IMPROVED ROOFING FABRIC

FIELD OF INVENTION

The invention relates to a ~~buidling~~ building material in the form of a laminated fabric and a method of producing same. The laminated fabric is suitable for a variety of applications. For example, laminated fabrics of the present invention are comprised in building materials, such as roofing underlay. This invention relates to air and vapour permeable laminated fabrics with improved levels of air permeability.

BACKGROUND TO INVENTION

Vapour permeable fabrics known in the art as possessing good barrier properties to water droplets and/or solid particles generally comprise co-extruded or monolayer films comprising a plurality of micropores or monolithic films. Such vapour permeable films are sometimes used as roofing underlays due to their ability to assist in evacuating unwanted moisture from roofspaces. Generally these vapour permeable films that provide a barrier to the passage of water droplets are air barrier materials known as vapour permeable/air barrier roofing underlays.

However, in the UK, it is increasingly acknowledged that roof tile underlays that are both vapour permeable and air permeable are very effective at evacuating large amounts of moisture from the roof space beneath the underlay. Air permeable and vapour permeable underlays are 'breathable' in the true sense of the word and are acknowledged to form an effective alternative to traditional mechanical vents in 'cold' unoccupied pitched roof spaces.

That is to say that the underlay is sufficiently breathable such that any moisture entering the roofspace from the occupied living area underneath will evacuate the roofspace into the atmosphere through the underlay itself. Typical air and vapour permeable underlay fabrics include nonwoven laminated materials comprising a meltblown layer, such as those described in EP 0742305 A1 (Don & Low Limited).

There are two typical roof constructions:

'warm' roofs – where the insulation is at rafter level with the roofspace itself being occupied, and

'cold' roof spaces - where the insulation is laid on the floor of the roofspace and it is unoccupied.

Traditionally unwanted moisture is evacuated from 'cold' roof spaces via the introduction of mechanical vents, typically at the eaves and the ridge. These mechanical vents allow atmospheric moisture to enter and leave the roofspace, which effectively transports unwanted moisture to the outside atmosphere. The use of mechanical vents at the eaves and/or ridge of a 'cold' unoccupied roof space can increase the heat losses from a property by various mechanisms including (i) increasing the temperature gradient between the occupied and unoccupied spaces, and (ii) air entering the roof space via mechanical vents at the eaves can pass through the glass wool insulation laid on the floor of the roofspace, thus reducing the efficiency of the insulation. Therefore the use of an air and vapour permeable roofing underlay, as an effective alternative to mechanical ventilation may reduce heat losses and improve the thermal efficiency of a property, whilst at the same time reducing the risk of condensation.

The superior performance of air permeable fabrics to reduce condensation in energy efficient 'cold' (unoccupied) unventilated roofspaces has been acknowledged by the National House Building Council (NHBC) in the UK. This national body now insist that, for any new build domestic property that incorporates a non-ventilated 'cold' roof space, i.e. where traditional mechanical vents are eliminated from the roof construction, only roofing underlays that are both air and vapour permeable are used. However, generally such air permeable underlays demonstrate decreased water hold-out performance in comparison to their vapour permeable/air barrier counterparts.

The elimination of mechanical vents in a non-ventilated cold roofing application has increased the demands on underlays to evacuate moisture vapour from roofspaces. In a typical building, condensate can accumulate overnight on a roofing underlay in an amount anywhere between 5g/m^2 up to around 50 g/m^2, depending on the atmospheric conditions. For example, a greater amount of condensate will accumulate on a colder night. Additionally, in newly constructed buildings, such as new build houses, the amount of condensation can be far greater and condensate in amounts over 100g/m^2 can accumulate as larger droplets. This is because newly constructed buildings incorporate large amounts of water during construction, particularly if they include concrete floors and an internal finish of wet plaster. In the early years of a building, it will dry out as this water slowly evaporates. This drying out process significantly increases the water vapour load within the building. If a large proportion of this water vapour enters the roofspace in cold weather, it can cause temporary and severe condensation, which may lead to damp problems.

Therefore there remains a need for improved fabrics for use as roofing underlays in such non-ventilated roofing applications.

It is an object of at least one embodiment of at least one aspect of the present invention to obviate or at least mitigate one or more problems or disadvantages in the prior art.

