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(72) Inventors:

- **Harder, Sven**
2625 Vallensbaek (DK)
- **Jensen, Eirik Sandberg**
40000 Roskilde (DK)

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(74) Representative: **Plougmann & Vingtoft A/S**

Sundkrogsgade 9

P.O. Box 831

2100 Copenhagen O (DK)

(71) Applicant: **Icopal A/S**
2730 Herlev (DK)

(54) **A flexible sheet material**

(57) A fire resistant flexible sheet material comprises a film or membrane (10) coated with a substantially non-combustible coating in order to obtain a high water vapour diffusion resistance and a low gross calorific po-

tential. The flexible sheet material may advantageously be used as a water vapour barrier in roof constructions.

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Description

Technical field

[0001] The present invention relates to a fire resistant flexible sheet material with a high water vapour diffusion resistance and a low gross calorific potential. The flexible sheet material may advantageously be used as a water vapour barrier in roof constructions.

Background of the invention

[0002] When the heat insulation is placed on the outside of the load-bearing construction as in for example steel deck constructions, the heat insulation is placed between two water impermeable membranes, i.e. the water vapour barrier and the roofing. This type of roof construction imposes requirements on the water vapour barrier used. To ensure that moisture is not accumulated in the insulation layer, the water vapour diffusion resistance of the water vapour barrier should be high, due to a high water vapour diffusion resistance of the roofing. The building code imposes requirements on the water vapour barrier with regard to the gross calorific potential which, as a consequence of fire classification of construction products and building elements, must be low.

[0003] Traditionally, a laminate including an aluminium foil has been used to obtain a water vapour barrier with a high water vapour diffusion resistance. However, the aluminium foil requires corrosion protection, e.g. with polyethylene, in order to prevent corrosion thereof, when the water vapour barrier is placed in a humid environment, such as in a roof construction or in a construction in swimming baths. A corrosion protection in the form of e.g. polyethylene will add to the gross calorific potential of the water vapour barrier and impede the fulfilment of the requirements of the building code. Moreover, if the flames used for attaching the roofing felt accidentally hit the laminate including an aluminium foil, e.g. along a skylight or ventilator cowl, the aluminium will act as a fire spreader and the fire may spread down through the roof construction. The problem cannot be solved by adding a large amount of fire retardant to the laminate due to the fact, that the second film of the laminate, i.e. the plastic film, cannot adhere to the aluminium foil, when using a large amount of fire retardant.

Summary of the invention

[0004] It is an object of the present invention to provide a flexible sheet material that is applicable as a water vapour barrier and, furthermore, fulfils the conflicting requirements mentioned above, i.e. a flexible sheet material with a high water vapour diffusion resistance and a low gross calorific potential.

[0005] According to a preferred embodiment of the present invention, there is provided a flexible sheet material comprising a first film or membrane having a thick-

ness of less than 50 μm , wherein said film or membrane is coated with a substantially non-combustible coating so as to obtain a water vapour diffusion resistance of the sheet material exceeding 45 m air column and a gross calorific potential not exceeding 4 MJ/m².

[0006] The gross calorific potential is defined as the calorific value of a material, when the combustion is complete and any produced water is entirely condensed, and the calorific value is defined as the thermal energy produced by combustion of unit of mass of a given substance.

[0007] In order to reduce the gross calorific potential of the flexible sheet material, the thickness of the film or membrane is reduced compared to traditional water vapour barriers with a high water vapour diffusion resistance. To obtain a high water vapour diffusion resistance, the film or membrane is coated with a substantially non-combustible coating.

[0008] The thickness of the first film or membrane may be less than 40 μm , such as less than 30 μm or less than 25 μm .

[0009] Furthermore, the film or membrane may in one embodiment be coated with a substantially non-combustible coating so as to obtain a water vapour diffusion resistance of the sheet material exceeding 60 m air column.

[0010] A second film or membrane may be laminated to the first film or membrane. Laminating the second film or membrane at the coated side of the first film or membrane, the second film or membrane may be used as a protection for the coating of the first film or membrane, whereby the sheet material may be used in e.g. a harsh environment.

[0011] The flexible sheet material may further comprise a fire retardant. The fire retardant may be arranged in any position within or adjacent to the first film or membrane. Thus, it may be arranged between the first and second films or membranes, and in a preferred embodiment the fire retardant may be incorporated in an adhesive layer arranged between the first and second films or membranes. The adhesive layer may comprise urethane, epoxy or other glue, an adhesive web or film, or others.

