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D2B
/

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DESCRIPTION

FLAME-RETARDANT OR NONFLAMMABLE DECORATIVE SHEET

TECHNICAL FIELD

The present invention relates to a flame-retardant or nonflammable decorative sheet used in various applications mainly as an interior material.

5 BACKGROUND ART

Many of the conventional flame-retardant or nonflammable decorative sheets are made of inorganic materials and have various problems in processability, impact resistance, health safety due to the presence of
10 asbestos, etc. However, decorative sheets made of organic resins cause severe heat generation and fuming when burned; are low in shape retainability after combustibility tests (the surface combustibility test and the material combustibility test both according to
15 Notification No. 1828 of the Ministry of Construction; hereinafter referred to also as noncombustibility tests); and have been unreliable as a flame-retardant or nonflammable decorative sheet.

Under the above situation, the present
20 invention provides a flame-retardant or nonflammable decorative sheet excellent in flame retardancy or nonflammability and low in dimensional change, warpage deformation, etc.



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DISCLOSURE OF THE INVENTION

The present invention relates to:

a flame-retardant or nonflammable decorative sheet which is a one-piece laminate of the following materials:

one or more layers of a sheet material as a core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide, the proportions of the former and the latter in the composition being 4-15% by weight and 96-85% by weight, respectively, and

a sheet material as a decorative layer, placed on at least one side of the sheet material as the core layer; and

a flame-retardant or nonflammable decorative sheet which is a one piece-laminate of the following materials:

two or more layers of a sheet material as a core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide, the proportions of the former and the latter in the composition being 4-15% by weight and 96-85% by weight, respectively,

a sheet material as a reinforcing layer,

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obtained by impregnating a base sheet material made of an inorganic fiber, with a thermosetting resin, the sheet material being interposed between the two or more layers of the sheet material as the core layer, and

5 a sheet material as a decorative layer, placed on at least one side of the sheet material as the core layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of a nonflammable decorative sheet 4 comprising a sheet material 1 for core layer and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 1 for core layer.

Fig. 2 is a sectional view of a nonflammable decorative sheet 4' comprising a sheet material 1' for core layer and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 1' for core layer.

Fig. 3 is a sectional view of a nonflammable decorative sheet 7 comprising a sheet material 5 for core layer, a sheet material 6 for reinforcing layer, interposed between the sheet material 5 for core layer, and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 5 for core layer.

Fig. 4 is a sectional view of a nonflammable decorative sheet 7' comprising a sheet material 5' for

core layer, a sheet material 6 for reinforcing layer, interposed between the sheet material 5' for core layer, and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 5' for core layer.

Fig. 5 is a sectional view of a decorative sheet 9 for comparison, comprising a sheet material 8 for core layer and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 8 for core layer.

Fig. 6 is a sectional view of a decorative sheet 9' for comparison, comprising a sheet material 8' for core layer and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 8' for core layer.

Fig. 7 is a schematic sectional view showing a step used in the production of a decorative sheet of the present invention, for producing a sheet material for core layer.

20 DETAILED DESCRIPTION OF THE INVENTION

In the present invention, there is no particular restriction with respect to the base sheet material made of an inorganic fiber. However, in order to coat the base sheet material with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide to impregnate them into the interior of the base sheet

material, the preferred base sheet material is a glass fiber nonwoven fabric, particularly a glass fiber nonwoven fabric having a basic weight of 30-100 g/m². When the basic weight is less than 30 g/m², the glass fiber nonwoven fabric has an insufficient strength and may have handling problems during impregnation of the composition into the glass fiber nonwoven fabric, molding or the like. When the basic weight exceeds 100 g/m², the adhesion between layers may be insufficient during molding.

The base sheet material is made of an inorganic fiber and used in the sheet material as a reinforcing layer. This is obtained by impregnating the base sheet material with a thermosetting resin. The preferred material is a glass nonwoven fabric having a basis weight of 30-100 g/m² or a glass woven fabric having a basis weight of 45-220 g/m². As the thermosetting resin, a melamine resin, a phenolic resin or the like can be used, and there is no particular restriction. However, a melamine resin is preferred in view of flame retardancy or nonflammability.

The composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide consists of 4-15% by weight of phenolic resin and/or melamine resin and 96-85% by weight of aluminum hydroxide and/or magnesium hydroxide. Therefore, the resulting decorative sheet has excellent flame retardancy, particularly when the phenolic resin

is 8% by weight or less or the melamine resin is 10% by weight or less. The resulting decorative sheet meets Notification No. 1828 of the Ministry of Construction, i.e. "DESIGNATION OF NONCOMBUSTIBLE MATERIALS". When
5 the phenolic resin and/or the melamine resin is less than 4% by weight, these resins are unable to fully act as a binder. As a result, there is a problem in interlaminar strength during the handling of sheet material for core layers and after molding.

10 As for the phenolic resin, ordinarily, used is a resol type phenolic resin, formed by using ammonia or an amine type catalyst such as triethylamine or the like. However, the phenolic resin is not restricted thereto.

15 As for the melamine resin, ordinarily used is a melamine resin whose formaldehyde/melamine molar ratio (hereinafter referred to simply as molar ratio) is 1.5-4.0. However, the molar ratio is not restricted to the above range. The molar ratio is preferably 1.5-3.0 in
20 view of fuming tendency, storability of resin varnish, etc. An acidic curing agent can be added if necessary.

 With respect to the aluminum hydroxide and/or the magnesium hydroxide, it is preferable that particles of large diameters and particles of small diameters are
25 used in combination and in closest packing. Use of small-diameter particles alone can ensure uniformity of a sheet material for core layer or a decorative sheet, but causes a problem during the mixing operation of the

composition. Use of large-diameter particles alone causes a problem in handling of the resulting sheet material for the core layer and further invites reduction in nonflammability, caused by decrease in surface area of the particles. By using the aluminum hydroxide and/or the magnesium hydroxide each having different particle diameters, in closest packing, the resulting composition can have improved saturation ability in production of a sheet material for the core layer. Various improvements are obtained in the mixing operation of the composition, handling of the resulting sheet, nonflammability of the sheet, etc.

In order to conduct the closest packing effectively, it is preferred that the particles of large diameters have an average particle diameter of 50-200 μm , the particles of small diameters have an average particle diameter of 1-30 μm , the total amount of the two kinds of particles is 50% by weight or more of the total filler amount, the ratio of the particle diameters of the two kinds of particles is 6 or more, and the compounding ratio of the two kinds of particles is 25:75 to 75:25. When the particle diameter ratio is smaller than 6 (the difference in particle diameters is small), the gap (volume) between particles is larger, the apparent density of resin/filler composition is smaller, and the bonding strength of resin is less. A compounding ratio deviating from the range of 25:75 to 75:25 is not preferred for flame retardancy or non-

flammability, because the surface area of particles is larger or the apparent density of the composition is smaller because of the increase of gap between particles and the resin is required in a larger amount. Keeping
5 the resin amount is not preferred from the productional standpoint.

When the particles of small diameters have an average particle diameter of less than 1 μm or when only particles of small diameters are used, the efficiency of
10 mixing operation of the composition to be obtained is low, which is undesirable. When the particles of large diameters have an average particle diameter of more than 200 μm or when only particles of large diameters are used, the handling of the resulting sheet material for
15 core layer is difficult. Furthermore, there is reduction in nonflammability, caused by the decrease in the surface area of particles. By using two or more kinds of aluminum hydroxide and/or magnesium hydroxide each having different particle diameters as mentioned above,
20 in closest packing, the resulting composition can have improved bonding strength of resin in production of sheet material for core layer. Moreover, various improvements are obtained in the mixing operation of the composition, handling of the resulting sheet material,
25 nonflammability of the sheet material, etc.

The composition is used as such or by diluting it with water, an organic solvent (e.g. alcohol) or the like. When the composition is impregnated into a base

sheet material made of an inorganic fiber, the impregnation is carried out by diluting the composition 9- to 30-fold by weight. When the dilution ratio is less than 9-fold, no sufficient adhesion or surface finish is
5 obtained in some cases. When the dilution ratio is more than 30-fold, the resulting sheet material for core layer has problems such as easy breakage and the like during its handling.

A preferred method consists of coating one
10 side of a long base sheet material made of an inorganic fiber, with a thermosetting resin composition composed of aluminum hydroxide and/or magnesium hydroxide filler and then, ordinarily, heat-drying the resulting material for impregnation to produce a sheet material for the
15 core layer. In this case, the composition is diluted with water, an organic solvent or the like so that the content of the filler in the composition becomes 70-90% by weight, whereby the composition has a high viscosity suitable for coating.