SUMMARY OF INVENTION

According to a first aspect of the present invention, there is provided a building material in the form of a laminated fabric comprising a first layer of meltblown material sandwiched between a second and a third layer of spunbond material and laminated by thermal point bond calendering; wherein~~,~~

the meltblown material is formed of fibres having a fibre diameter greater than 3 μm;

the laminated fabric has an air permeability greater than ~~65~~ 75 l/m^2/s;

the meltblown and spunbond layers are formed of a propylene; and wherein

the laminated fabric has a pore size diameter greater than 20 μm.

According to a second aspect of the present invention, there is provided a building material in the form of a laminated fabric comprising a first layer of meltblown material sandwiched between a second and a third layer of spunbond material and laminated by thermal point bond calendering; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 μm;

the laminated fabric has an air permeability greater than 65 l/m^2/s;

the meltblown and spunbond layers are formed of polypropylene; and wherein

the laminated fabric has a pore size diameter between 25 μm and 30 μm.

The following features may apply to either of the first or second aspects.

Preferably the laminated fabric may comprise a vapour permeable laminate, in particular a water vapour permeable laminate.

In use, laminated fabrics according to embodiments of the present invention are used as building materials, for example, as roofing underlays. Advantageously, roofing underlays comprising laminated fabrics of the invention may be used in 'cold' roofspaces, such as cold non-ventilated roofspaces. By a cold roofspace, it is meant where roofing insulation is provided, e.g. laid on the floor of the roofspace and the roofspace is unoccupied. Such roofs are particularly found in the UK. As used herein, non-vented or non-ventilated roofs are roofs which do not comprise mechanical vents, for example, a roof which does not comprise mechanical vents at its eaves or ridges.

As used herein, a pitched roof may be any roof which comprises a sloping surface, or any roof in which two or more roof surfaces are pitched at an angle, e.g not a flat roof.

Laminated fabrics of the present invention may show improved levels of air permeability. In some applications, the air permeability of a laminated fabric has been found to be a more suitable gauge (than e.g. moisture vapour transmission rate (MVTR)) for establishing the ability of a laminated fabric to evacuate moisture vapour. In use as a roofing underlay, improved levels of air permeability may improve the ability of laminated fabrics of the invention to evacuate moisture vapour, thus further decreasing condensation risk in a building. In particular, roofing underlays comprising laminated fabrics of the invention may be particularly beneficial for use in the roofs of newly or recently constructed buildings, and/or in non-ventilated roofspaces e.g. non-vented cold pitched roofs.

The laminated fabric comprises a third layer of spunbond material. The third layer of material is laminated to one side of the first layer and the second layer is laminated to a second side of the first layer. The first layer of meltblown material is sandwiched between the second and third layers of spunbond material. In these and other embodiments, the second and/or third layers of spunbond material comprise outer layers of the laminated fabric and may provide support to the meltblown layer. The second and/or third layers of spunbond material may act as an abrasion resistant, durable and/or protective cover for the meltblown material. Where the meltblown sheet is processed to form the intermediate layer of a three-layer structure, the two outer layers being spunbonded layers, the structure may conveniently be referred to an SMS (spunbonded/meltblown/spunbonded) structure.

The laminated fabric may be gas and/or water vapour permeable.

For the first aspect the laminated fabric may have an air permeability greater than 80 $l/m^2/s$. The laminated fabric may have an air permeability between 75 $l/m^2/s$ and 100 $l/m^2/s$.

For the second aspect, ~~T~~the laminated fabric may have an air permeability greater than about 70 l/m^2/s, greater than about 75 l/m^2/s or greater than about 80 l/m^2/s. The laminated fabric may have an air permeability between 65 l/m^2/s and 120 l/m^2/s, between 70 l/m^2/s and 110 l/m^2/s, between 75 l/m^2/s and 100 l/m^2/s. The laminated fabric may have an air permeability of approximately 80 l/m^2/s.

Prior to lamination, the first layer of meltblown material may have an air permeability greater than 300 l/m^2/s, greater than 325 l/m^2/s, or greater than 350 l/m^2/s. Prior to lamination, the first layer of meltblown material may have an air permeability between 300 l/m^2/s and 400 l/m^2/s, between 325 l/m^2/s and 380 l/m^2/s, or between 350 l/m^2/s and 370 l/m^2/s. Prior to lamination, the first layer of meltblown material may have an air permeability of approximately 360 l/m^2/s or 365 l/m^2/s.

In these and other embodiments, the air permeability of the meltblown layer and/or of the laminated fabric may assist in allowing the passage of water vapour through the fabric. For example, the air permeability of the fabric may assist in evacuating moisture from the roofspace, thus reducing the risk of condensation in the roofspace.