[0012] The fire retardant used in the flexible sheet material according to the invention may comprise any conventional fire retardant, such as water glass or different types of fire retardant including bromine. However, in a preferred embodiment the fire retardant may be intumescent graphite which may expand to a volume being up to 100 times the initial volume.

[0013] The second film or membrane may be coated with a substantially non-combustible coating in order to obtain a flexible sheet material comprising two films or membranes being coated with a substantially non-combustible coating, whereby the thickness of each of the films may be reduced without reducing the water vapour diffusion resistance of the sheet material.

[0014] Furthermore or alternatively, the second film or

membrane may comprise a porous fibrous material, such as felt with a low calorific value, e.g. Nylon felt or glass felt. By the use of a porous fibrous material, the second film or membrane may serve as a sound absorber and/or as physical protection of the flexible sheet material.

[0015] The first film or membrane may comprise a layer of a plastic material. Furthermore, the second film or membrane may also comprise a layer of a plastic material. As an example, the plastic material may be polyethylene terephthalate (PETP), polyethylene naphthalate (PEN), or copolymers thereof, oriented polypropylene (OPP), polyethylene (PE), oriented polyamide (OPA), Cyclic Olefinic Copolymers (COC) or Aclar, Aclar being a flexible thermoplastic made of fluorinated-chlorinated resins. Other plastic materials may also be used.

[0016] An example of an Aclar-film is Aclar CxTM8A (33 μm), which is a heat-sealable polychlorotrifluoroethylene (PCTFE) homopolymer film co-extrusion. The structure consists of an 8 μm Aclar film layer laminated to a 25 μm layer of polyethylene (PE).

[0017] The films or membranes may be coated with a substantially non-combustible coating, such as silicon oxide, aluminium oxide, aluminium or polyvinylidenechloride. The films or membranes may be coated more than once using one or more of the coatings in combination, whereby a synergy effect may be achieved in that one film or membrane coated twice may be used instead of using a laminate of two films or membranes each coated once. An example of a combination of coatings is a PVdC-coating (polyvinylidenechloride) followed by an aluminium coating. Another example is an EVOH-coating (ethylene vinyl alcohol) followed by an aluminium coating. Other combinations may also be used.

[0018] The coating using silicon oxide (SiO_x), aluminium oxide or aluminium may be performed under low pressure and high temperature, such as a plasma deposition coating. By the use of plasma deposition coating a thin coating with an even surface structure may be obtained. Condensation or spray coating may also be used. The coating using polyvinylidenechloride may be performed as a standard coating process using gravure rollers and drying tunnel. However, other coating processes may also be used.

[0019] In order to increase the strength of the sheet material, it may further comprise reinforcing means. The reinforcing means may be arranged in any position adjacent to the first film or membrane. Thus, it may be arranged between the first and second films or membranes, and in a preferred embodiment, the reinforcing means may be incorporated in an adhesive layer arranged between the first and second films or membranes. The reinforcing means may comprise a netting. As an example, the reinforcing means may be made of glass, polypropylene, polyester or polyethylene.

[0020] In another preferred embodiment of the present invention, the flexible sheet material may have

a gross calorific potential not exceeding 2 MJ/m².

[0021] In a third preferred embodiment of the present invention, the flexible sheet material may have a gross calorific potential not exceeding 1.4 MJ/m², and/or a water vapour diffusion resistance exceeding 90 m air column.

[0022] According to other preferred embodiments of the present invention a flexible sheet material is used as a water vapour barrier or an underroof for buildings. The flexible sheet material comprise a first film or membrane having a thickness of less than 50 μm , and this first film or membrane is coated with a substantially non-combustible coating so as to obtain a water vapour diffusion resistance of the flexible sheet material exceeding 45 m air column and a gross calorific potential of the flexible sheet material not exceeding 4 MJ/m².

[0023] Any of the features of the flexible sheet material according to the invention may be used in combination with the flexible sheet material used as a water vapour barrier or as an underroof for buildings.

