waterproofing materials have a laminate structure comprising a support sheet having at least one major surface coated with a membrane of a bituminous composition. The bituminous composition has adhesive properties which render it adherent to the support sheet and to the substructure, such as a concrete slab, to which it is applied.

The laminated structures currently available are supplied in the form of rolls. In this form, the laminated structure further comprises a flexible release sheet, such as in the form of a siliconized paper, positioned adjacent to the surface of the bituminous membrane which after removal of the release sheet will eventually be placed in contact with a concrete substructure. This release sheet is needed prior to application to prevent the adhesive membrane from adhering to the sheet immediately adjacent thereto and to protect the adhesive membrane layer from various forms of degradation. This release sheet must be removed to expose the adhesive membrane when applying the waterproofing sheet material to the substructure.

This type of waterproofing sheet material is normally applied after the concrete substructure has been formed. Usually these substructures, such as building foundations, are situated with sufficient space around their perimeter to allow the application of these waterproofing sheets. However, in urban locations, as well as elsewhere, structures are built closely between existing foundations. In fact, to maximize the utility of the land, new buildings are often built directly adjoining the existing ones. Thus, there is no room to apply an external waterproofing sheet. In such situations it is advantageous to pre-apply the waterproofing material in a manner to have it become an integral part of the part of the ultimately formed concrete substructure formation. Typically, this is done by applying the waterproofing material to an outer concrete form, known as lagging.

However, the conventional laminated structure of the bituminous waterproofing sheet material and release sheet presents problems of removal and disposal of the release sheets. This is particularly true when re-bars and inner concrete forms are placed in front of the lagging prior to casting the concrete.

An object of this invention is to provide a waterproofing sheet material capable of adhering to freshly poured concrete compositions and the cured substructures formed therefrom.

Another object of this invention is to provide a laminate sheet material comprising an adhesive sheet-like bituminous waterproofing membrane with a non-tacky surface that is capable of adhering to freshly poured concrete compositions and the cured substructures formed therefrom.

In accordance with this invention, there have been provided certain novel adhesive waterproof sheet materials which comprise adhesive bituminous membranes having at least one major surface coated with a tack-free composition, which, when contacted with the freshly poured concrete, are capable of providing adhesive capability between the membrane and the freshly poured concrete surface. The waterproofing sheet materials of this invention are prepared by coating at least one major surface of a bituminous membrane with a water-insoluble polymeric composition comprised of a polymer selected from a polyvinyl alcohol or an alpha-beta ethylenically unsaturated carboxylic acid or esters thereof.

The present invention is therefore directed to a waterproof coating for application to concrete comprising a bituminous sheet having at least one major surface coated with a tack-free coating comprising a water-insoluble polymer, which is a polyvinyl alcohol or an α - β -ethylenically unsaturated carboxylic acid or ester polymer, the polymer coating being capable of adhering to freshly poured concrete compositions and to the cured concrete formed therefrom.

The invention further provides a method of providing a waterproof bituminous coating to a concrete structure which method comprises providing a concrete form having a cavity, the outer member of which comprises lagging, applying to the inner surface of the outer member such a coating with the bituminous sheet facing the lagging and the tack-free coating adjacent the cavity of the form, and pouring a concrete composition into the cavity to form a concrete having the waterproof bituminous coating adhered thereto.

The polymer coating may optionally have therein a filler capable of absorbing or reflecting infrared or ultra violet radiation and/or plasticiser. For the purposes of this invention, the term "water soluble" polymer refers to those polymers which, after application to the membrane are insoluble in water under ambient temperature

conditions. The water-insoluble polymer for use in this invention is in one embodiment alpha-beta-ethylenically unsaturated carboxylic acid polymer or copolymer of in an alternative embodiment polyvinyl alcohol polymer.