Prior to lamination, the second and/or third layer(s) of spunbond material may have an air permeability greater than 1100 l/m^2/s, or between 1100 l/m^2/s and 9000 l/m^2/s, or even greater than 9000 l/m^2/s. Typically a heavier weight (e.g. approximately 90 g/m^2) spunbond fabric may have an air permeability of approximately 1100 l/m^2/s and a lighter weight (e.g. approximately 15g/m^2) spunbond fabric may have an air permeability greater than 9000 l/m^2/s. The air permeability of the second and/or third layer(s) of spunbond material may be greater than the air permeability of the first layer of meltblown material.

Laminated fabrics of the invention may be resistant to the passage of water droplets and may have the ability to hold-out water. Levels of water hold-out may be quantified by hydrostatic head measurements. The laminated fabric may have a hydrostatic head greater than 60cm, greater than 70cm, or greater than 75cm. The laminated fabric may have a hydrostatic head between 50cm and 100cm, between 60cm and 90cm, or between 70cm and 90cm. The laminated fabric may have a hydrostatic head less than 100cm, or less than 90cm. The laminated fabric may have a hydrostatic head of approximately 75cm or 90cm.

Prior to lamination, the first layer of meltblown material may have a hydrostatic head of greater than 60cm, greater than 70cm, or greater than 75cm. Prior to lamination, the first layer of meltblown material may have a hydrostatic head between 60cm and 100cm, between 65cm and 90cm, or between 65cm and 80cm. Prior to lamination, the first layer of meltblown material may have a hydrostatic head of approximately 65cm or 75cm.

Advantageously the inventors have identified that meltblown materials formed of coarser fibres can provide laminated fabrics having improved levels of air permeability with sufficient levels of water hold-out to be useful as a roofing underlay.

The first layer of meltblown material may be formed of fibres having a fibre diameter greater than 3.2 μm, greater than 3.5 μm or greater than 3.8 μm. The fibres in the meltblown material may have a diameter between 3.0 μm and 5.0 μm, between 3.2 μm and 4.5 μm, or between 3.3 μm and 4 μm. The fibres in the meltblown material may have a fibre diameter of approximately 3.3 μm or 4.0 μm.

As used herein, the fibre diameter may mean the mean or average fibre diameter of the fibres in a layer of material.

In some instances, where a meltblown is formed from coarser fibres, (e.g. those having a fibre diameter greater than 3.5 μm or between 3.3 μm and 4 μm), the meltblown layer may be passed through a compression roller prior to lamination.

The first layer of meltblown material may have a basis weight between 10 g/m^2 and 60 g/m^2, or between 20 g/m^2 and 50 g/m^2 or between 30 g/m^2 and 40 g/m^2. For example, the first layer of calendered meltblown material may have a basis weight of approximately 35 g/m^2.

In these and other embodiments, a laminated fabric advantageously provides increased levels of air permeability to a laminated fabric comprising a typical meltblown layer of the same basis weight.

The second and/or third layer of spunbond material may have a basis weight between 15 and 150 g/m^2, or between 40 and 100 g/m^2. The second and/or third layer of spunbond material may have a basis weight of approximately 50 g/m^2 or approximately 90 g/m^2. The second and third layers of spunbond material may have different basis weights. For example, when used as a roofing underlay, the layer of spunbond material comprising the underside (i.e. the layer facing the roofspace) may have a lower basis weight than the opposing layer of spunbond material facing outwards.

For the first aspect, ~~T~~the laminated fabric may have a pore size diameter greater than 25 µm. The laminated fabric may have a pore size diameter between 20 µm and 40 µm, or between 25 µm and 30 µm.

For either of the first or second aspects, ~~T~~the pore size diameter may be the average or mean pore size diameter of the laminated fabric.

In the present invention, the first layer of meltblown material and the second and third layers of spunbond material are formed of polypropylene.

Meltblown and spunbond materials may be formed of single component fibres or bicomponent fibres. Bicomponent fibres may have a core-sheath, layered or matrix-type structure. Preferably, the meltblown and spunbond materials comprise fibres formed of a single polymer component, such as homopolymer fibres.

