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(54) **NON-COMBUSTIBLE HIGH PRESSURE LAMINATE**

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(57) **ABSTRACT**

A high pressure laminate includes a first layer of resin impregnated paper and at least one layer of fiber reinforced veil. Each layer of fiber reinforced veil includes binder and filler. The laminate is characterized by having a caloric value of lower than **3.0** MJ/kg when tested in accordance with ISO **1716.** A method for producing this high pressure laminate is also provided.

TABLE 1

Process step	example 1	std HPL	fire retardant HPL 1	example 2	example 3	example 4	example 5
Glass veil manufacturing							
glass type	E-glass			E-glass	Advantex glass	Advantex glass	Advantex glass
fiber diameter (um)	11			13	11	11	11
fiber length(mm)	10			11	6	6	6
weight (g/m2)	100			50	70	90	105
bonded with:	poly vinyl alcohol			poly vinyl alcohol	poly vinyl alcohol	poly vinyl alcohol	poly vinyl alcohol
binder content (%)	16			14	11	11	11
Impregnation							
resin type	phenol formaldehyde	phenol formaldehyde	phenol formaldehyde + fire retardant additives	melamine formaldehyde	phenol formaldehyde	phenol formaldehyde	phenol formaldehyde
resin concentration (%)	21			15	9.5	9.1	10.4
calcium carbonate (%)	26			20	16.5	18.3	0
Aluminium hydroxide (%)	53			65	66.6	63.5	72.9
final pre-preg weight (g/m2)	1000			900	922	1004	630
Pressing							
pressure (kg/cm2)	100	70	70	50	75	75	75
temperature (° C)	150	160	160	145	150	150	150
pressing cycle time (min)	20	20	22	20	20	20	20
press package build-up for a 3 mm laminate	melamine formaldehyde impregnated decorative paper - 5 fiber reinforced prepregs - melamine formaldehyde impregnated decorative paper	melamine formaldehyde impregnated decorative paper - 12 phenolic resin impregnated kraft papers - melamine formaldehyde impregnated decorative paper	melamine formaldehyde impregnated decorative paper - 11 FR phenolic resin impregnated kraft papers - melamine formaldehyde impregnated decorative paper	melamine formaldehyde impregnated decorative paper - 5 fiber reinforced prepregs - phenol formaldehyde impregnated kraft paper	melamine formaldehyde impregnated decorative paper - 4 fiber reinforced prepregs - melamine formaldehyde impregnated decorative paper	melamine formaldehyde impregnated decorative paper - 4 fiber reinforced prepregs - melamine formaldehyde impregnated decorative paper	melamine formaldehyde impregnated decorative paper - 8 fiber reinforced prepregs - melamine formaldehyde impregnated decorative paper

decorative paper: weight = 160 g/m2
60 g/m2 base weight paper + 80 g/m2 melamine formaldehyde resin

Fig. 1

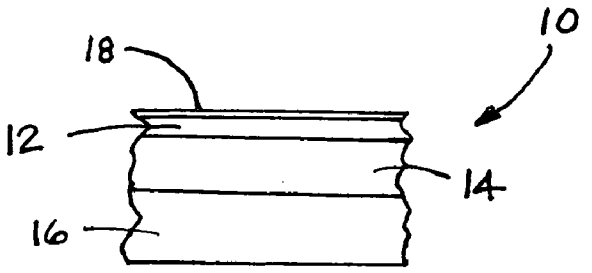


Fig. 2

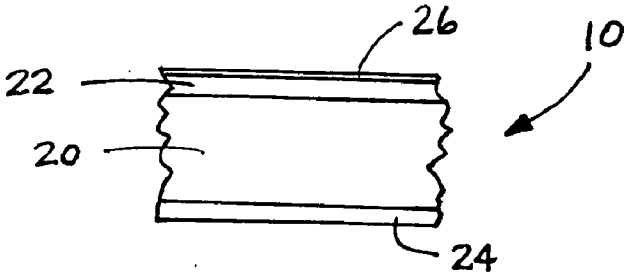
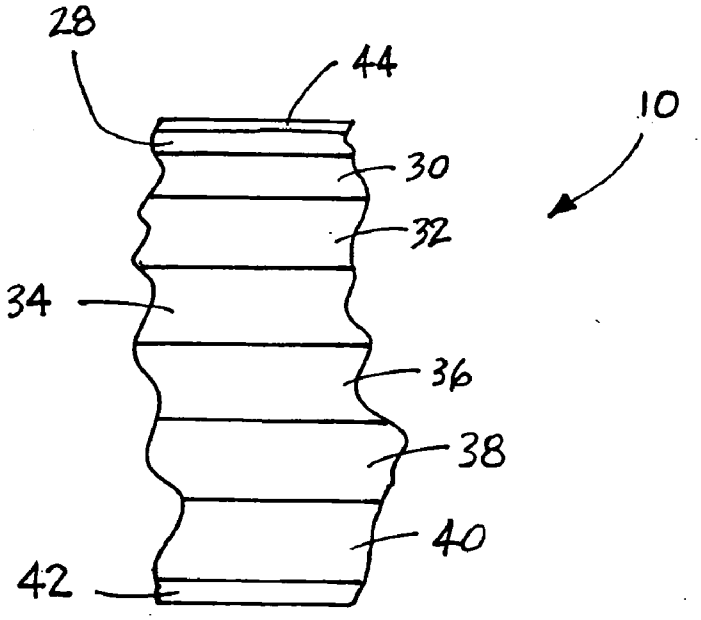