20 A description is made on the general practice of the above coating step with reference to Fig. 7 (a schematic sectional drawing).

A long base material 12 unwound from an unwinder 11 is transferred by a transfer roller 13.
25 During the transfer, the upper side of the long base material 12 is coated with a thermosetting resin varnish 14 containing an inorganic filler, by a coater 15, so as to give a desired film thickness. The long base

material is not restricted to glass fiber woven fabric, glass fiber nonwoven fabric or the like, but glass fiber woven or nonwoven fabric is preferred in the matter of flame resistance.

5 As for the coater 15, a comma roll coater, a knife coater, a die coater, a reverse coater or the like can be used. However, since the thickness of the film formed is as large as 0.3-2.0 mm and accordingly the composition applied needs to have a high viscosity, a
10 coater suitable for such a high-viscosity composition, such as comma roll coater, knife coater or the like is preferred.

 After the long base material has been coated with a thermosetting resin composition containing an
15 inorganic filler, the coated long base material is passed through a dryer 16 to vaporize the water or solvent of the composition, to obtain a sheet material (prepreg) 18 for the core layer. The heat-drying conditions vary depending upon the amount of resin in
20 the composition, the kind and amount of volatile substance in the composition and the thickness of the composition applied, but are generally 100-160°C and about 5-15 minutes. After the drying, the prepreg 18 is cut in a desired length by a cutter 17. Or, the prepreg
25 may be used for continuous molding without being cut.

 Next, as for the sheet material for the decorative layer placed on the face of the sheet material for core layer, generally used is a sheet

material obtained by impregnating a fibrous base sheet material for the decorative layer with a thermosetting resin. Preferably, used is an impregnated sheet or paper obtained by impregnating a sheet or paper of 40-
5 120 g/m² basic weight made of a pulp, a linter, a synthetic fiber, a glass fiber or the like, with a mixture comprising 60-95% of a melamine resin and 40-5% of aluminum hydroxide or magnesium hydroxide or silica. The degree of impregnation with the mixture is generally
10 100-400% by weight based on the sheet or paper.

The sheet material for decorative layer is placed on one side of the sheet material for core layer and they are made into a one-piece laminate. In order to prevent warpage, etc., it is preferable to use a
15 sheet material equivalent to the above sheet material for the decorative layer, also on the other side of the sheet material for core layer. Desirably, the total thickness of the sheet material(s) placed on one or both sides of the sheet material for core layer is 0.5 mm or
20 less and the content of organic substance in the sheet material(s) for decorative layer is 300 g/m² or less. When these ranges are not met, it is difficult for the resulting decorative sheet to pass the noncombustibility tests. Also when the final decorative sheet has a total
25 thickness of less than 3 mm, it may be difficult for the decorative sheet to pass the noncombustibility tests.

The thus-produced sheet material for the core layer is used in one sheet or a number of laminated

sheets. On one or both sides the sheet material for the decorative layer or its equivalent sheet is placed.

They are heat-pressed and molded into a flame-retardant or nonflammable decorative sheet as in the present

5 invention. During the molding process, a mirror-finish sheet, an embossed sheet, an embossed film or the like is laminated, whereby the final product has a surface of mirror-finish, embossed finish or the like.

In the present invention, preferred embodiments are:
10

a nonflammable decorative sheet which is a one-piece laminate of the following materials:

one or more layers of a sheet material for a core layer, obtained by impregnating a base sheet
15 material made of an inorganic fiber, with a composition comprising a phenolic resin and aluminum hydroxide, the proportions of the former and the latter in the composition being 4-8% by weight and 96-92% by weight, respectively, and

20 a sheet material for decorative layer having a thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the sheet material being placed on at least one side of the sheet material for the core layer; and

25 a nonflammable decorative sheet which is a one-piece laminate of the following materials:

two or more layers of a sheet material for a core layer, obtained by impregnating a base sheet

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material made of an inorganic fiber, with a composition comprising a phenolic resin and aluminum hydroxide, the proportions of the former and the latter in the composition being 4-8% by weight and 96-92% by weight, respectively,

a sheet material for a reinforcing layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a melamine resin, the sheet material being interposed between the two or more layers of the sheet material for the core layer, and

a sheet material for decorative layer having a thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the sheet material being placed on at least one side of the sheet material for the core layer. These decorative sheets pass the above-mentioned noncombustibility tests and have excellent nonflammability.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention is described specifically below by way of Examples and Comparative Examples.