In embodiments, the laminated material may comprise additives. Additives may be present in the first, second and/or third layers of the laminated fabric. Additives may include hydrophobic melt additives and the like, for example an organic fluorocarbon derivative. Such additives are known in the art and may be added to polymers from which meltblown materials are made to improve their hydrophobic and/or oleophobic barrier properties. Other additives, such as UV absorbing additives may be advantageously added to the melt polymer so as to inhibit the polymer degradation due to, for example, exposure to ultraviolet light. Examples of other additives which may be comprised in the laminated material, and/or added to the meltblown material, include conventional additives such as flame retardants, pigments and plasticisers, and the like.

The fabrics of the invention may typically take the form of sheeting, strips, rolls and the like.

There is provided a method of making a laminated fabric comprising

providing a first layer of meltblown material being formed of fibres having a fibre diameter greater than 3 μm; and

laminating the first layer of meltblown material to at least a second layer of spunbond material to provide a laminated fabric having an air permeability greater than 65 $l/m^2/s$.

According to a ~~second~~ third aspect of the present invention there is provided a method of making a building material comprising

laminating a first layer of meltblown material to at least a second and a third layer of spunbond material to provide a spunbond-meltblown-spunbond (SMS) laminated fabric having an air permeability greater than ~~65~~ 75 $l/m^2/s$ and a pore size diameter greater than 20 μm;

wherein the meltblown material is formed of fibres having a fibre diameter greater than 3 μm;

laminating meltblown sheets to the second and third layer of spunbond material is effected by passing the sheet materials simultaneously through a thermal point bond calendering process; and the meltblown and spunbond layers are formed of polypropylene.

According to a fourth aspect there is provided a method of making a building material comprising

laminating a first layer of meltblown material to at least a second and a third layer of spunbond material to provide a spunbond-meltblown-spunbond (SMS) laminated fabric having an air permeability greater than 65 $l/m^2/s$ and a pore size diameter between 25 µm and 30 µm; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 µm;

laminating meltblown sheets to the second and third layer of spunbond material is effected by passing the sheet materials simultaneously through a thermal point bond calendering process; and

the meltblown and spunbond layers are formed of polypropylene.

The following features may apply to either of the third or fourth aspects.

Laminating comprises passing the first, second and third layers of material through heated calender rollers, optionally under pressure. Typically temperatures for laminating a polypropylene SMS may be between 120 °C and 170 °C and pressures between 30 N/mm – 150 N/mm may be employed in the laminating process. SMS fabrics produced with different polymers may require different lamination process conditions dependant on polymer melt temperature.

Laminating meltblown sheets to such supportive, open layers, such as the second and/or third layer of spunbond material, may be effected by passing the sheet materials simultaneously through, for example, a point bonding calendering process. In this process, which is known in the art, a combination of heat and pressure is applied in an intermittent pattern known as point bonding. The area of such bond points is typically 5% to 40% of the total area of the bonded materials and may preferably be in the range 15% to 20%.

The method may comprise producing a first layer of meltblown material by increasing the throughput of a meltblown extrusion line which results in increased fibre diameters, for example fibre diameters greater than 3 μm. There are a variety of techniques for modifying fibre diameter as would be known to those skilled in the art. For instance, the use of spinneret die plates with varying hole sizes.

The method may comprise providing a pre-compressed first layer of meltblown material. The method may comprise compressing a first layer of meltblown material, preferably prior to lamination. Meltblown layers formed of coarser fibres, e.g. fibre diameters greater than 3 μm, may be passed through a compression roller to minimise any detrimental effects on the water hold-out properties of the laminated fabric.

Compressing a material typically involves applying pressure, sometimes with gentle heating. However, as would be understood by the person skilled in the art, pressures and/or temperatures used in compressing step are not high enough to cause softening of fibres and/or filaments in the material.

According to a ~~third~~ fifth aspect of the present invention there is provided a roof comprising a building material laminated fabric according to the first, ~~or~~ second, third or fourth aspects of the present invention.

Advantageously, the roof may be an unsupported roof, such as an unsupported cold pitched roof and/or a non-vented roof, e.g. a non-vented cold pitched roof. Alternatively the roof may be a fully supported (sarked) roof.

An unsupported roof may comprise a laminated fabric, in particular a roofing underlay, draped between rafters in a roof (hence the underlay is termed as being 'unsupported'). Battens may be placed on top of the underlay onto which the tile and slates may be secured.

A non-vented roof is one in which there are no mechanical vents incorporated into the roof design, e.g. no mechanical vents at the eaves or ridges of the roof.