Fig. 3



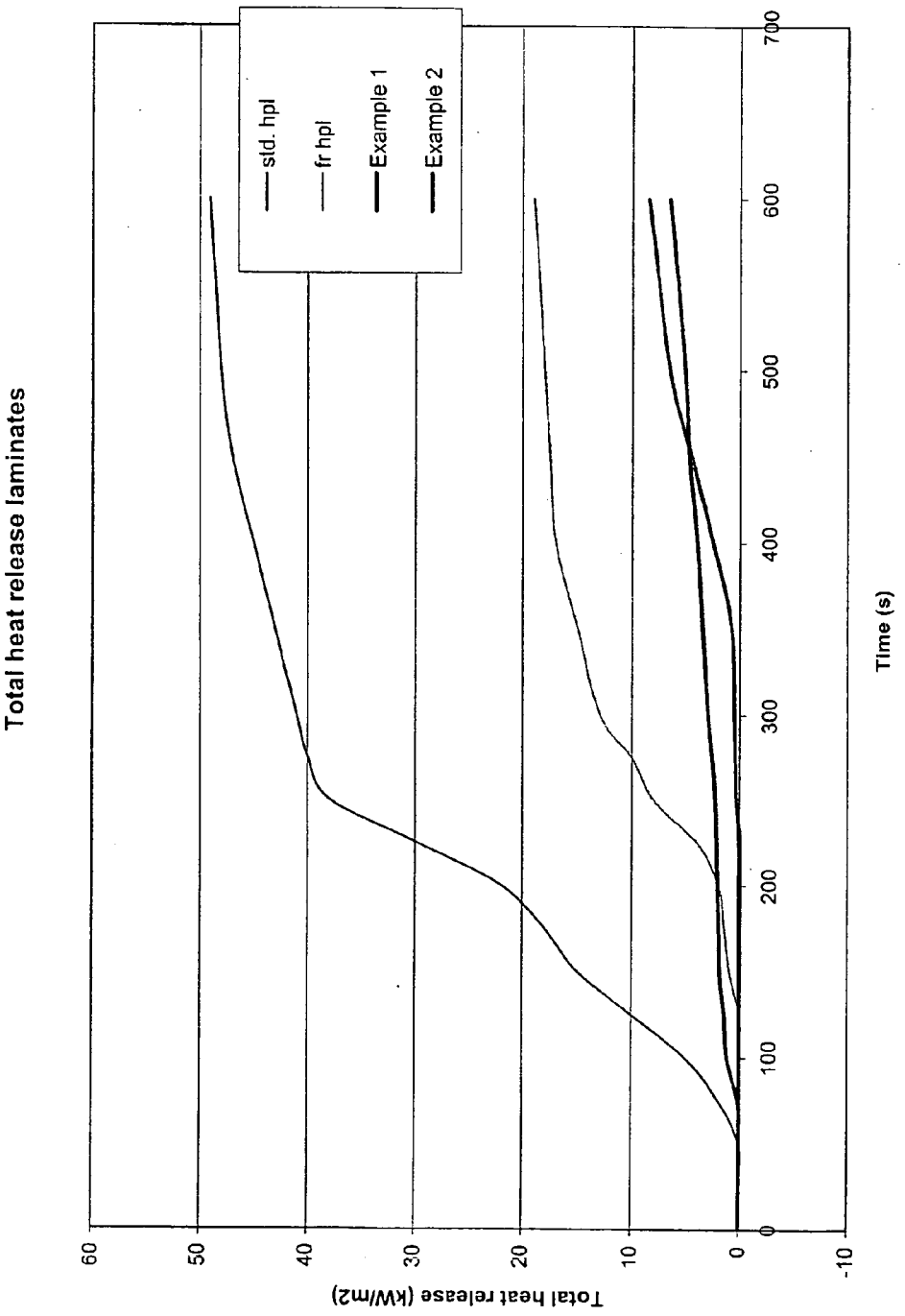

Total heat release laminates
std. hpl
fr hpl
Example 1
Example 2
Total heat release (kW/m2)
60
50
40
30
20
10
0
-10
0
100
200
300
400
500
600
700
Time (s)

