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(54) Title: COATED SCRIM REINFORCED THERMOPLASTIC OLEFIN ROOFING MEMBRANE

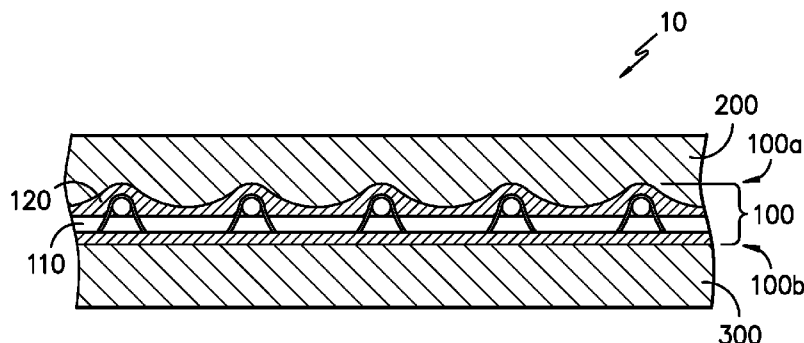


FIG. -1-

(57) Abstract: A scrim reinforced roofing membrane comprising a coated scrim layer having a first side and a second side and a first TPO layer on the first side of the coated scrim layer. The coated scrim layer contains a scrim fabric which contains a plurality of warp yarns in a first direction and a plurality of weft yarns in a second direction approximately perpendicular to the first direction. The warp yarns cross the weft yarns at crossing points. The scrim fabric has a polyvinyl acetate coating which is located along the length of the warp yarns and the weft yarns and between the warp and weft yarns at the crossing points. The coated scrim is at least partially embedded in the first TPO layer.



COATED SCRIM REINFORCED THERMOPLASTIC OLEFIN ROOFING MEMBRANE

TECHNICAL FIELD

[0001] The present disclosure relates generally to roofing membranes containing a coated scrim, more particularly roofing membranes containing thermoplastic olefin films.

BACKGROUND

[0002] Many membranes, such as membranes used as roofing, contain a fabric layer embedded into a polymer. There is a need for a membrane with enhanced tear resistance.

BRIEF SUMMARY

[0003] A scrim reinforced roofing membrane comprising a coated scrim layer having a first side and a second side and a first thermoplastic olefin layer on the first side of the coated scrim layer. The coated scrim layer contains a scrim fabric which contains a plurality of warp yarns in a first direction and a plurality of weft yarns in a second direction approximately perpendicular to the first direction. The warp yarns cross the weft yarns at crossing points. The scrim fabric has a polyvinyl acetate coating which is located along the length of the warp yarns and the weft yarns and between the warp and weft yarns at the crossing points. The coated scrim is at least partially embedded in the first thermoplastic olefin layer.

BRIEF DESCRIPTION OF THE DRAWING(S)

[0004] Exemplary embodiments will now be described by way of example, with reference to the accompanying drawings, wherein:

[0005] Figure 1 is a cross-sectional illustration of one embodiment of the scrim reinforced roofing membrane.

[0006] Figure 2 is an illustration of one embodiment of a scrim fabric.

5 DETAILED DESCRIPTION

[0007] Figure 1 illustrates one embodiment of the scrim reinforced roofing membrane 10. The membrane 10 contains a coated scrim layer 100 having a first side 100a and a second side 100b. The coated scrim layer contains a scrim fabric 110 and a coating 120. The scrim fabric 110 comprises a plurality of warp yarns in a first
10 direction and a plurality of weft yarns in a second direction approximately perpendicular to the first direction. The warp yarns cross the weft yarns at crossing points. The coating 120 comprises polyvinyl acetate and is located along the length of the warp yarns and the weft yarns and is located between the warp and weft yarns at the crossing points. The scrim reinforced roofing membrane 10 contains at least a first
15 thermoplastic olefin (TPO) layer 200 on the first side 100a of the coated scrim layer 100. The coated scrim 100 is at least partially embedded in the first TPO layer 200. Figure 1 shows an optional second TPO layer 300 on the second side 100b of the coated scrim layer 100.