A fully supported or sarked roof may comprise boards or sheets placed onto rafters. In such embodiments, the laminated fabric may be placed directly on the rigid upper surface of the boards or sheets (hence the underlay is termed as being 'supported').

According to a ~~fourth~~ sixth aspect of the present invention there is provided a building or building structure with a roof comprising building material according to the first, ~~or~~ second, third or fourth aspects.

According to a seventh~~fifth~~ aspect of the present invention there is provided a use of a laminated fabric as defined in any of the first, second, ~~or~~ third, fourth or fifth aspects as a building material.

In certain embodiments, the laminated fabric may be used as a roofing underlay. For example, the laminated material may be used on an unsupported roof e.g. a non-vented cold pitched roof, or, alternatively, it may be used on a fully supported (sarked) roof. Advantageously, laminated fabrics of the invention may be used in non-vented cold pitched roofs, the improved levels of air permeability may improve the ability of the fabric to evacuate moisture vapour from the roofspace, thus reducing risk of condensation.

Beneficially, laminated fabrics of the invention may be used in newly constructed buildings. Without being bound by hypothesis, the improved levels of air permeability enable fabrics of the invention to better evacuate water vapour. In these and other embodiments, laminated fabrics of the invention may be able to better evacuate the high levels of moisture load present in cold non-ventilated roofspaces experienced during the initial 'drying out' of a new-build property.

As used herein, "newly constructed" or "new build" may mean that the building is younger than 10 years old, or 5 years old or even 2 years old.

It is to be appreciated that the various embodiments may be applied to each of the aspects without departing from the scope of the invention. For example, any features of the first aspect may be equally applicable with the second, third, fourth, ~~or~~ fifth, sixth or seventh aspects. However, for the sake of brevity, these embodiments have not been repeated in relation to each aspect.

BRIEF DESCRIPTION OF DRAWINGS

These and other aspects of the present invention will now be described by way of example only, with reference to the accompanying drawings.

Figure 1 shows a schematic representation of a side view of a laminated fabric comprising a first layer of a calendered meltblown material laminated to a second layer of spunbond material according to an embodiment of the present invention;

Figure 2 shows a schematic representation of a side view of a laminated fabric comprising a first layer of a calendered meltblown material laminated to a second and third layer of spunbond material according to an embodiment of the present invention;

Figure 3 shows a schematic cross-sectional representation of an unsupported roof;

Figure 4 shows a schematic cross-sectional representation of a fully supported or sarked roof; and

Figure 5 shows a perspective view of a laminated fabric according to one embodiment of the present invention.

DETAILED DESCRIPTION OF DRAWINGS

Referring to Figure 1, there is shown a laminated fabric 10 according to a first embodiment of the present invention. The fabric 10 comprises a first layer of a meltblown material 12 laminated to a second layer of spunbond material 14. The laminated fabric 10 has an air permeability greater than 65 $l/m^2/s$.

A second embodiment of the present invention is shown in Figures 2 and 5. The first layer of meltblown material 22 is sandwiched between the second and third layers of spun-bond material (24, 26). The second and third layers of spunbond material (24, 26) act as an abrasion resistant, durable and protective cover for the meltblown material 22.

The meltblown material layer (12, 22) is laminated to the layer(s) of spunbond material (14, 24, 26) by passing the sheet materials simultaneously through, for example, a point bonding calendering process. In this process, which is known in the art, a combination of heat and pressure is applied in an intermittent pattern known as point bonding. An example pattern is illustrated most clearly in Figure 5. The area of such bond points is typically 5% to 40% of the total area of the bonded materials and may preferably be in the range 15% to 20%.

Laminated fabrics according to these and other embodiments of the present invention are air permeable and vapour permeable. Thus, air and vapour are able to pass through the membrane as illustrated by arrows 'B' in Figure 5. As is also illustrated on Figure 5, laminated fabrics according to embodiments of the present invention provide levels of water hold-out meaning that the fabric resists the passage of water droplets (as shown by arrows 'A').

Laminated fabrics according to embodiments of the present invention are used as building materials, for example, as roofing underlays. Typical roof constructions for 'cold' unoccupied roof spaces are shown in Figures 3 and 4. Figure 3 shows an unsupported roof, wherein the underlay, for example a laminated fabric 10,20) is draped between the rafters 30. Battens 42 are placed on top of the underlay and the tiles or slates 40 are secured onto these battens.