Example 1 (Fig. 1)

A glass fiber nonwoven fabric having a basis weight of 75 g/m², a specific gravity of 0.23 g/cm³ and an organic binder content of 11% was impregnated with a composition of 92% by weight of aluminum hydroxide (a mixture of 46% by weight of aluminum hydroxide having an

average particle diameter of 160 μm and 46% by weight of aluminum hydroxide having an average particle diameter of 10 μm) and 8% by weight of a resol type phenolic resin, to obtain sheet materials 1 for the core layer
5 wherein the degree of impregnation was 20-fold. Next, a decorative base sheet as construction material having a basis weight of 80 g/m^2 was impregnated with a melamine resin containing a curing agent, to produce a sheet material 2 for decorative layer wherein the degree of
10 impregnation was 100%. Also, a decorative base sheet as construction material having a basis weight of 60 g/m^2 was impregnated with a melamine resin containing a curing agent, to produce a sheet material 3 for decorative layer wherein the degree of impregnation was
15 115%.

Four sheet materials 1 for core layer were laminated; on one side of the resulting laminate was placed one sheet material 2 for a decorative layer; on the other side of the laminate was placed one sheet
20 material 3 for a decorative layer; and the resulting material was molded at 140°C at 100 kg/cm^2 for 20 minutes to obtain a nonflammable decorative sheet 4 having a thickness of 3.5 mm.

Example 2 (Fig. 2)

25 A glass fiber nonwoven fabric having a basis weight of 75 g/m^2 , a specific gravity of 0.23 g/cm^3 and an organic binder content of 11% was impregnated with a

composition of 92% by weight of aluminum hydroxide (a mixture of 46% by weight of aluminum hydroxide having an average particle diameter of 160 μm and 46% by weight of aluminum hydroxide having an average particle diameter of 10 μm) and 8% by weight of a methyl-etherified melamine resin of 2.5 molar ratio containing a curing agent, to obtain sheet materials 1' for core layer wherein the degree of impregnation was 20-fold. Next, a decorative base sheet as construction material having a basis weight of 80 g/m^2 was impregnated with a melamine resin containing a curing agent, to produce a sheet material 2 for decorative layer wherein the degree of impregnation was 100%. Also, a decorative base sheet as construction material having a basis weight of 60 g/m^2 was impregnated with the same melamine resin as mentioned above, to produce a sheet material 3 for decorative layer wherein the degree of impregnation was 115%.

Four sheet materials 1' for the core layer were laminated; on one side of the resulting laminate was placed one sheet material 2 for a decorative layer; on the other side of the laminate was placed one sheet material 3 for a decorative layer; and the resulting material was molded under the same conditions as employed in Example 1, to obtain a nonflammable decorative sheet 4' having a thickness of 3.5 mm.

Example 3 (Fig. 3)

On a long glass fiber nonwoven fabric having a basis weight of 75 g/m^2 , a specific gravity of 0.23 g/cm^3 and an organic binder content of 11% was coated, by the use of a comma roll coater, a composition of 95% by weight of aluminum hydroxide (a mixture of 25% by weight of aluminum hydroxide having an average particle diameter of $100 \text{ }\mu\text{m}$ and 75% by weight of aluminum hydroxide having an average particle diameter of $8 \text{ }\mu\text{m}$) and 5% by weight of a resol type phenolic resin (the composition had a volatile content of about 15% by weight when prepared) so that the thickness of the resulting film became 1.15 mm after drying. The resulting material was heat-dried for impregnation, to obtain sheet materials 5 for a core layer wherein the degree of impregnation was 20-fold. Next, a glass woven fabric having a basis weight of 210 g/m^2 and an organic binder content of 0.08% was impregnated with a melamine resin containing a curing agent, to obtain a sheet material 6 for a reinforcing layer wherein the degree of impregnation was 40%. This sheet material 6 for a reinforcing layer was inserted between the second and third sheets of four laminated sheet materials 5 for a core layer. In the same manner as in Example 1, on one side of the resulting laminate was placed the sheet material 2 for a decorative layer, and on the other side of the laminate was placed the sheet material 3 for a decorative layer. The resulting material was molded under the same heat

and pressure conditions as employed in Example 1, to obtain a nonflammable decorative sheet 7 having a thickness of 3.6 mm.