The preferred alpha-beta ethylenically unsaturated carboxylic acid polymers for use in this invention include, but are not limited to, the various homopolymers and co-polymers of acrylic acid, C₁-C₃ alkyl substituted acrylic acid, and esters thereof such as acrylic acid, methacrylic acid, ethacrylic acid, methyl acrylate, ethyl acrylate, n-propyl acrylate, methyl methacrylate, methyl ethacrylate, isopropylacrylate, n-butyl acrylate, isobutyl acrylate, tert-butyl acrylate; copolymers of olefin-acrylic acid or esters such as, ethylene acrylic acid; as well as homo and copolymers of dicarboxylic acids, their esters and anhydrides, such as styrene-maleic anhydride, itaconic acid, maleic acid, fumaric acid, and the like, and mixtures thereof.

The preferred polyvinyl alcohols for use in this invention are those that: a) are at least 97% hydrolyzed and are preferably completely hydrolyzed, b) have a high molecular weight, preferably having a number molecular weight of about 105,000 to about 110,000, and a weight average molecular weight of about 195,000 to about 205,000, and c) a degree of polymerization of about 2400 to about 2500.

A plasticizer may optionally be added to the polymeric coating to enhance the flexibility of the coating and is added in a weight proportion of polymer:plasticizer in the range 1:0-0.7. Suitable plasticizers for addition to the polyvinyl alcohol include, but are not limited to, glycerin, sodium thiocyanate, polyethoxylated sorbitol, triethanol amine neutralized with acetic acid, diethylene triamine, and the like, and mixtures thereof. Suitable plasticizers for addition to the alpha-beta ethylenically unsaturated carboxylic acid polymers include, but are not limited to, triaryl phosphate, N-n-butylbenzenesulfonamide, primary alcohol ethoxylate, sulfonate type polymers such as salts of naphthalene sulfonate-formaldehyde condensate, and the like, and mixtures thereof. Various other plasticizers are well known to those skilled in the art, and the choice of a particular plasticizer is not critical per se to the invention, provided, however, that the particular plasticizer enhances the flexibility of the final dried polymeric coating to aid in the application of the bituminous sheets to the lagging without having excessive cracking in the coating.

A filler material capable of absorbing or reflecting ultraviolet and infrared radiation may also be added to the polymeric coating to protect the waterproof bituminous sheets from the effects of outdoor exposure. Suitable fillers for use in this invention, effective as ultra violet absorbing or reflecting, infrared reflecting agents include, but are not limited to, silica sand, titanium dioxide, carbon black, aluminum powder, calcium carbonate, talc, delaminated hydrous kaolin, surface modified calcined kaolin and the like, and mixtures thereof. The preferred mesh size for these fillers is in the range 70 to 325 mesh and is preferably 150 to 225 mesh. The most preferred filler is a 200 mesh silica sand. The final polymeric coating contains a weight proportion of polymer:filler in the range 1:8-11, and preferably 1:9-10.

In a preferred embodiment, the non-tacky coating composition of this invention is prepared by adding powdered polyvinyl alcohol (PVA) to water with rapid stirring while slowly heating until almost boiling. The PVA solution is then cooled, and a 200 mesh silica sand filler and glycerin plasticizer are then added with stirring to form a coating composition. The final coating composition is a suspension containing a weight proportion of PVA:filler:plasticizer 1:10:0.5.

The coating suspension can then be coated onto one or both sides of the adhesive waterproofing bituminous sheets to give a dry loading in the range 7 g/ft² to 10 g/ft². The coating suspension can be applied to the bituminous sheet by any of the various techniques known to those skilled in the art including, but not limited to, roller application, spray application, immersion, co-extrusion and the like. After drying, the coated surface of the bituminous sheet is non-tacky, insoluble in water under ambient temperature conditions, impervious to degradation by ultraviolet radiation, reflective so as to reduce solar heating, and yet permits the formation of a strong adhesive bond between the membrane and the cured concrete substructure when contacted with freshly poured concrete.

It is believed that one skilled in the art, using the preceding detailed description, can utilize the present invention to its fullest extent. The principles, preferred embodiments and modes of operation of the present invention have been described in the foregoing specification. The following examples are provided to illustrate the invention in accordance with the principles of this invention, but is not to be construed as limiting the invention in any way except as indicated in the appended claims. Variations and changes may be made by those skilled in the art without departing from the spirit of the invention. All parts and percentages are by weight unless otherwise indicated.