An alternative construction is a fully supported or sarked roof as is shown in Figure 4. In this type of construction, boards or sheets 44 are placed on the rafters 30. These boards or sheets 44 are commonly known in the art as sarking and are typically made out of timber or fibreboard, such as oriented strand board (OSB). An underlay, such as a laminated fabric 10,20, is laid directly onto the sarking 44. Tiles or slates 40 are secured directly through the underlay to the sarking (as shown in Figure 4). Alternatively battens may be laid on top of the underlay and secured to the sarking and the tiles or slates secured to these battens.

Example 1

A polypropylene meltblown layer of basis weight 35 g/m^2 and an average fibre diameter of 3.3 µm was provided. The polypropylene layer was pre-compressed and then thermally laminated using a point-bonding calendering process at a temperature of 120 – 170 °C and a pressure of 30 – 150 N/mm to a second polypropylene spunbond layer having a basis weight of 90 g/m^2 and a third polypropylene spunbond layer having a basis weight of 50 g/m^2.

Example 2

A polypropylene meltblown layer of basis weight 35 g/m^2 and an average fibre diameter of 4.0 µm was provided. The polypropylene meltblown layer was compressed in-line on the meltblown line. The polypropylene meltblown layer was then passed through a compression roller and then thermally laminated using a point-bonding calendering process at a temperature of 120 – 170 °C and a pressure of 30 – 150 N/mm to a second polypropylene spunbond layer having a basis weight of 90 g/m^2 and a third polypropylene spunbond layer having a basis weight of 50 g/m^2.

Comparative Example 1

A pre-compressed polypropylene meltblown layer having a basis weight of 35 g/m^2 and a fibre diameter of 2.8 µm was thermally laminated using a point-bonding calendering process to a second polypropylene spunbond layer having a basis weight of 90 g/m^2 and a third polypropylene spunbond layer having a basis weight of 50 g/m^2 as described for Example 1.

Air permeability

Air permeability may be quantified by measuring the quantity of air that passes through a fixed area of fabric at a set pressure drop across the fabric. The air permeability of the Example fabrics was measured using the test method EDANA140.2-99 (developed by The European Disposables & Nonwovens Association (EDANA)). In this test method, the quantity of air (measured in $l/m^2/s$) passing through a $20cm^2$ of fabric is measured at a pressure drop of 200 Pa.

Hydrostatic Head

Hydrostatic head is a measurement of the ability of a fabric to resist water penetration. It is the pressure, measured in cm H_2O, required to force water through the fabric. The value quoted is the pressure reached when 3 drops of water have penetrated the fabric. Hydrostatic head was measured according to the test method as set out in BS EN 20811:1992 Textiles – Determination of resistance to water penetration – Hydrostatic pressure test.

Pore Size is measured using BS 3221 (1986) – Measurement of the equivalent pore size of fabrics (bubble pressure method)

Table 1 - Meltblown Properties

		Meltblown Information		
Property	Units	Comparative Example 1	Example 1	Example 2
Basis weight	g/m^2	35	35	35
Air permeability	$l/m^2/s$	300	360	365
Hydrostatic head	cm	>75	76	65
Filament Diameter	µm	2.8	3.3	4.0

Table 2 –Laminate Properties

Property	Units	Laminated Fabric		
Laminate weight	g/m²	175	175	175
SMS Laminate Spunbond layer 1	g/m²	90 polypropylene spunbond	90 polypropylene spunbond	90 polypropylene spunbond
SMS Laminate Meltblown layer 2	g/m²	35 Comparative Example 1	35 Example 1	35 Example 2
SMS Laminate Spunbond layer 3	g/m²	50 polypropylene spunbond	50 polypropylene spunbond	50 polypropylene spunbond
Hydrostatic Head	cm	115	87	76
Air Permeability	l/m²/s	61	79	81
Pore Size	μm	20	26	28

The data illustrates that the laminated fabrics of Examples 1 and 2 show an improved air permeability in comparison to the laminated fabric of Comparative Example 1. The data shows that the use of meltblown layers formed of coarser fibres provides a laminated fabric with a larger mean pore size diameter which is more highly air permeable.

The air permeability of a laminated fabric has been shown to be a more suitable gauge (than e.g. moisture vapour transmission rate (MVTR)) for establishing the ability of a laminated fabric to evacuate moisture vapour. The inventors have identified laminated fabrics with higher levels of air permeability which will demonstrate an improved ability to evacuate moisture vapour. Thus, when used in roofspaces, laminated fabrics of the invention can reduce the risk of condensation and may find particular application in non-vented cold pitched roofs.