[0024] According to European Standard EN 13501-1, a non-homogeneous product is a product composed of one or more components which may be substantial or non-substantial. A non-substantial component is a material which does not constitute a significant part of a non-homogeneous product. Furthermore, a layer with a mass/unit area of less than 1.0 kg/m² and a thickness of less than 1.0 mm is considered to be a non-substantial component. An internal non-substantial component is defined as a non-substantial component covered on both sides by at least one substantial component, whereas an external non-substantial component is not covered at one side of a substantial component. As a consequence of these definitions, a water vapour barrier may be classified as an external non-substantial component of a non-homogeneous product.

[0025] According to the requirements of EN 13501-1, the gross calorific potential of a water vapour barrier, i.e. an external non-substantial component of a non-homogeneous product should not exceed 2 MJ/m², when belonging to class A1. Furthermore, the gross calorific potential of a water vapour barrier, i.e. an external non-substantial component of a non-homogeneous product should not exceed 4 MJ/m², when belonging to class A2. Class A1 and A2 are the two highest classes in the classification of reaction to fire performance for construction products being tested in accordance with the Standard, class A1 being higher than A2 as the requirements of A1 are more strict than the requirements of A2.

Brief description of the drawings

[0026] Embodiments of a flexible sheet material according to the present invention are for illustration of the invention described below with reference to the accompanying drawings of which

[0027] Figs. 1-4 show sectional views of four different embodiments of a flexible sheet material.

Detailed description of the drawings

[0028] Fig. 1 is a sectional view of a first embodiment of a flexible sheet material according to the invention. The flexible sheet material comprises upper and lower layers, 10 and 11, respectively, of coated films of polyethylene terephthalate each having a thickness of 12 μm . The polyethylene terephthalate films are coated with silicon oxide. The upper layer 10 is laminated to the lower layer 11 by means of an intermediate adhesive layer 12, such as urethane glue of approximately 2 μm , having a fire retardant, such as intumescent graphite, incorporated therein. The gross calorific value of this flexible sheet material is 0.8 MJ/m², and the water vapour diffusion resistance is 180 m air column.

[0029] Fig. 2 is a sectional view of a second embodiment of a flexible sheet material according to the invention. The second embodiment also comprises upper and lower layers, 10 and 11, of coated films of polyethylene terephthalate each having a thickness of 12 μm . Also these layers are laminated together by an adhesive layer 12, such as urethane glue of approximately 2 μm , having a fire retardant, such as intumescent graphite, incorporated therein. Furthermore, a glass netting 13 is incorporated in the adhesive layer 12 in order to increase the strength of the flexible sheet material. The gross calorific value of this flexible sheet material is 1.0 MJ/m², and the water vapour diffusion resistance is 150 m air column.

[0030] Fig. 3 illustrates a sectional view of a third embodiment of a flexible sheet material according to the invention. The flexible sheet material illustrated in Fig. 3 comprises an upper layer 10 formed by a coated film of polyethylene terephthalate having a thickness of 12 μm laminated to an intermediate film 14 of polyethylene with a thickness of 30 μm . An adhesive layer 12, such as urethane glue of approximately 2 μm , having a fire retardant, such as intumescent graphite, incorporated therein is arranged between the upper layer 10 and the intermediate layer 14. A lower layer 15 of glass felt with a thickness grammage of 50 gr/m² is laminated to the intermediate film 14 of polyethylene. The gross calorific value of this flexible sheet material is 2.2 MJ/m², and the water vapour diffusion resistance is 98 m air column.

[0031] Fig. 4 illustrates a sectional view of a fourth embodiment of a flexible sheet material according to the invention. The flexible sheet material of Fig. 4 comprises an upper layer 10 of coated polyethylene terephthalate having a thickness of 12 μm laminated to a lower layer 11 of co-extruded oriented polypropylene having a thickness of 18 μm by an intermediate adhesive layer 12 in the form of urethane glue of approximately 2 μm . The gross calorific value of this flexible sheet material is 1.8 MJ/m², and the water vapour diffusion resistance is 82 m air column.