Fig. 4a

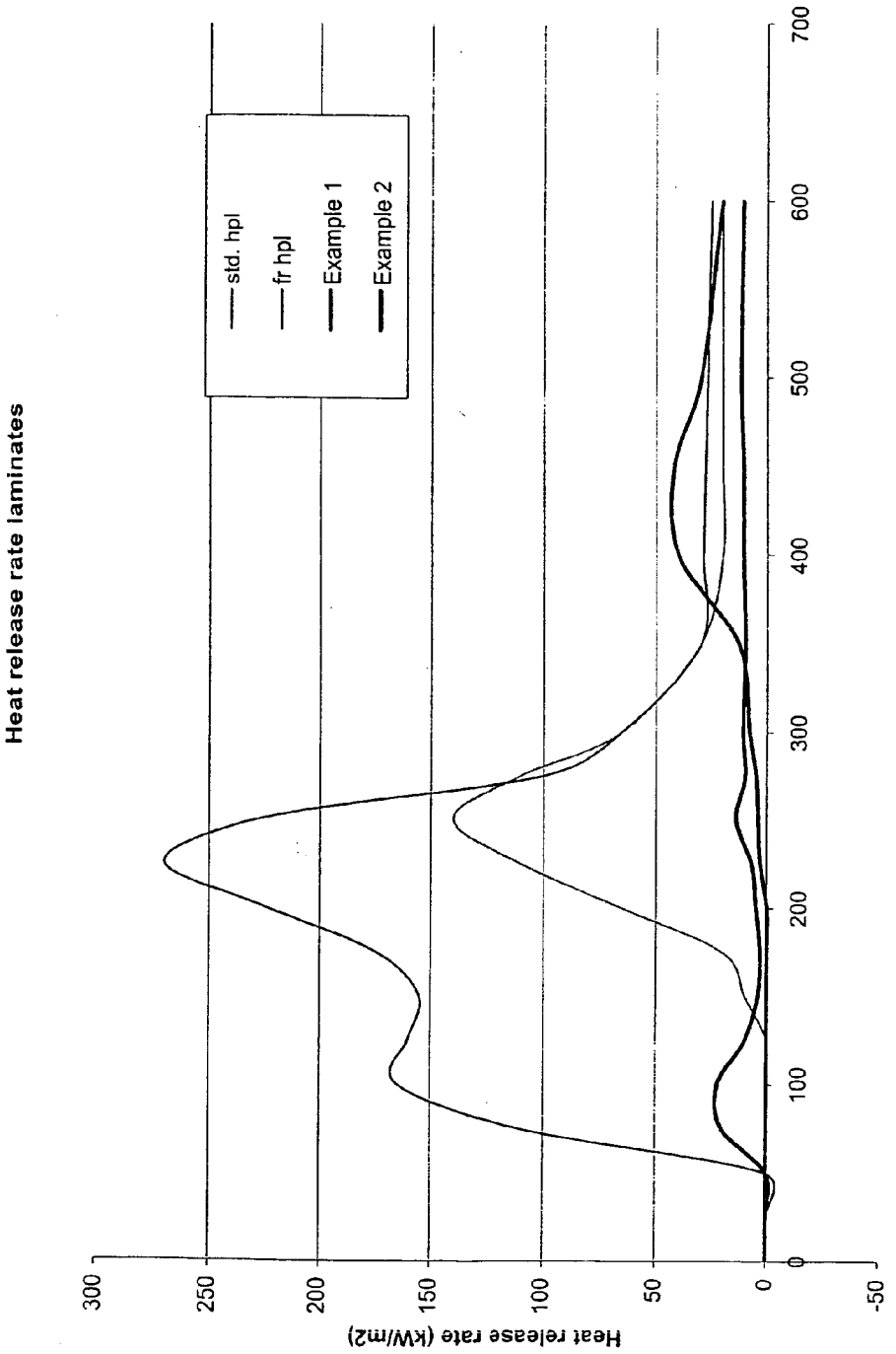

Heat release rate laminates
std. hpl
fr hpl
Example 1
Example 2
Heat release rate (kW/m2)
300
250
200
150
100
50
0
-50
0
100
200
300
400
500
600
700
Time (s)

Fig. 4b

TABLE 2

test	norm	example 1	std HPL	fire retardant HPL	example 2	example 3	example 4	example 5
thickness(mm)		2.96	2.99	2.75	3	2.2	2.4	2.3
density (kg/m3)		1849	1442	1500	1750	1847	1845	1870
2 hr water boiling test	EN 438							
visual observation		ok	ok	ok	ok	ok	ok	ok
thickness increase(%)		1,6	4,9	7	1.4	1.6	3	1.7
water absorption(%)		5,84	1,34	5	3.5	8.5	9.4	7.1
Dimensional stability	EN 438							
70 ± 2 °C; machine direction(%)		0,32	0,20	1.1				
70 ± 2 °C; cross direction(%)		0,32	0,45	2.3				
20 ± 2 °C; machine direction(%)		0,15	0,13	0.65				
20 ± 2 °C; cross direction(%)		0,18	0,30	0.98				
Flexural strength (Mpa)	ISO 178	87	180	179		54	62	86
Flexural modulus (Mpa)	ISO 178	14809	17652	23155		12200	11400	13600
Deflection((%)	ISO 178	0.7	1.11	0.8				
Tensile strength(Mpa)	ISO 3268	39	131	113				
Tensile modulus(Mpa)	ISO 3268	12410	18996	17634				
Elongation (%)	ISO 3268	0.4	0.74	0.68				
Impact F max (kN)	ISO 6603-2	1.9	1.9	1.2				
Impact energy (J)	ISO 6603-2	7.8	6.2	4.9				
Cone calorie measurements	ISO 5660	see THR HRR curves	see THR HRR curves	see THR HRR curves	see THR HRR curves			
Caloric value (MJ/kg)	ISO 1716	2.95	20.4	19.4	2.35	2.29	2.37	2
Limited Oxygen Index (%)	ISO 4589	100	40	46	100	100	100	100

NON-COMBUSTIBLE HIGH PRESSURE LAMINATE

TECHNICAL FIELD AND INDUSTRIAL APPLICABILITY OF THE INVENTION

[0001] This invention relates generally to high pressure laminates and more particularly to a high pressure laminate complying with prEN 13823 and having a caloric value of lower than 3.0 MJ/kg when tested in accordance with ISO 1716.

BACKGROUND OF THE INVENTION

[0002] High pressure laminates (HPL) are well known in the art and HPL panels are used, for example, as wall linings, for furniture, facade cladding, bench tops and the like.

[0003] One of the most important parameters of HPL panels, especially in the building industry, is fire performance. Since 2003, all building materials in Europe must comply with prEN 13823 (reaction to fire tests for building products). This norm describes the Single Burning Item (SBI) test. A1 and A2 classification of additional caloric value measurement according to ISO 1716 is required.

[0004] State of the art HPL panels are made fire retardant by using fire retardant kraft paper or by using a fire retardant phenol-formaldehyde resin. State of the art FR-HPL products have achieved an SBI classification of as high as B (above 3.0 MJ/kg when tested under ISO 1716).