Example 4 (Fig. 4)

5 A long glass fiber nonwoven fabric having a basis weight of 75 g/m², a specific gravity of 0.23 g/cm³ and an organic binder content of 11% was coated, by the use of a comma roll coater, with composition of 95% by weight of aluminum hydroxide (a mixture of 25% by weight
10 of aluminum hydroxide having an average particle diameter of 100 μm and 75% by weight of aluminum hydroxide having an average particle diameter of 8 μm) and 5% by weight of the same melamine resin as used in Example 2 (the composition had a volatile content of about 15% by
15 weight when prepared) so that the thickness of the resulting film became 1.15 mm after drying. The resulting material was heat-dried for impregnation, to obtain sheet materials 5' for core layer wherein the degree of impregnation was 20-fold. Next, a glass woven
20 fabric having a basis weight of 210 g/m² and an organic binder content of 0.08% was impregnated with the same melamine resin containing a curing agent as mentioned above, to obtain a sheet material 6 for a reinforcing layer wherein the degree of impregnation was 40%. This
25 sheet material 6 for a reinforcing layer was inserted between the second and third sheets of four laminated sheet materials 5' for a core layer. In the same manner

as in Example 2, on one side of the resulting laminate was placed the sheet material 2 for a decorative layer, and on the other side of the laminate was placed the sheet material 3 for a decorative layer. The resulting material was molded under the same heat and pressure conditions as employed in Example 3, to obtain a nonflammable decorative sheet 7' having a thickness of 3.6 mm.

Comparative Example 1 (Fig. 5)

10 A glass fiber nonwoven fabric having a basis weight of 75 g/m², a specific gravity of 0.23 g/cm³ and an organic binder content of 11% was impregnated with a composition of 80% by weight of aluminum hydroxide having an average particle diameter of 10 μm and 20% by weight of a resol type phenolic resin, to obtain sheet materials 8 for core layer wherein the degree of impregnation was 20-fold. Four sheet materials 8 for a core layer were laminated; on one side of the resulting laminate was placed the same sheet material 2 for a decorative layer as used in Example 1; on the other side of the laminate was placed the same sheet material 3 for a decorative layer as used in Example 1; and the resulting material was molded under the same heat and pressure conditions as employed in Example 1, to obtain a decorative sheet 9 having a thickness of 3.5 mm.

Comparative Example 2 (Fig. 6)

A glass fiber nonwoven fabric having a basis weight of 75 g/m², a specific gravity of 0.23 g/cm³ and an organic binder content of 11% was coated with a composition of 80% by weight of aluminum hydroxide having an average particle diameter of 10 μm and 20% by weight of the same melamine resin as used in Example 1, to obtain sheet materials 8' for core layer wherein the degree of impregnation was 20-fold. Four sheet materials 8' for a core layer were laminated; on one side of the resulting laminate was placed the same sheet material 2 for a decorative layer as used in Example 1; on the other side of the laminate was placed the same sheet material 3 for a decorative layer as used in Example 1; and the resulting material was molded under the same heat and pressure conditions as employed in Example 2, to obtain a decorative sheet 9' having a thickness of 3.5 mm.

The nonflammable decorative sheets 4, 4', 7 and 7' obtained in Examples and the decorative sheets 9 and 9' obtained in Comparative Examples were measured for properties. The results are shown below.

	Examples				Comp. Examples	
	1	2	3	4	1	2
Material combustibility test	Pass	Pass	Pass	Pass	Fail	Fail
Surface combustibility test						
1	No	No	No	No	No	No
2	No	No	No	No	No	No
3	No	No	No	No	No	No
4	0	0	0	0	0	0
5	15	13	12	11	30	28
Rating	Pass	Pass	Pass	Pass	Pass	Pass
Overall rating	Pass	Pass	Pass	Pass	Fail	Fail

(Test method)

Material combustibility test: Was conducted in accordance with Notification No. 1828 of the Ministry of Construction.

- 5 Surface combustibility test: Was conducted in accordance with Notification No. 1828 of the Ministry of Construction.

Rating 1: None of deformation damaging the fire resisting property of specimen, generation of

gases extremely hazardous to escape, etc.
shall be observed.