Claims

1. A flexible sheet material comprising a first film or membrane having a thickness of less than 50 μm , wherein said film or membrane is coated with a substantially non-combustible coating so as to obtain a water vapour diffusion resistance of said sheet material exceeding 45 m air column and a gross calorific potential of said sheet material not exceeding 4 MJ/m².
2. A flexible sheet material according to claim 1, wherein the thickness of said first film or membrane is less than 30 μm .
3. A flexible sheet material according to claim 1 or 2, wherein said film or membrane is coated with a substantially non-combustible coating so as to obtain a water vapour diffusion resistance of said sheet material exceeding 60 m air column.
4. A flexible sheet material according to any of the preceding claims, further comprising a second film or membrane laminated to said first film or membrane.
5. A flexible sheet material according to any of the preceding claims, further comprising a fire retardant.
6. A flexible sheet material according to claim 4 and 5, wherein the fire retardant is incorporated in an adhesive layer arranged between said first and second films or membranes.
7. A flexible sheet material according to any of claims 4-6, wherein the second film or membrane is coated with a substantially non-combustible coating.
8. A flexible sheet material according to any of claims 4-7, wherein the second film or membrane comprises a porous fibrous material.
9. A flexible sheet material according to claim 8, wherein the second film or membrane comprises Nylon felt or glass felt.
10. A flexible sheet material according to any of the preceding claims, wherein the first film or membrane comprises a layer of a plastic material.
11. A flexible sheet material according to any of claims 4-10, wherein the second film or membrane comprises a layer of a plastic material.
12. A flexible sheet material according to claim 10 or 11, wherein the plastic material is selected from the group consisting of polyethylene terephthalate (PETP), polyethylene naphthalate (PEN), or copolymers thereof, oriented polypropylene (OPP), pol-

yethylene (PE), oriented polyamide (OPA), Aclar and Cyclic Olefinic Copolymers (COC).

13. A flexible sheet material according to any of the preceding claims, wherein the coating of said first and/or second film or membrane comprises at least one material selected from the group consisting of silicon oxide, aluminium oxide, aluminium and polyvinylidenechloride. 5
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14. A flexible sheet material according to any of the preceding claims and further comprising reinforcing means for increasing the strength of the sheet material. 15
15. A flexible sheet material according to claim 14, wherein the reinforcing means comprises a netting.
16. A flexible sheet material according to claim 14 or 15, wherein the reinforcing means is made of a material selected from the group consisting of glass, polypropylene, polyester, and polyethylene. 20
17. A flexible sheet material according any of the preceding claims, and having a gross calorific potential not exceeding 2 MJ/m². 25
18. A flexible sheet material according to claim 17, wherein the gross calorific potential does not exceed 1.4 MJ/m². 30
19. A flexible sheet material according any of the preceding claims, wherein the water vapour diffusion resistance exceeds 90 m air column. 35
20. Use of a flexible sheet material as a water vapour barrier or underroof for buildings, said flexible sheet material comprising a first film or membrane having a thickness of less than 50 µm, wherein said film or membrane is coated with a substantially non-combustible coating so as to obtain a water vapour diffusion resistance of said sheet material exceeding 45 m air column and a gross calorific potential of said sheet material not exceeding 4 MJ/m². 40
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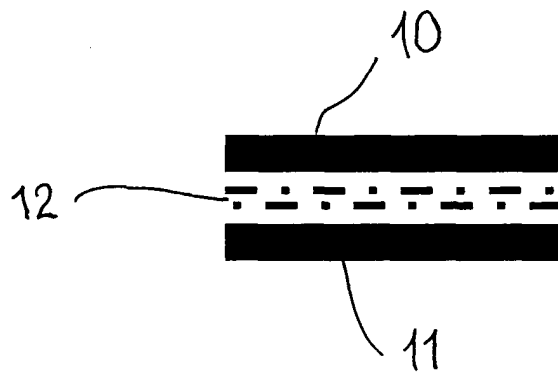


Fig. 1

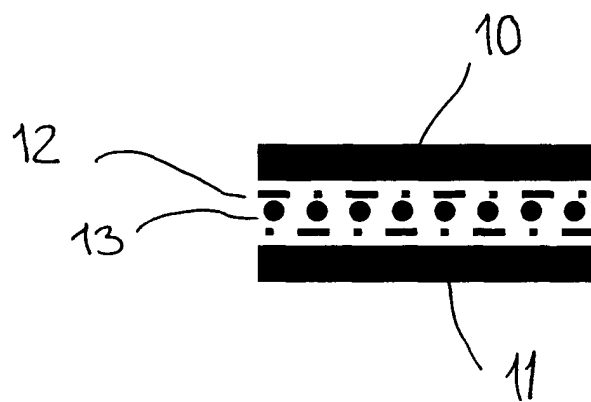


Fig. 2