[0005] HPL manufacturers have a strong desire for an SBI A2 classified HPL panel. Such a classification would allow the manufacturers to expand the application range for their products and thereby penetrate additional markets. To date, this hasn't been achieved because no one has been able to meet the caloric value requirement and still achieve the desired mechanical properties and fire propagation characteristics. The present invention relates to the first HPL panel meeting all these requirements including those for A2 classification (below 3.0 MJ/kg when tested under ISO 1716).

SUMMARY OF THE INVENTION

[0006] The high pressure laminate of the present invention comprises a first layer of resin impregnated paper and at least one layer of fiber reinforced veil. Each layer of fiber reinforced veil includes both a secondary binder and a filler. The high pressure laminate is characterized by having a caloric value of lower than about 3.0 MJ/kg when tested in accordance with ISO 1716.

[0007] The laminate may further include a second layer of resin impregnated paper. In such an embodiment the layer or layers of fiber reinforced veil are sandwiched between the first and second layers of resin impregnated paper.

[0008] In any of the possible embodiments the secondary binder is a heat curable resin. Typically the binder is selected from a group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an epichlorohydrin-polyamide resin and mixtures thereof. The filler is typically selected from a group consisting of metal hydroxides, metal carbonates, titanium dioxide, calcined clay, barium sulfate, magnesium sulfate, aluminum sulfate, zinc oxide, kaolin clay, chlorite, diatomite, feldspar, mica, nepheline syenite, pyrophyllite (aluminum silicate), silica, talc, wollastonite, montmorillonite (bentonite), hectorite, saponite, calcium carbonate, magnesium carbonate, aluminum oxide, iron oxide, magnesium hydroxide, glass micro beads and mixtures thereof.

[0009] In a particularly preferred embodiment the filler is selected from a group consisting of metal hydroxides, metal carbonates and mixtures thereof. A mixture of calcium carbonate and aluminum hydroxide is a particularly useful filler for the present invention. This is particularly true when the binder is melamine-formaldehyde.

[0010] In one possible embodiment each layer of fiber reinforced veil includes between about 1 and about 95 weight percent reinforcement fibers about 5 and about 50 weight percent melamine-formaldehyde, between about 10 and about 80 weight percent calcium carbonate and about 20 and about 90 weight percent aluminum hydroxide.

[0011] Still further describing the invention, each fiber reinforced veil includes reinforcing fibers that may be selected from a group consisting of glass fibers, basalt fibers, inorganic fibers and mixtures thereof. Typically the fibers are chopped. In a particularly useful embodiment the veil includes chopped glass fibers. The chopped fibers may include strands, rovings and individual chopped glass fibers or mixtures thereof. The glass fibers may, for example, be made from E-glass, ECR-glass, AR-glass, C-glass, M-glass, S-glass, S2-glass and mixtures thereof

[0012] The fiber reinforced veil may be woven or nonwoven. Where multiple layers of fiber reinforced veil are provided, they may all be woven, they may all be nonwoven or the layers may be a mixture of woven and nonwoven.

[0013] The high pressure laminate of the present invention may be made more aesthetically appealing when the first layer of resin impregnated paper is a melamine impregnated decor paper. Further, the product may include a radiation cured paint film or coating such as a UV cured paint film or an electron beam cured paint film on an exposed face of the first layer of resin impregnated paper. In yet another alternative the product may include a thermally cross-linked urethane acrylate paint layer on an exposed face of the first layer of the resin impregnated paper.

[0014] In accordance with yet another aspect of the present invention a method is provided for making a high pressure laminate. That method comprises pressing a first layer of resin impregnated paper and at least one layer of fiber reinforced veil together at a pressure of between about 525 N/m^2 and about 15,750 N/m^2 while simultaneously heating the layers to a temperature of between about 120 degrees C. and about 220 degrees C. to form a laminate. In addition the method includes the step of using a combination of secondary binder and filler to provide a caloric value of lower than 3.0 MJ/kg when the laminate is tested in accordance with ISO 1716.

[0015] The method may further include the selecting of the secondary binder from a group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an

epichlorohydrin-polyamide resin and mixtures thereof. The filler may be selected from a group consisting of metal hydroxides, metal carbonates and mixtures thereof. In a particularly useful embodiment the filler is selected from a mixture of calcium carbonate and aluminum hydroxide.

[0016] In one possible embodiment the method includes the forming of the first layer of resin impregnated paper from melamine impregnated decor paper. In addition, the method may include the painting of an exposed face of the first layer of resin impregnated paper with a radiation cured paint. In yet another possible embodiment the method may include the painting of an exposed face of the first layer of resin impregnated paper with a thermally crosslinked urethane acrylate paint.

[0017] In the following description there is shown and described several different embodiments of this invention, simply by way of illustration of some of the modes best suited to carry out the invention. As it will be realized, the invention is capable of other different embodiments and its several details are capable of modification in various, obvious aspects all without departing from the invention. Accordingly, the drawings and descriptions will be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings incorporated in and forming a part of the specification, illustrate several aspects of the present invention, and together with the description serve to explain certain principles of the invention. In the drawings:

[0019] **FIG. 1** is a side elevational view of one possible embodiment of the present invention;

[0020] **FIG. 2** is a side elevational view of a first alternative embodiment of the present invention;

[0021] **FIG. 3** is a side elevational view of yet another possible embodiment of the present invention;

[0022] **FIG. 4***a* is a total heat release graph comparing two representative examples of the present invention with two representative state of the art products; and

[0023] **FIG. 4***b* is a heat release rate graph comparing the same two representative examples of the present invention with two representative state of the art products.

[0024] Reference will now be made in detail to the present preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings.