[0008] The scrim fabric 110 may be any suitable scrim layer including any
20 suitable light-weight woven, knit, or nonwoven fabric. Preferably, the scrim layer is a weft inserted warp knit scrim, one example of which is shown in Figure 2. The weft inserted warp knit scrim 110 contains a plurality of warp yarns 113, weft yarns 115, and stitching yarns 117. The stitching yarns may have any suitable stitching pattern, including tricot stitches (shown in Figure 2) or pillar stitches, or other stitches. While
25 the fabric in Figure has the weft is laid in every third course, or every third row of stitches, the weft may be inlaid in any desirable pattern, preferably every course. Additionally, the weft yarn in Figure 2 is a continuous weft, in an alternatively preferred

embodiment, the weft yarn is a laid in yarn from a warp bar with a long shog and the weft may be cut on both ends after it is laid in.

[0009] The scrim fabric 110 is preferably open meaning that there are large amounts of open space between the yarns within the scrim layer 110. This is preferred so that there can be good adhesion between all of the layers within the scrim reinforced roofing membrane 10. In one embodiment, the scrim layer contains between 6 and 18 warp yarns per inch, more preferably between 8 and 12 warp yarns per inch. In another embodiment, the scrim layer contains between 4 and 18 weft yarns per inch, more preferably between 7 and 12 weft yarns per inch.

[0010] The yarns used in the scrim fabric 110 may be any suitable yarn, including but not limited to a spun staple yarn, a multifilament yarn, and/or a monofilament yarn. "Yarn", in this application, as used herein includes a monofilament elongated body, a multifilament elongated body, ribbon, strip, fiber, tape, and the like. The term yarn includes a plurality of any one or combination of the above. Some suitable materials for the yarns include polyamide, aramids (including meta and para forms), rayon, PVA (polyvinyl alcohol), polyester, polyolefin, polyvinyl, nylon (including nylon 6, nylon 6, 6, and nylon 4,6), polyethylene naphthalate (PEN), cotton, steel, carbon, fiberglass, steel, polyacrylic or any other suitable artificial or natural fiber. In one embodiment, the yarns in the scrim layer 110 are preferably continuous multifilament polyester. Continuous multifilament polyester has been shown to have good adhesion and strength characteristics.

[0011] Within the coated scrim layer 100, the scrim fabric 110 is coated with a coating 120 comprising polyvinyl acetate (PVAC). The coating may also include other suitable additives such as adhesion promoters, anti-wicking chemistries, colorants, anti-microbial chemistries, abrasion resistance, UV stabilizers, and the like. Preferably, the coating 120 also contains a fluorochemical, preferably a fluorocarbon. The preferred ratio by weight of PVAC to fluorocarbon is in the range of between about 10:1 and 20:1, more preferably about 16:1. The preferred amount of total solids add-on is the range of between about 1 and 30% wt., more preferably between about 5 and 15% wt., more

preferably between about 8 and 12% wt., more preferably approximately 10% wt. Chemistry application is by way of a submerged dip with heated can drying immediately after.

[0012] The coating is located along the length of the warp yarns and the weft
5 yarns and is located between the warp and weft yarns at the crossing points. Figure 1 is not drawn to scale, typically the coating 120 on the scrim fabric 110 is very thin and cannot be easily seen (the coating 120 in the Figure was enlarged so that it was more easily seen). Preferably, the coating 120 does not window the scrim fabric 110 meaning that it does not fill the open space within the scrim fabric 110 with a film of coating.

[0013] The scrim reinforced roofing membrane 10 contains at least a first TPO
10 layer 200 on the first side 100a of the coated scrim layer 100. The coated scrim 100 is at least partially embedded in the first TPO layer 200. Preferably the coated scrim layer 100 is fully embedded and encapsulated by the TPO layer(s) 200, 300. Figure 1 shows an optional second TPO layer 300 on the second side 100b of the coated scrim layer
15 100. TPO layers have been found to produce roofing membranes with good properties and cost effectiveness. In one embodiment, the TPO layer(s) 200, 300 have a thickness of between about 10 – 40 mils, more preferably between about 15 – 40 mils, more preferably between about 1.2 and 2.2 mm. When both the first TPO layer 200 and the second TPO layer 300 are used in the membrane 10, preferably the two layers 200,
20 300 touch and adhere to each other through the open areas of the scrim fabric 110.