Example 1

A non-tacky coating composition was prepared by adding polyvinyl alcohol (PVA) (commercially available from du Pont as Elvanol H.V.) to water with rapid stirring at room temperature and then heated to almost boiling. Upon cooling, a finely powdered silica sand having a particle size distribution of:

<u>Mesh</u>	<u>Weight %</u>
+ 70	0
70-200	24.2
200-325	47.4
- 325	28.4

was added to the PVA solution together with glycerin at a weight proportion of 1:10:0.5 of PVA:silica:glycerin. The mixture was coated onto the adhesive side of a bituminous sheet in an amount to give a dry loading of 8.6 g/Ft². The coated membrane was exposed outdoors for varying times up to eight weeks, and then had concrete poured against them. After the concrete cured for one week, the adhesive strength was determined in a 90° peel test at 2 inches/minute. The results are as follows:

<u>Exposure (weeks)</u>	<u>Peel Strength (pounds/inch)</u>
0	12.5
2	11.8
4	12.5
8	12.5

All samples exhibited strong adhesive bonding at the concrete-membrane interface, and samples separated in the asphalt layer rather than at the interface.

Example 2

This example illustrates the use of alpha-beta ethylenically unsaturated carboxylic acid polymer coatings on the bituminous membranes. The bituminous membranes were coated on a dry loading basis with a commercial solution of 20% polyacrylic acid solution and 20% TiO₂. The membranes were exposed to the outdoor elements for various times and evaluated for peel strengths. The results are outlined in Table 1.

TABLE 1
Peel Strengths of Coated Samples/Effect of Contact Time

Sample No.	Coating, (a) g/ft ² mils	90° Peel Strength, lbs/in (Z Cohesive Failure)											
		1 Day		2 Days		7 Days		14 Days		28 Day			
		V	H	V	H	V	H	V	H	V	H		
1	0	10.8(100)	11.7(90)	10.2(100)	11.3(100)	11.7(60)	11.0(90)	11.8(70)	10.0(90)	10.3(40)	8.7(100)		
2	0.41	10.3(100)	13.2(90)	11.0(60)	12.7(90)	11.7(L)	11.0(L)	11.7(60)	10.7(60)	12.5(10)	11.0(90)		
3	0.52	11.7(100)	10.3(100)	10.2(100)	12.5(100)	12.0(80)	11.3(90)	11.3(80)	9.2(L)	11.3(80)	10.7(100)		
4	0.56	11.2(90)	12.8(100)	11.3(60)	12.0(90)	11.7(50)	10.0(L)	11.7(10)	11.4(90)	10.0(95)	10.0(95)		
5	1.22	10.7(100)	8.7(L)	9.3(100)	11.7(100)	10.0(90)	9.0(90)	10.8(90)	8.2(100)	11.7(30)	9.2(95)		
6	1.44	10.0(90)	8.7(L)	10.0(100)	10.8(100)	8.3(100)	10.5(100)	10.7(80)	10.0(90)	2.0(100)	8.2(90)		
7	1.76	9.0(100)	10.5(100)	5.8(100)	10.0(100)	1.2(100)	5.0(100)	10.0(100)	3.8(100)	2.3(100)	2.5(100)		
8	2.54	4.2(100)	9.2(100)	6.0(100)	5.8(100)	2.3(100)	2.3(100)	1.7(100)	2.5(100)	2.3(100)	2.5(100)		

V = Vertical cast concrete
H = Horizontal cast concrete
L = Polyethylene delaminated during peel test.

Example 3

The experiment as described in Example 2 was repeated except that various other alpha-beta ethylenically unsaturated carboxylic acid polymers as indicated in Table 2 were used in the coating composition.