Detailed Description and Preferred Embodiments of the Invention

[0025] Three possible embodiments of the high pressure laminate **10** of the present invention are illustrated in **FIGS. 1-3**. The high pressure laminate **10** may be generally described as comprising a first layer of resin impregnated paper and at least one layer of fiber reinforced veil, Each layer of fiber reinforced veil further includes a secondary binder and filler so that the high pressure laminate is characterized by having a caloric value of lower than 3.0 MJ/kg when tested in accordance with ISO 1716. The term "secondary binder" is defined as a binder which is applied in a second processing step which is discussed in more detail below.

[0026] As illustrated in the **FIG. 1** embodiment, the high pressure laminate **10** includes a first layer **12** of resin impregnated paper, such as melamine impregnated decor paper. In addition, the laminate **10** includes two layers **14**, **16** of fiber reinforced veil.

[0027] Each layer **14**, **16** of fiber reinforced veil is impregnated with a secondary binder and filler composition. The secondary binder is a heat curable resin. Typically, the secondary binder is selected from a group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an epichlorohydrin-polyamide resin and mixtures thereof.

[0028] The filler is selected from a group consisting of metal hydroxides, metal carbonates, titanium dioxide, calcined clay, barium sulfate, magnesium sulfate, aluminum sulfate, zinc oxide, kaolin clay, chlorite, diatomite, feldspar, mica, nepheline syenite, pyrophyllite (aluminum silicate), silica, talc, wollastonite, montmorillonite (bentonite), hectorite, saponite, calcium carbonate, magnesium carbonate, aluminum oxide, iron oxide, magnesium hydroxide, glass micro beads and mixtures thereof. Typically the filler is selected from a group consisting of metal hydroxides, metal carbonates and mixtures thereof. A mixture of calcium carbonate and aluminum hydroxide is particularly useful in the present invention. This is particularly true when used in conjunction with a melamine-formaldehyde binder. The particle size of the fillers typically ranges from about 0.3 μm to about 150 μm, more preferably between about 1 μm to about 75 μm, and most preferably between about 4 μm to about 50 μm.

[0029] The fiber reinforced veil includes reinforcing fibers selected from a group consisting of glass fibers, basalt fibers, inorganic fibers (carbide, nitride, etc.) and mixtures thereof. Glass fibers particularly useful in the present invention include E-glass (such as Advantex glass), ECR-glass, AR-glass, C-glass, M-glass, D-glass, S-glass, S2-glass and mixtures thereof. The fibers are typically chopped in lengths of between about 0.1 mm and 100 mm and may be in the forms of chopped strands, chopped rovings or chopped individual fibers or mixtures thereof. Where individual fibers are utilized, the diameter of those fibers is typically between about 3 and about 50 microns.

[0030] The fiber reinforced veils, prior to impregnation of the secondary binder and fillers, contain up to about 95 weight percent glass fibers, preferably between about 75 to about 95 weight percent glass fibers, more preferably between about 78 to about 93 weight percent glass fibers, and most preferably between about 80 to about 92.5 weight percent glass fibers. Preferably, the fiber reinforced veil layer includes E-glass fibers.

[0031] The fiber reinforced veil, prior to impregnation of the secondary binder composition and fillers, may include a binder, as mentioned above, preferably the binder is a polyvinyl alcohol. Preferably, the binder is present in the veil at a content of about 5 to about 25 percent by weight.

[0032] In the embodiment illustrated in **FIG. 1**, the laminate **10** incorporates two layers **14**, **16** of veil. Each veil layer **14**, **16** may be woven or nonwoven. In the embodiment

illustrated in **FIG. 1**, both veil layers **14**, **16** may be woven, both may be nonwoven or one may be woven while the other is nonwoven.

[**0033**] A particularly useful embodiment of the present invention incorporates one or more veil layers **14**, **16** including between about 1 and about 95 weight percent reinforcement fibers, preferably between about 75 weight percent to about 95 weight percent reinforcement fibers, more preferably between about 78 to about 93 weight percent reinforcement fibers, most preferably between about 80 to about 92.5 weight percent reinforcement fibers, prior to impregnation of the secondary binder composition and fillers. The veil layers also contain between about 2 to about 50 weight percent, preferably between about 5 to about 25 weight percent melamine-formaldehyde secondary binder and at least one filler in the amount of between about 10 and about 80 weight percent, preferably between about 17.5 to about 65 weight percent calcium carbonate and about 20 to about 90 weight percent, preferably about 35 to about 70 weight percent aluminum hydroxide.

[**0034**] As further illustrated in **FIG. 1**, the laminate **10** may be made more aesthetically pleasing by including a radiation curable paint such as an electron beam cured or UV cured paint film **18** on an otherwise exposed face of the first layer of resin impregnated paper **12**. Alternatively, the layer **18** may comprise a thermally cross-linked urethane acrylate paint.

[**0035**] An alternative embodiment of the present invention is illustrated in **FIG. 2**. In this embodiment, the high pressure laminate **10** includes a single fiber reinforced veil layer **20** sandwiched between first and second layers **22**, **24** of resin impregnated paper. The laminate **10** of **FIG. 2** may also include a layer **26** of radiation cured paint such as an electron beam cured or UV cured paint film or a thermally cross-linked urethane acrylate paint. The layer **26** is, however, optional.

[**0036**] In still another embodiment illustrated in **FIG. 3**, the laminate **10** may include a first layer **28** of resin impregnated paper, six intermediate layers **30**, **32**, **34**, **36**, **38**, **40** of fiber reinforced veil and a second layer **42** of resin impregnated paper. The **FIG. 3** embodiment may also include an optional layer **44** comprising a radiation cured paint such as an electron beam or UV cured paint film or a thermally cross-linked urethane acrylate paint layer for enhanced aesthetic appearance.