[0014] The TPO layer(s) 200, 300 may be applied to the coated scrim layer 100 in any suitable manner such as coating, extruding, and lamination. In one preferred embodiment, the TPO layer(s) 200, 300 is laminated onto the coated scrim layer 100. A TPO layer(s) 200, 300 are delivered to the coated scrim layer 100 as a free standing
25 film that is then adhered to the coated scrim layer 100 using heat and/or pressure and/or adhesive. The TPO layer(s) 200, 300 may be applied to only one side of the coated scrim layer 100 or may be applied to both sides of the knit fabric sequentially or simultaneously.

[0015] In another preferred embodiment, the TPO layer(s) 200, 300 are extruded onto the coated scrim layer 100. The TPO layer(s) 200, 300 are delivered to the coated scrim layer 100 in a molten state on one or both sides of the coated scrim layer 100.

[0016] The membrane 10 may be subjected to additional processing steps such as coatings, surface treatments, adhering the membrane to additional components, and calendaring. Calendaring further compresses the coated scrim layer 100 and the TPO layer(s) 200, 300 to deliver a thinner membrane 10. Calendaring may be part of the process of coating the coated scrim layer 100 with the TPO layer(s) 200, 300 such as in the lamination process or a separate operation.

EXAMPLES

Example 1

[0017] A weft inserted warp knit scrim was formed using 1000 denier high tenacity, low shrink continuous multifilament polyester yarns as the warp, weft, and 70 denier polyester stitching yarns. The scrim fabric was formed having 9 warps per inch, 8 wefts per inch, and a stitching yarn having a tricot stitch. The scrim was then dip coated in an aqueous coating of PVAC available from Celanese. The coating was approximately 34% wt PVAC and the add-on weight was 10%.

[0018] The scrim fabric was placed between two TPO films, each having a thickness of 60 mils. The stacked films and scrim were then heated in belt press laminator at 180 °C and 60 psi for about 1 minute.

Results

[0019] The membrane from Example 1 was tested using a modified version of ASTM D751 Tear Resistance tearing in the machine or warp direction of the scrim fabric. The tear resistance of Example 1 was 92 pounds.

[0020] All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

5 [0021] The use of the terms “a” and “an” and “the” and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms “comprising,” “having,” “including,” and “containing” are to be construed as open-ended terms (i.e., meaning “including, but
10 not limited to,”) unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless
15 otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., “such as”) provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the
20 invention.

[0022] Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such
25 variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-

described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

CLAIMS:

1. A scrim reinforced roofing membrane comprising:

a coated scrim layer having a first side and a second side, wherein the coated scrim layer comprises:

5 a scrim fabric, wherein the scrim fabric is a weft insert warp knit fabric and comprises a plurality of warp yarns in a first direction and a plurality of weft yarns in a second direction approximately perpendicular to the first direction, wherein the warp yarns cross the weft yarns at crossing points; and,

10 a coating comprising polyvinyl acetate and a fluorocarbon, wherein the coating is located along the length of the warp yarns and the weft yarns and is located between the warp and weft yarns at the crossing points;

a first thermoplastic olefin layer on the first side of the coated scrim layer, and;

15 a second thermoplastic olefin layer on the second side of the coated scrim layer, wherein the coated scrim layer is fully embedded and encapsulated by the first thermoplastic olefin layer and the second thermoplastic olefin layer.

2. The scrim reinforced roofing membrane of claim 1, wherein the warp yarns and weft yarns of the scrim fabric comprise polyester yarns.

20 3. The process of forming a scrim reinforced roofing membrane comprising, in order:

forming a weft insert warp knit fabric scrim fabric, wherein the scrim fabric comprises a plurality of warp yarns in a first direction and a plurality of weft yarns in a second direction approximately perpendicular to the first direction, wherein the warp yarns cross the weft yarns at crossing points;

25 coating the scrim fabric with a coating comprising polyvinyl acetate, wherein the coating is located along the length of the warp yarns and the weft yarns and is located between the warp and weft yarns at the crossing points forming a coated scrim fabric;

applying a first thermoplastic olefin layer on the first side of the coated scrim layer;
and,

applying a second thermoplastic olefin layer on the second side of the coated scrim
layer, wherein the coated scrim layer is fully embedded and encapsulated by the first
5 thermoplastic olefin layer and the second thermoplastic olefin layer.