Table 2
Adhesive Strengths of Coated Samples

	Coating	Loading g/ft ²	Peel Strengths, ppi after QUV exposure of			
			0	1 wk.	2 wks.	4 wks.
5	Ethylene acrylic acid ⁽¹⁾	.59	.8	0.5	9.0	10.5
10	Ethylene acrylic acid + TiO ₂	1.07	10.0	10.0	6.3	2.5
	Ethylene acrylic acid + C	.40	8.8	9.0	7.6	8.8
	BT-8	.51	7.5			
	BT-8/TiO ₂	.64	11.5			
15	BT-8/C	.54	2.5			

QUV = The Q-Panel Co., Cleveland, Ohio.

(1) Commercially available as 5120 from Allied Corporation

BT-8 = acrylic coating commercially available from ICI.

C = Vulcan carbon black dispersed with the sodium salt of naphthaline sulfonate-formaldehyde condensate before use, commercially available as Daxad 19 from W. R. Grace & Co-Conn.

Example 4

The experiment as described in Example 2 was repeated except that various plasticizers were added to the alpha-beta ethylenically unsaturated carboxylic acid polymers.

Table 3
Adhesive Strengths of Plasticized Acrylic Coatings

No.	Formulation (gms)	g/ft ²	Peel Strengths, ppi after QUV exposure of	
			0 wk.	1 wk.
1	A(90)/TCP(10)	.41	13.8	11.0
2	A(135)/TCP(15)/C(3)	.71	8.8	3.8
3	A(90)/BSA(10)	.54	13.3	3.5
4	A(135)/BSA(15)/C(3)	.74	6.0	2.5
5	A(90)/23-65(15)/C(3)	.40	0	12.5
6	A(135)/BSA(15)/C(3)	.75	0	1.4

A = Polyacrylic acid solution

TCP = Triaryl phosphate commercially available from FMC
Kronitex

BSA = N-n-Butylbenzenesulfonamide commercially available
from CP Hall Plasthall

23-65 = linear primary alcohol ethoxylate commercially
available from Shell

C = Vulcan carbon black dispersed with the sodium salt of
naphthalene sulfonate-formaldehyde condensate before
use, commercially available as Daxad 19 from W. R.
Grace & Co-Conn.

Claims

1. A waterproof coating for application to concrete comprising a bituminous sheet having at least one major surface coated with a tack-free coating comprising a water-insoluble polymer, which is a polyvinyl alcohol or an α - β -ethylenically unsaturated carboxylic acid or ester polymer, the polymer coating being capable of adhering to freshly poured concrete compositions and to the cured concrete formed therefrom.
2. A waterproof coating according to claim 1 wherein the polymer coating comprises a plasticiser.
3. A waterproof coating according to claim 1 or 2 wherein the polymer coating comprises a filler material capable of absorbing or reflecting U.V. and I.R. radiation.
4. A waterproof coating according to claim 3 wherein the filler comprises silica sand, titanium dioxide, carbon black, aluminum powder, calcium carbonate, talc, kaolin, or a mixture thereof.
5. A waterproof coating according to any one of the preceding claims wherein the water-insoluble polymer is a polyvinyl alcohol having a degree of polymerisation of 2400 to 2500, a number average molecule weight of 105,000 to 110,000 and a weight average molecular weight of 195,500 to 203,500 and is over 97% hydrolysed.
6. A waterproof coating according to claim 5 wherein the polymer coating comprises, as plasticiser, polyethoxylated sorbitol, triethanol amine, diethylene triamine, glycerin or a mixture thereof.



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2. A waterproof coating according to claim 1 wherein the polymer coating comprises a plasticiser.
3. A waterproof coating according to claim 1 or 2 wherein the polymer coating comprises a filler material capable of absorbing or reflecting U.V. and I.R. radiation.
4. A waterproof coating according to claim 3 wherein the filler comprises silica sand, titanium dioxide, carbon black, aluminum powder, calcium carbonate, talc, kaolin, or a mixture thereof.
5. A waterproof coating according to any one of the preceding claims wherein the water-insoluble polymer is a polyvinyl alcohol having a degree of polymerisation of 2400 to 2500, a number average molecule weight of 105,000 to 110,000 and a weight average molecular weight of 195,500 to 203,500 and is over 97% hydrolysed.
6. A waterproof coating according to claim 5 wherein the polymer coating comprises, as plasticiser, polyethoxylated sorbitol, triethanol amine, diethylene triamine, glycerin or a mixture thereof.