Rating 2: Neither melting through the full thickness of
specimen, nor cracks reaching the back side of
specimen having a width of 1/10 or more of the
full thickness shall be observed.

Rating 3: No flame remaining for 30 seconds or longer
after the end of heating shall be observed.

Rating 4: The exhaust temperature curve [a curve to be
recorded by the thermometer described in item
3 (2)] of specimen shall not exceed a standard
temperature curve [a curve connecting the
values to be obtained by adding 50 degrees to
the exhaust temperatures at one minute
intervals after adjusting the furnace as
provided in item 2 (1) (d)].

Rating 5: The smoke generation coefficient C_A per unit
area to be obtained by the following formula
shall not exceed 30.

$$C_A = 24 \log_{10} I_0 / I$$

where

I_0 : initial intensity of the light beam at the
start of the heating test (in lux), and

I : minimum intensity of the light beam during
the heating test (in lux).

As made clear from the foregoing Examples, the
flame-retardant or nonflammable decorative sheet accord-

ing to the present invention is formed by placing a decorative layer or its equivalent layer on one side or both sides of a sheet material for core layer obtained by impregnating a base sheet material (e.g. a nonwoven
5 fabric made of an inorganic fiber such as glass fiber or the like) with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide (the resin content is 15% by weight or less) and molding them into one piece; therefore, in
10 the present decorative sheet, the amounts of heat and smoke generated during combustion are controlled at very low levels.

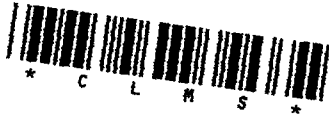
Particularly when the present decorative sheet is formed by placing a decorative layer or its equivalent layer each having a thickness of 0.5 mm or less and
15 an organic substance content of 300 g/m² or less, on one side or both sides of a sheet material for core layer obtained by coating, on a base sheet material such as the above-mentioned nonwoven fabric or the like, a
20 composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide (the melamine resin content is 10% by weight or less or the phenolic resin content is 8% by weight or less) and molding them into one piece, the amounts of
25 heat and smoke generated during combustion are controlled at very low levels and, moreover, there is substantially no destruction of sheet shape after combustion; therefore, the present decorative sheet can

be recognized as a noncombustible material meeting Notification No. 1828 of the Ministry of Construction.

Further in the present decorative sheet, there can be used, for the decorative layer, any of the same sheet materials for decorative layer as used in conventional decorative sheets; therefore, the present decorative sheet can be used as a flame-retardant or nonflammable material for various applications by appropriately selecting the decorative layer from a variety of colors and patterns.

INDUSTRIAL APPLICABILITY

Thus, the decorative sheet of the present invention has excellent flame retardancy or nonflammability and therefore can be used as a flame-retardant or nonflammable material in various applications such as houses and the like.



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1. A flame-retardant or nonflammable decorative sheet which is a one-piece laminate of the following materials:

5 one or more layers of a sheet material for a core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide, the
10 proportions of the former and the latter in the composition being 4-15% by weight and 96-85% by weight, respectively, and

a sheet material for decorative layer, placed on at least one side of the sheet material for the core
15 layer.

2. A flame-retardant or nonflammable decorative sheet which is a one-piece laminate of the following materials:

two or more layers of a sheet material for a
20 core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium hydroxide, the proportions of the former and the latter in the compo-
25 sition being 4-15% by weight and 96-85% by weight, respectively,

a sheet material for a reinforcing layer, obtained by impregnating a base sheet material made of

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an inorganic fiber, with a thermosetting resin, the sheet material being interposed between the two or more layers of the sheet material for the core layer, and

5 a sheet material for decorative layer, placed on at least one side of the sheet material for the core layer.

3. A flame-retardant or nonflammable decorative sheet according to Claim 1 or 2, wherein the aluminum hydroxide and/or magnesium hydroxide consists of two or
10 more kinds of particles different in particle diameter, the particles of large diameters have an average particle diameter of 50-200 μm , the particles of small diameters have an average particle diameter of 1-30 μm , the ratio of the average particle diameters of the two
15 kinds of particles is 6 or more, the compounding ratio of the two kinds of particles is 25:75 to 75:25, and the total amount of the two kinds of particles is 50% by weight or more of the total filler amount.