[**0037**] It should be appreciated that the resin impregnated paper layers **22**, **24**, **28** and **42** of the embodiments illustrated in **FIGS. 2 and 3** are similar or identical to the resin impregnated paper layer **12** of the first embodiment illustrated in **FIG. 1**. Similarly, the fiber reinforced veil layers **20**, **30**, **32**, **34**, **36**, **38**, **40** of the embodiments illustrated in **FIGS. 2 and 3** are also identical or similar to the veil layers **14**, **16** of the **FIG. 1** embodiment. As illustrated, the laminate **10** of the present invention may include any number of fiber reinforced veil layers while still meeting the fire propagation, caloric value and mechanical properties of any particular end product application.

[**0038**] Typically, each fiber reinforced veil layer is a prepreg or ready-to-mold sheet of woven or nonwoven reinforcement fibers impregnated with a resin binder and stored for subsequent use such as the final construction of the laminate product by a manufacturer. Any water-based, wet strength binder known in the art could be used. Useful binders include but are not limited to the following polyvinyl alcohol, (partially hydrolyzed) polyvinyl acetate, acrylic polymers and copolymers, crosslinkable acrylic polymers and copolymers, polymerizable polyfunctional N-methylol compounds, notably N-methylol ureas such as dimethylol urea and N-methylol melamine type resins, melamine formaldehyde, phenol formaldehyde, furfuryl formaldehyde, resorcinol formaldehyde, styrene butadiene copolymer latices, cationic polyamideepichlorohydrin, aminoresins, epoxyresins, polystyrene emulsion binder, polycarboxylic acid based binders, other latices and/or acrylic polymers or copolymers like acrylamide, ethylene vinyl acetate/vinyl chloride, alkyl acrylate polymer,styrene-butadiene rubber, acrylonitrile polymer, polyurethane resins, polyvinyl chloride, polyvinylidene chloride, copolymers of vinylidene chloride with other monomers, polyvinyl acetate, polyvinyl pyrrolidone, polyester resins, acrylate emulsion resin, styrene acrylate. More preferably, the binder is polyvinyl alcohol.

[**0039**] The prepreg is impregnated with the secondary binder and filler composition. The secondary binder and filler composition preferably includes between about 2 to about 30 weight percent glass, in addition to the glass already present in the prepreg, more preferably between about 3 to about 25 weight percent glass, and most preferably between about 4 to about 20 weight percent glass. The prepreg also contains between about 5 to about 25 weight percent secondary binder, preferably between about 7 to about 20 weight percent secondary binder, most preferably between about 8 to about 18 weight percent secondary binder. The prepreg also contains between about 50 to about 93 weight percent fillers, more preferably between about 55 to about 90 weight percent fillers and most preferably between about 60 to about 88 weight percent total fillers.

[**0040**] Typically the filler is a mixture of metal hydroxide and metal carbonate at a ratio of between about 1:0.01 and about 1:100. Preferably, the metal hydroxide aluminum hydroxide and is present in the prepreg the amount of between about 20 to about 90 weight percent, more preferably between about 30 to about 80 weight percent, and most preferably between about 35 to about 70 weight percent. The preferred metal carbonate is calcium carbonate and is present in the prepreg in the amount of about 10 to about 80 weight percent, more preferably about 15 to about 70 weight percent and most preferably between about 17.5 to about 65 weight percent.

[**0041**] The particle size of the fillers typically ranges from about 0.3 μm to about 150 μm, more preferably between about 1 μm to about 75 μm, and most preferably between about 4 μm to about 50 μm.

[**0042**] Following impregnation, and before pressing, a typical fiber reinforced veil prepreg will have a total weight per unit area of between about 250 g/m^2 and about 2000 g/m^2, a density of between about 500 kg/m^3 and about 2000 kg/m^3 The high pressure laminate **10** is constructed by pressing a first layer of resin impregnated paper and at least one layer of fiber reinforced veil together at a pressure of between about 525 N/m^2 and about 15,750 N/m^2 (about 5 and about 150 bar) while simultaneously heating the layers to a temperature of between about 120 degrees C. and about

220 degrees C. to form the laminate. In addition the method includes the step of using a combination of binder and filler to provide a caloric value of lower than 3.0 MJ/kg when the laminate is tested in accordance with ISO 1716. This allows one to produce an HPL panel or product with an SBI A2 classification.

[0043] In order to achieve this end, the secondary binder is selected from a group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an epichlorohydrin-polyamide resin and mixtures thereof. The filler is selected from a group of materials consisting of metal hydroxides, metal carbonates, titanium dioxide, calcined clay, barium sulfate, magnesium sulfate, aluminum sulfate, zinc oxide, kaolin clay, chlorite, diatomite, feldspar, mica, nepheline syenite, pyrophyllite (aluminum silicate), silica, talc, wollastonite, montmorillonite (bentonite), hectorite, saponite, calcium carbonate, magnesium carbonate, aluminum oxide, iron oxide, magnesium hydroxide, glass micro beads and mixtures thereof.

[0044] Typically, the filler is selected from a group consisting of metal hydroxides, metal carbonates and mixtures thereof. Calcium carbonate and aluminum hydroxide are particularly useful in this method.

[0045] In order to further enhance the aesthetic appeal of the product, the method may also include forming the first layer of resin impregnated paper from melamine impregnated decor paper. Further, the method may include painting an exposed face of the first layer of resin impregnated paper with electron beam cured paint. Alternatively the method may include painting an exposed face of the first layer of resin impregnated paper with a thermally crosslinked urethane acrylate paint.