The use of meltblown layers formed of coarser fibres did result in a slight decrease in hydrostatic head (in comparison to the typical meltblown material) and the meltblown layer of Example 2 was additionally passed through a compression roller prior to lamination to minimise any detrimental effects to water hold-out. However, the hydrostatic heads of the laminated fabrics of Examples 1 and 2 were surprisingly found to be greater than 75cm. Thus, these laminated fabrics would still be suitable for use as roofing underlays that can provide protection against wind-driven rain and the like.

CLAIMS

1. A building material in the form of a laminated fabric comprising a first layer of meltblown material sandwiched between a second and a third layer of spunbond material and laminated by thermal point bond calendering; wherein~~,~~

the meltblown material is formed of fibres having a fibre diameter greater than 3 µm;

the laminated fabric has an air permeability greater than ~~65~~ 75 l/m^2/s;

the meltblown and spunbond layers are formed of polypropylene; and wherein the laminated fabric has a pore size diameter greater than 20 µm.

2. A building material in the form of a laminated fabric comprising a first layer of meltblown material sandwiched between a second and a third layer of spunbond material and laminated by thermal point bond calendering; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 µm;

the laminated fabric has an air permeability greater than 65 l/m^2/s;

the meltblown and spunbond layers are formed of polypropylene; and wherein the laminated fabric has a pore size diameter between 25 µm and 30 µm.

~~2~~3. A building material according to claim 1 or 2 for use as a roofing underlay.

~~3~~4. A building material according to any preceding claim ~~1 or 2~~ for use on an unsupported roof or on a non-vented cold pitched roof.

5. A building material according to claim 1 or claim 3 or 4, when dependent on claim 1, wherein the laminated fabric has an air permeability greater than 80 l/m²/s.

6. A building material according to claim 1 or 7 or claim 3 or 4, when dependent on claim 1, wherein the laminated fabric has an air permeability between 75 l/m²/s and 100 l/m²/s.

~~4~~7. A building material according to ~~any preceding~~ claim 2 or claim 3 or 4, when dependent on claim 2, wherein the laminated fabric has an air permeability greater than 70 l/m²/s, greater than 75 l/m²/s or greater than 80 l/m²/s.

~~5~~8. A building material according to ~~any preceding~~ claim 2 or 5 or claim 3 or 4, when dependent on claim 2, wherein the laminated fabric has an air permeability between 65 l/m²/s and 120 l/m²/s, between 70 l/m²/s and 110 l/m²/s, between 75 l/m²/s and 100 l/m²/s.

~~6~~9. A building material according to any preceding claim, wherein prior to lamination, the first layer of meltblown material has an air permeability greater than 300 l/m²/s, greater than 325 l/m²/s, or greater than 350 l/m²/s.

~~7~~10. A building material according to any preceding claim, wherein prior to lamination, the first layer of meltblown material has an air permeability between 300 l/m²/s and 400 l/m²/s, between 325 l/m²/s and 380 l/m²/s, or between 350 l/m²/s and 370 l/m²/s.

~~8~~11. A building material according to any preceding claim, wherein prior to lamination, the second and/or third layer(s) of spunbond material have an air permeability between 1100 $l/m^2/s$ and 9000 $l/m^2/s$.

~~9~~12. A building material according to any preceding claim, wherein the laminated fabric has a hydrostatic head between 50cm and 100cm, between 60cm and 90cm, or between 70cm and 90cm.

~~10~~13. A building material according to any preceding claim, wherein prior to lamination, the first layer of meltblown material has a hydrostatic head between 60cm and 100cm, between 65cm and 90cm, or between 65cm and 80cm.

~~11~~14. A building material according to any preceding claim, wherein the first layer of meltblown material is formed of fibres having a fibre diameter greater than 3.2 µm, greater than 3.5 µm or greater than 3.8 µm.

~~12~~15. A building material according to any preceding claim, wherein the fibres in the meltblown material have a diameter between 3.0 µm and 5.0 µm, between 3.2 µm and 4.5 µm, or between 3.3 µm and 4 µm.

~~13~~16. A building material according to any preceding claim, wherein the first layer of meltblown material has a basis weight between 10 g/m^2 and 60 g/m^2, or between 20 g/m^2 and 50 g/m^2 or between 30 g/m^2 and 40 g/m^2.