4. The process of claim 3, wherein the warp yarns and weft yarns of the scrim fabric
comprise polyester yarns.

10 5. The process of claim 3, wherein the coating further comprises a fluorocarbon.

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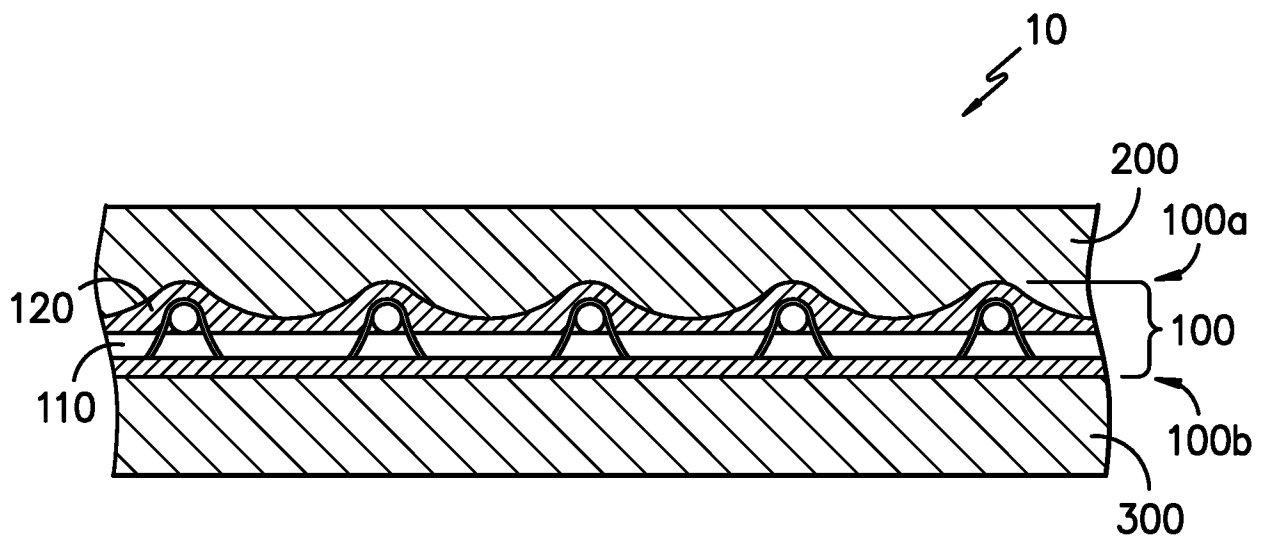