[0046] The following example is presented to further illustrate the invention, but it is not to be considered as limited thereto.

EXAMPLE

[0047] Five examples of a high pressure laminate of the present invention were prepared. In the first (Example 1), five fiber reinforced glass veils were sandwiched between two layers of melamine formaldehyde impregnated decorative paper.

[0048] The glass fiber utilized in the glass veils was E-glass having a fiber diameter of 11 microns and a length of 10 mm. The glass veils each had a weight per unit area of 100 g/m^2. The glass veils included a poly vinyl alcohol binder at a content of 16 weight percent.

[0049] The decorative paper layers each had a weight per unit area of 160 g/m^2 including 80 g/m^2 base weight paper and 80 g/m^2 melamine formaldehyde resin.

[0050] The stacked layers of glass veil were then impregnated with a secondary binder and filler formulation including 21 weight percent phenol formaldehyde, 26 weight percent calcium carbonate and 53 weight percent aluminum hydroxide. The final glass veil weight was 1000 g/m^2.

[0051] The stacked layers were pressed together at a pressure of 100 kg/cm^2 at a temperature of 150 degrees C. for 20 minutes to produce a 2.96 mm thick laminate.

[0052] In the second (Example 2), five fiber reinforced glass veils were sandwiched between a layer of melamine formaldehyde decorative paper and a layer of phenol formaldehyde impregnated kraft paper.

[0053] The glass fibers utilized in the Example 2 product were E-glass having a fiber diameter of 13 microns and a length of 11 mm. The glass veils each had a weight per unit area of 50 g/m^2 and included a poly vinyl alcohol binder at a content of 14 weight percent.

[0054] The stacked layers of glass veil were impregnated with a secondary binder and filler formulation of 15 weight percent melamine formaldehyde, 20 weight percent calcium carbonate and 65 weight percent aluminum hydroxide. The final glass veil weight was 900 g/m^2.

[0055] The stacked layers of the Example 2 product were pressed together at a pressure of 50 kg/cm^2 at a temperature of 145 degrees C. for 20 minutes in order to produce a 3 mm thick laminate.

[0056] Additional Examples 3, 4 and 5 of the present invention are presented in Table 1 below along with Examples 1 and 2. Additionally, the Table includes corresponding measurements for representative state of the art HPL (std HPL) and state of the art FR-HPL (fire retardant HPL) products for purposes of comparison. Test results for each of these Examples 1-5 and the state of the art products std HPL and FR-HPL are presented (where available) in Table 2. Relevant total heat release (THR) and heat release rate (HRR) curves are illustrated respectively in **FIGS. 4***a* and **4***b*.

[0057] The foregoing description of the preferred embodiments of the invention have been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings.

[0058] The embodiments were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally and equitably entitled. The drawings and preferred embodiment do not and are not intended to limit the ordinary meaning of the claims and their fair and broad interpretation in any way.

What is claimed is:

1. A high pressure laminate, comprising:

a first layer of resin impregnated paper; and

at least one layer of fiber reinforced veil, each layer of fiber reinforced veil being impregnated with a secondary binder and at least one filler;

said high pressure laminate being characterized by having a caloric value of lower than about 3.0 MJ/kg when tested in accordance with ISO 1716.

2. The laminate of claim 1 including a second layer of resin impregnated paper, said at least one layer of fiber

reinforced veil being sandwiched between said first and second layers of resin impregnated paper.

3. The laminate of claim 1, wherein said secondary binder is a heat curable resin.

4. The laminate of claim 3 wherein said secondary binder is selected from a group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an epichlorohydrin-polyamide resin and mixtures thereof.

5. The laminate of claim 3, wherein said filler is selected from a group consisting of metal hydroxides, metal carbonates, titanium dioxide, calcined clay, barium sulfate, magnesium sulfate, aluminum sulfate, zinc oxide, kaolin clay, chlorite, diatomite, feldspar, mica, nepheline syenite, pyrophyllite, silica, talc, wollastonite, montmorillonite, hectorite, saponite, calcium carbonate, magnesium carbonate, aluminum oxide, iron oxide, magnesium hydroxide, glass micro beads and mixtures thereof.

6. The laminate of claim 1, wherein said filler is selected from a group consisting of metal hydroxides, metal carbonates and mixtures thereof.

7. The laminate of claim 6, wherein said mixtures of metal hydroxides to metal carbonates are provided at a ratio of between about 1:0.01 and about 1:100.

8. The laminate of claim 1, wherein said filler is selected from a mixture of calcium carbonate and aluminum hydroxide.

9. The laminate of claim 8 wherein said secondary binder is melamine-formaldehyde.

10. The laminate of claim 9, wherein each said layer of fiber reinforced veil following impregnation includes between about 1 and about 95 weight percent reinforcement fibers, about 2 and about 50 weight percent melamine-formaldehyde, between about 1 and about 85 weight percent calcium carbonate and about 1 and about 85 weight percent aluminum hydroxide.

11. The laminate of claim 10 wherein each said layer of fiber reinforced veil following impregnation and prior to pressing has a weight per unit area of between about 250 g/m^2 and about 2000 g/m^2 and a density of between about 500 kg/m^3 and about 2000 kg/m^3.

12. The laminate of claim 10, wherein said reinforcement fibers are glass fibers selected from a group consisting of E-glass, ECR-glass, AR-glass, M-glass, D-glass, C-glass, S-glass, S2-glass and mixtures thereof.