~~14~~17. A building material according to any preceding claim, wherein the second and/or third layer of spunbond material has a basis weight between 15 and 150 g/m^2, or between 40 and 100 g/m^2.

~~15~~18. A building material according to ~~any preceding~~ claim 1, or any of claims 3 to 17, when dependent on claim 1, wherein the laminated fabric has a pore size diameter greater than 25 μm.

~~16~~19. A building material according to ~~any preceding~~ claim 1 or 18, or any of claims 3 to 17, when dependent on claim 1, wherein the laminated fabric has a pore size diameter between 20 μm and 40 μm, or between 25 μm and 30 μm.

~~17~~20. A building material according to any preceding claim, wherein the laminated material comprises additives selected from hydrophobic melt additives, an organic fluorocarbon derivative, UV absorbing additives, flame retardants, pigments and plasticisers.

~~18~~21. A method of making a building material comprising

laminating a first layer of meltblown material to at least a second and a third layer of spunbond material to provide a spunbond-meltblown-spunbond (SMS) laminated fabric having an air permeability greater than ~~65~~ 75 l/m^2/s and a pore size diameter greater than 20 μm; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 μm;

laminating meltblown sheets to the second and third layer of spunbond material is effected by passing the sheet materials simultaneously through a thermal point bond calendering process; and

the meltblown and spunbond layers are formed of polypropylene.

22. A method of making a building material comprising

laminating a first layer of meltblown material to at least a second and a third layer of spunbond material to provide a spunbond-meltblown-spunbond (SMS) laminated fabric having an air permeability greater than 65 $l/m^2/s$ and a pore size diameter between 25 µm and 30 µm; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 µm;

laminating meltblown sheets to the second and third layer of spunbond material is effected by passing the sheet materials simultaneously through a thermal point bond calendering process; and

the meltblown and spunbond layers are formed of polypropylene.

~~19~~23. A method of making a building material according to claim ~~18~~21 or 22, wherein laminating comprises passing the first, second and third layers of material through heated calender rollers and optionally under pressure.

~~20~~24. A method of making a building material according to any of claims ~~18~~ 21 to ~~19~~23, wherein the area of bond points formed by the point bonding calendering process is 5% to 40% or 15% to 20% of the total area of the bonded materials.

~~21~~25. A method of making a building material according to any of claims ~~18~~ 21 to 24~~20~~, wherein the method comprises providing a pre-compressed first layer of meltblown material.

~~22~~26. A method of making a building material according to any of claims ~~18~~ 21 to ~~21~~25, wherein when the meltblown layer is formed of fibres having a fibre diameter greater than 3 µm, the meltblown layer is passed through a compression roller prior to lamination.

~~23~~27. A roof comprising a building material according to any of claims 1 to ~~17~~20.

~~24~~28. A roof according to claim ~~23~~27, wherein the roof is an unsupported roof, or an unsupported cold pitched roof, or a non-vented roof, or a non-vented cold pitched roof.

~~25~~29. A building or building structure with a roof comprising a building material according to any of claims 1 to ~~17~~20.

~~26~~30. Use of a laminated fabric as a roofing underlay, the laminated fabric comprising a first layer of meltblown material sandwiched between a second and a third layer of spunbond material and laminated by thermal point bond calendering; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 µm;

the laminated fabric has an air permeability greater than ~~65~~ 75 l/m^2/s and a pore size diameter greater than 20 µm; and

the meltblown and spunbond layers are formed of polypropylene.

31. Use of a laminated fabric as a roofing underlay, the laminated fabric comprising a first layer of meltblown material sandwiched between a second and a third layer of spunbond material and laminated by thermal point bond calendering; wherein

the meltblown material is formed of fibres having a fibre diameter greater than 3 µm;

the laminated fabric has an air permeability greater than 65 l/m^2/s and a pore size diameter between 25 µm and 30 µm; and

the meltblown and spunbond layers are formed of polypropylene.

~~27~~32. Use of a laminated fabric as a roofing underlay as defined in claim ~~26~~ 30 or 31 as a roofing underlay on an unsupported roof.

~~28~~33. Use of a laminated fabric as a roofing underlay according to claim ~~27~~32, in a newly constructed building.

~~29~~34. A building material substantially as described herein with reference to the accompanying drawings.

~~30~~35. A method of making a building material substantially as described herein with reference to the accompanying drawings.

~~31~~36. Use of a building material substantially as described herein with reference to the accompanying drawings.