FIG. -1-

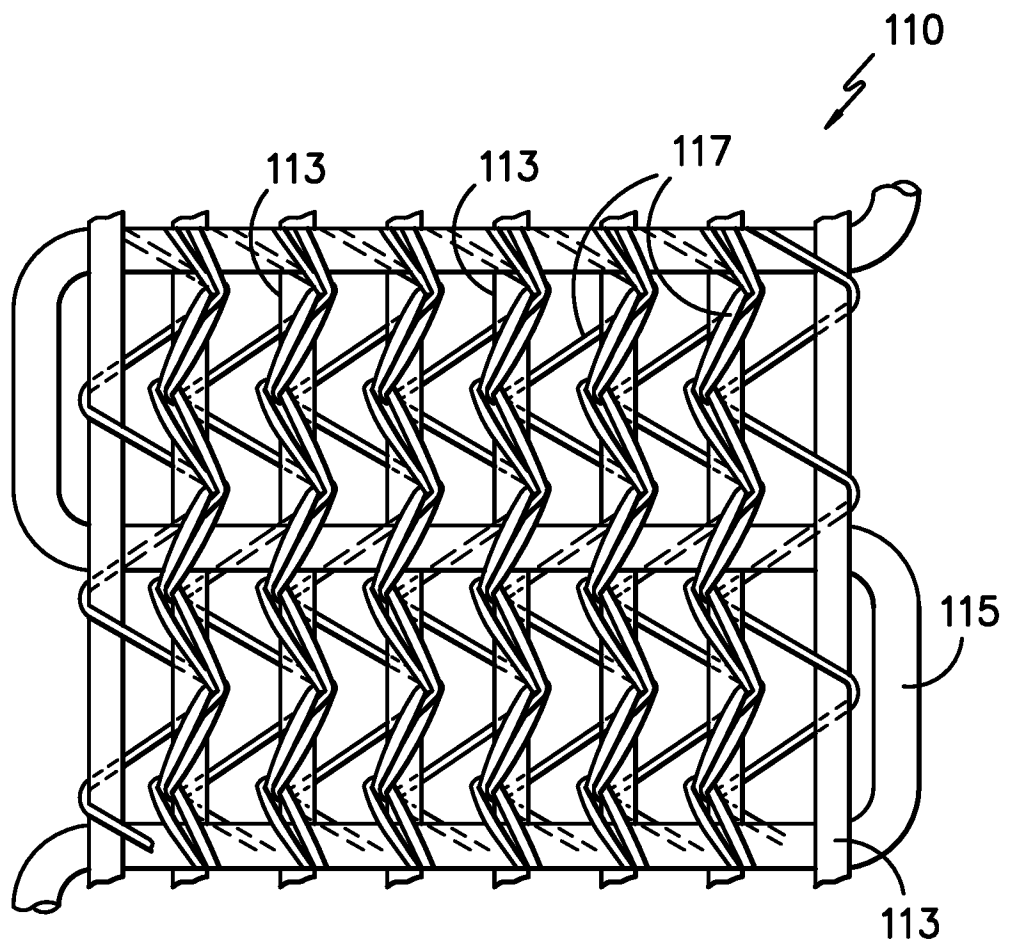


FIG. -2-

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. B32B5/02 B32B27/30 D06N5/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B32B D06N

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 practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2003/100233 A1 (FYNAN ROGER T [US] ET AL) 29 May 2003 (2003-05-29) paragraph [0014]; claims 6,7,10; figures 1,2	1-5
Y	US 2004/185734 A1 (GRAY HUGH DOUGLAS [US] ET AL) 23 September 2004 (2004-09-23) paragraphs [0009], [0013], [0025], [0028], [0033]; claims 21,22,25,26; figure 2	1-5
A	US 5 540 971 A (DAURER MARK D [US] ET AL) 30 July 1996 (1996-07-30) claim 1; figures 1,3	1-5
A	US 6 355 329 B1 (ROSE ALFREDO P [US] ET AL) 12 March 2002 (2002-03-12) claim 1; figure 1	1-5
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002/132078 A1 (WONG ROY [US]) 19 September 2002 (2002-09-19) paragraph [0035] -----	1,5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/014713

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003100233 A1	29-05-2003	US 2003100233 A1 WO 03037615 A1	29-05-2003 08-05-2003
US 2004185734 A1	23-09-2004	AU 2003297870 A1 CA 2519347 A1 EP 1606105 A1 US 2004185734 A1 WO 2004094137 A1	19-11-2004 04-11-2004 21-12-2005 23-09-2004 04-11-2004
US 5540971 A	30-07-1996	CA 2154412 A1 DE 69521578 D1 DE 69521578 T2 EP 0703312 A1 US 5525413 A US 5540971 A	22-03-1996 09-08-2001 13-06-2002 27-03-1996 11-06-1996 30-07-1996
US 6355329 B1	12-03-2002	NONE	
US 2002132078 A1	19-09-2002	AT 294224 T BR 0207916 A CA 2440450 A1 CN 1514864 A CN 1727422 A DE 60203892 D1 DE 60203892 T2 EP 1370623 A2 JP 2004523631 A KR 20040030533 A US 2002132078 A1 US 2004022952 A1 WO 02074876 A2	15-05-2005 02-03-2004 26-09-2002 21-07-2004 01-02-2006 02-06-2005 16-02-2006 17-12-2003 05-08-2004 09-04-2004 19-09-2002 05-02-2004 26-09-2002