13. The laminate of claim 1 wherein said at least one layer of fiber reinforced veil is woven.

14. The laminate of claim 1, wherein said at least one layer of fiber reinforced veil is nonwoven.

15. The laminate of claim 1, including at least two layers of fiber reinforced veil wherein a first layer of said two layers is woven and a second layer of said two layers is nonwoven.

16. The laminate of claim 1, wherein said at least one fiber reinforced veil includes reinforcing fibers selected from a group consisting of glass fibers, basalt fibers, inorganic fibers and mixtures thereof.

17. The laminate of claim 1, wherein said at least one fiber reinforced veil includes chopped glass fibers

18. The laminate of claim 17, wherein said chopped glass fibers include chopped glass strands, chopped glass rovings, individual chopped glass fibers and mixtures thereof.

19. The laminate of claim 1, wherein said first layer of resin impregnated paper is a melamine impregnated decor paper.

20. The laminate of claim 1, further including a radiation cured paint film on an exposed face of said first layer of resin impregnated paper.

21. The laminate of claim 1, further including a thermally cross-linked urethane acrylate paint layer on an exposed face of said first layer of resin impregnated paper.

22. A fiber reinforced veil comprising a secondary binder and at least one filler; wherein said veil has a caloric value of lower than about 3.0 MJ/kg when tested in accordance with ISO 1716.

23. The fiber reinforced veil of claim 22, wherein said secondary binder is selected from the group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an epichlorohydrin-polyamide resin and mixtures thereof.

24. The fiber reinforced veil of claim 22, further comprising a binder selected from the group consisting of polyvinyl alcohol, (partially hydrolyzed) polyvinyl acetate, acrylic polymers and copolymers, crosslinkable acrylic polymers and copolymers, polymerizable polyfunctional N-methylol compounds, notably N-methylol ureas such as dimethylol urea and N-methylol melamine type resins, melamine formaldehyde, phenol formaldehyde, furfuryl formaldehyde, resorcinol formaldehyde, styrene butadiene copolymer latices, cationic polyamideepichlorohydrin, aminoresins, epoxyresins, polystyrene emulsion binder, polycarboxylic acid based binders, other latices and/or acrylic polymers or copolymers like acrylamide, ethylene vinyl acetate/vinyl chloride, alkyl acrylate polymer,styrene-butadiene rubber, acrylonitrile polymer, polyurethane resins, polyvinyl chloride, polyvinylidene chloride, copolymers of vinylidene chloride with other monomers, polyvinyl acetate, polyvinyl pyrrolidone, polyester resins, acrylate emulsion resin, and styrene acrylate.

25. The fiber reinforced veil of claim 22, wherein said filler is selected from a group consisting of metal hydroxides, metal carbonates, titanium dioxide, calcined clay, barium sulfate, magnesium sulfate, aluminum sulfate, zinc oxide, kaolin clay, chlorite, diatomite, feldspar, mica, nepheline syenite, pyrophyllite, silica, talc, wollastonite, montmorillonite, hectorite, saponite, calcium carbonate, magnesium carbonate, aluminum oxide, iron oxide, magnesium hydroxide, glass micro beads and mixtures thereof.

26. The fiber reinforced veil of claim 22, wherein said fiber reinforced veil includes reinforcing fibers selected from a group consisting of glass fibers, basalt fibers, inorganic fibers and mixtures thereof.

27. A method of making a high pressure laminate, comprising:

pressing a first layer of resin impregnated paper and at least one layer of fiber reinforced veil together at a pressure and temperature sufficient to laminate said paper and said at least one layer of veil together; and

impregnating said paper and said fiber reinforcing veil with a secondary binder and at least one filler to provide a caloric value of lower than 3.0 MJ/kg when said laminate is tested in accordance with ISO 1716.

28. The method of claim 27 wherein said step of pressing said paper and said veil together further includes pressing said paper and said veil together at a pressure of between about 525 $N/N/m^2$ and about 15,750 N/m^2 and simultaneously heating said paper and said veil at a temperature of between about 120 degrees C. and about 220 degrees C.

29. The method of claim 27 including selecting said secondary binder from a group consisting of melamine-formaldehyde, phenol-formaldehyde, urea-formaldehyde, epoxy resin, unsaturated polyesters, cross-linkable acrylic resin, polyurethane resin, an epichlorohydrin-polyaminopolyamide resin, an epichlorohydrin-polyamine resin, an epichlorohydrin-polyamide resin and mixtures thereof.

30. The method of claim 29, including selecting said filler from a group consisting of metal hydroxides, metal carbonates, titanium dioxide, calcined clay, barium sulfate, magnesium sulfate, aluminum sulfate, zinc oxide, kaolin clay, chlorite, diatomite, feldspar, mica, nepheline syenite, pyrophyllite, silica, talc, wollastonite, montmorillonite, hectorite, saponite, calcium carbonate, magnesium carbonate, aluminum oxide, iron oxide, magnesium hydroxide, glass micro beads and mixtures thereof.

31. The method of claim 29, including selecting said filler from a group consisting of metal hydroxides, metal carbonates and mixtures thereof.

32. The method of claim 29, including selecting said filler from a mixture of calcium carbonate and aluminum hydroxide.

33. The method of claim 27, including selecting said filler from a group consisting of metal hydroxides, metal carbonates and mixtures thereof.

34. The method of claim 27, including selecting said filler from a mixture of calcium carbonate and aluminum hydroxide.

35. The method of claim 27, further including forming said first layer of resin impregnated paper from melamine impregnated decor paper.

36. The method of claim 27, further including painting an exposed face of said first layer of resin impregnated paper with radiation cured paint.

37. The method of claim 27 further including painting an exposed face of said first layer of resin impregnated paper with a thermally crosslinked urethane acrylate paint.

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