4. A nonflammable decorative sheet which is a
20 one-piece laminate of the following materials:

one layer or two or more layers of a sheet material for a core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition comprising a phenolic resin and aluminum
25 hydroxide, the proportions of the former and the latter in the composition being 4-8% by weight and 96-92% by weight, respectively, and

a sheet material for a decorative layer having

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a thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the sheet material being placed on at least one side of the sheet material for the core layer.

- 5 5. A nonflammable decorative sheet which is a one-piece laminate of the following materials:

 two or more layers of a sheet material for a core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition
10 comprising a phenolic resin and aluminum hydroxide, the proportions of the former and the latter in the composition being 4-8% by weight and 96-92% by weight, respectively,

 a sheet material for a reinforcing layer,
15 obtained by impregnating a base sheet material made of an inorganic fiber, with a melamine resin, the sheet material being interposed between the two or more layers of the sheet material for the core layer, and

 a sheet material for decorative layer having a
20 thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the sheet material being placed on at least one side of the sheet material for the core layer.

6. A nonflammable decorative sheet according to
25 Claim 4 or 5, wherein the aluminum hydroxide consists of two or more kinds of particles different in particle diameter, the particles of large diameters have an average particle diameter of 50-200 μm, the particles of





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small diameters have an average particle diameter of 1-
30 μm , the ratio of the average particle diameters of
the two kinds of particles is 6 or more, the compounding
ratio of the two kinds of particles is 25:75 to 75:25,
5 and the total amount of the two kinds of particles is
50% by weight or more of the total filler amount.

7. A process for producing a flame-retardant or
nonflammable decorative sheet set forth in Claim 1, 2,
3, 4, 5 or 6, which comprises coating a phenolic resin
10 and/or a melamine resin each containing aluminum
hydroxide and/or magnesium hydroxide, on one side of a
long base sheet material made of an inorganic fiber, to
impregnate the long base sheet material to produce a
sheet material for a core layer, placing, on one layer
15 or two or more layers of the sheet material for the core
layer, one or two layers of a sheet material for a
decorative layer, or one layer or two layers of the
sheet material for a decorative layer and a sheet
material for a reinforcing layer, and molding them into
20 a one piece laminate.

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ABSTRACT

The present invention provides a flame-retardant or nonflammable decorative sheet which is a one-piece laminate of the following materials:

- 5 one layer or two or more layers of a sheet material for a core layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a composition comprising a phenolic resin and/or a melamine resin and aluminum hydroxide and/or magnesium
- 10 hydroxide, the proportions of the former and the latter in the composition being 4-15% by weight and 96-85% by weight, respectively, and
- 15 a sheet material for a decorative layer, placed on at least one side of the sheet material for the core layer. When the sheet material for the core
- 20 layer consists of two or more layers, there can be interposed, between the layers of the sheet material for the core layer, a sheet material for a reinforcing layer obtained by impregnating a base sheet material made of
- an inorganic fiber, with a thermosetting resin. The present invention also provides a process for producing such a flame-retardant or nonflammable decorative sheet.