7. A waterproof coating according to any one of claims 1 to 4 wherein the water-insoluble polymer is an α - β -ethylenically unsaturated carboxylic acid polymer which comprises acrylic acid, methyl acrylate, ethyl acrylate, n-propyl acrylate, isopropylacrylate, n-butyl acrylate, isobutyl acrylate, tert-butyl acrylate, ethylene acrylic acid, styrene-maleic anhydride, itaconic acid, maleic acid, fumaric acid, a mono ester of a dicarboxylic acid, or a mixture thereof.
8. A waterproof coating according to claim 7 wherein the polymer coating comprises, as plasticiser, a triaryl phosphate, N-n-butylbenzenesulfonamide, primary alcohol ethoxylate or sulfonate polymer, or a mixture thereof.
9. A method of providing a waterproof bituminous coating to a concrete structure which method comprises providing a concrete form having a cavity the outer member of which comprises lagging, applying to the inner surface of the outer member, a coating according to any one of claims 1 to 8 with the bituminous sheet facing the lagging and the tack-free coating adjacent to the cavity of the form, and pouring a concrete composition into the cavity to form a concrete having the waterproof bituminous coating adhered thereto.

Patentansprüche

1. Wasserdichte Beschichtung zur Aufbringung auf Beton, die eine bituminöse Folie umfaßt, bei der mindestens eine Hauptfläche mit einem nicht-klebenden Überzug beschichtet ist, der wasserunlösliches Polymer umfaßt, das ein Polyvinylalkohol oder ein α - β -ethylenisch ungesättigtes Carbonsäure- oder Carbonsäureesterpolymer ist, wobei der Polymerüberzug in der Lage ist, an frisch gegossenen Betonzusammensetzungen und an daraus gebildetem gehärtetem Beton zu haften.
2. Wasserdichte Beschichtung nach Anspruch 1, bei der der Polymerüberzug Weichmacher umfaßt.
3. Wasserdichte Beschichtung nach Anspruch 1 oder 2, bei der der Polymerüberzug Füllmaterial umfaßt, das in der Lage ist, UV- und IR-Strahlung zu absorbieren oder zu reflektieren.
4. Wasserdichte Beschichtung nach Anspruch 3, bei der der Füllstoff Siliciumdioxidsand, Titandioxid, Ruß, Aluminiumpulver, Calciumcarbonat, Talkum, Kaolin und/oder eine Mischung derselben umfaßt.
5. Wasserdichte Beschichtung nach einem der vorhergehenden Ansprüche, bei der das wasserunlösliche Polymer Polyvinylalkohol mit einem Polymerisationsgrad von 2400 bis 2500, einem durchschnittlichen zahlenmäßigen Molekulargewicht von 105000 bis 110000 und einem durchschnittlichen gewichtsmäßigen Molekulargewicht von 195500 bis 203500 ist und über 97% hydrolysiert ist.
6. Wasserdichte Beschichtung nach Anspruch 5, bei der die Polymerbeschichtung als Weichmacher polyethoxyliertes Sorbit, Triethanolamin, Diethylentriamin, Glycerin oder eine Mischung derselben umfaßt.
7. Wasserdichte Beschichtung nach einem der Ansprüche 1 bis 4, bei der das wasserunlösliche Polymer ein α - β -ethylenisch ungesättigtes Carbonsäurepolymer ist, das Acrylsäure, Methacrylat, Ethylacrylat, n-Propylacrylat, Isopropylacrylat, n-Butylacrylat, Isobutylacrylat, tert.-Butylacrylat, Ethylen-Acrylsäure, Styrol-Maleinsäureanhydrid, Itakonsäure, Maleinsäure, Fumarsäure, einen Monoester einer Dicarbonsäure oder eine Mischung derselben umfaßt.
8. Wasserdichte Membran nach Anspruch 7, bei der der Polymerüberzug als Weichmacher Triarylphosphat, N-n-Butylbenzolsulfonamid, primäres Alkoholethoxylat oder Sulfonatpolymer oder eine Mischung derselben umfaßt.
9. Verfahren zur Ausstattung einer Betonstruktur mit einer wasserdichten bituminösen Beschichtung, bei dem eine Betonform mit einem Hohlraum bereitgestellt wird, deren äußeres Element eine Verschalung umfaßt, auf die innere Oberfläche des äußeren Elements eine Beschichtung gemäß einem der Ansprüche 1 bis 8 aufgebracht wird, wobei die bituminöse Folie zur Verschalung weist und der nicht-klebende Überzug an den Hohlraum der Form angrenzt, und eine Betonzusammensetzung in den Hohlraum gegossen wird, um Beton zu bilden, der eine daran haftende wasserdichte bituminöse Beschichtung aufweist.

**Revendications**

1. Revêtement imperméable pour application à du béton, comprenant une feuille bitumineuse ayant au moins une surface majeure enduite d'un revêtement non adhésif comprenant un polymère insoluble dans l'eau, qui est un alcool polyvinylique ou un acide carboxylique à saturation α - β -éthylénique ou un polymère d'ester, le revêtement du polymère pouvant adhérer à des compositions de béton fraîchement versées et au béton durci qui en est formé.
2. Revêtement imperméable selon la revendication 1, où le revêtement du polymère comprend un plastifiant.
3. Revêtement imperméable selon la revendication 1 ou 2, où le revêtement du polymère comprend une matière de charge capable d'absorber ou de réfléchir des rayonnements ultraviolets et infrarouges.
4. Revêtement imperméable selon la revendication 3, où la charge comprend du sable de silice, du bioxyde de titane, du noir de carbone, de la poudre d'aluminium, du carbonate de calcium, du talc, du kaolin ou leur mélange.
5. Revêtement imperméable selon l'une quelconque des revendications précédentes, où le polymère insoluble dans l'eau est un alcool polyvinylique ayant un degré de polymérisation de 2.400 à 2.500, un poids moléculaire moyen en nombre de 105.000 à 110.000 et un poids moléculaire moyen en poids de 195.500 à 203.500 et il est hydrolysé à plus de 97%.
6. Revêtement imperméable selon la revendication 5, où le revêtement du polymère contient, comme plastifiant, du sorbitol polyéthoxylé, de la triéthanol amine, de la diéthylène triamine, de la glycérine ou un mélange.
7. Revêtement imperméable selon l'une quelconque des revendications 1 à 4, où le polymère insoluble dans l'eau est un polymère d'acide carboxylique à insaturation α - β -éthylénique qui comprend l'acide acrylique, l'acrylate de méthyle, l'acrylate d'éthyle, l'acrylate de n-propyle, l'acrylate d'isopropyle, l'acrylate de n-butyle, l'acrylate d'isobutyle, l'acrylate de butyle tertiaire, l'acide éthylène acrylique, l'anhydride styrène maléique, l'acide itaconique, l'acide maléique, l'acide fumarique, un mono ester d'un acide dicarboxylique ou un mélange.
8. Revêtement imperméable selon la revendication 7, où le revêtement du polymère contient comme plastifiant un phosphate de triaryle, du N-n-butylbenzènesulfonamide, un polymère d'éthoxylate ou de sulfonate d'alcool primaire ou un mélange.
9. Méthode pour former un revêtement bitumineux imperméable sur une structure en béton, laquelle méthode consiste à produire un moule en béton ayant une cavité dont l'organe externe comprend une garniture, à appliquer, à la surface interne de l'organe externe, un revêtement selon l'une quelconque des revendications 1 à 8 avec la feuille bitumineuse tournée vers la garniture et le revêtement non adhésif adjacent à la cavité du moule, et à verser une composition de béton dans la cavité pour former un béton auquel adhère le revêtement bitumineux imperméable.