FIG. 1

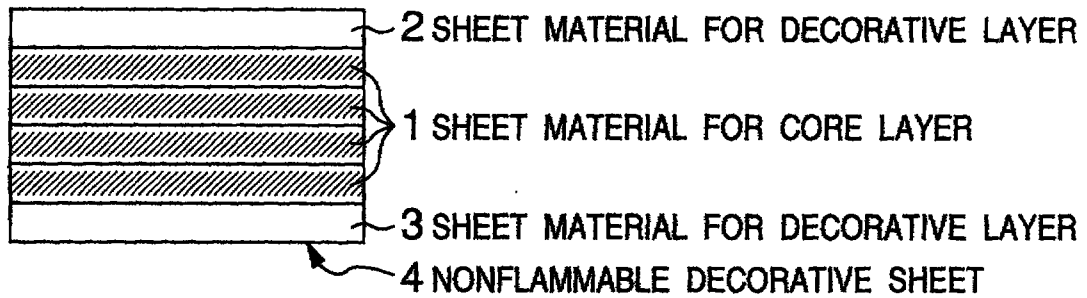


FIG. 2

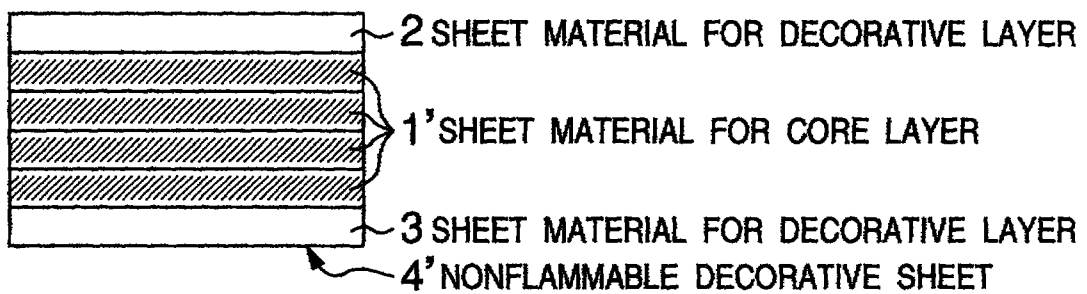


FIG. 3

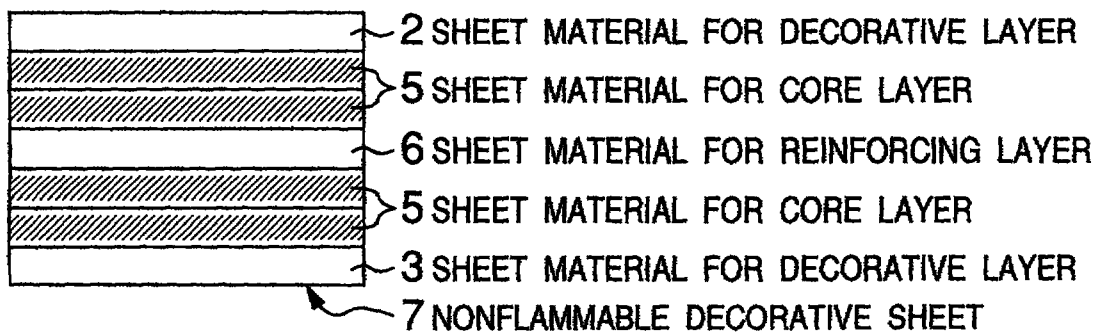


FIG. 4

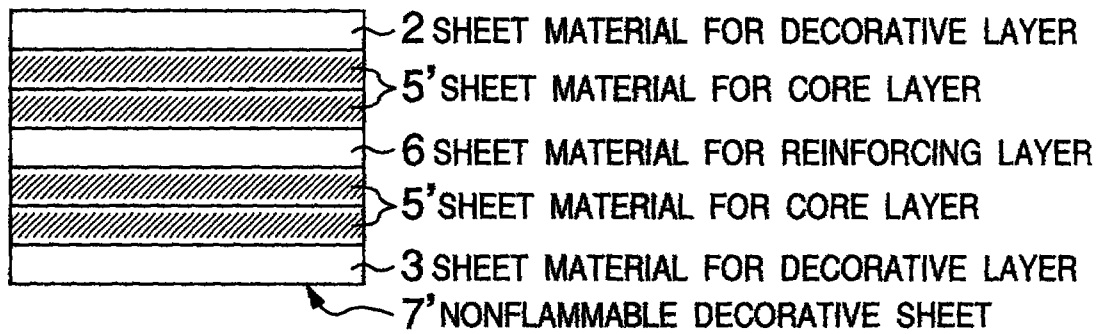


FIG. 5

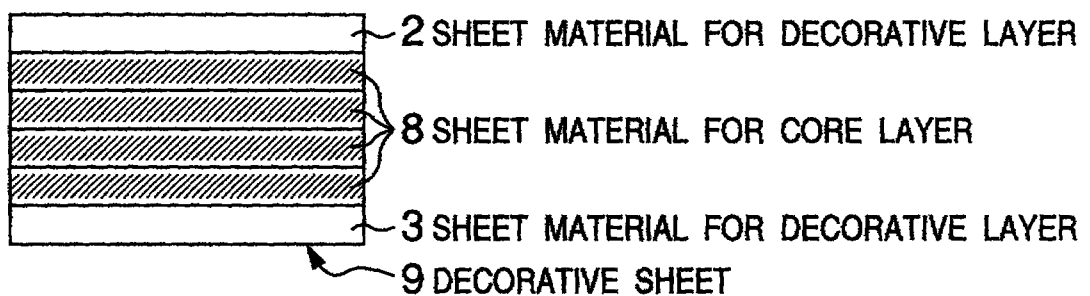


FIG. 6

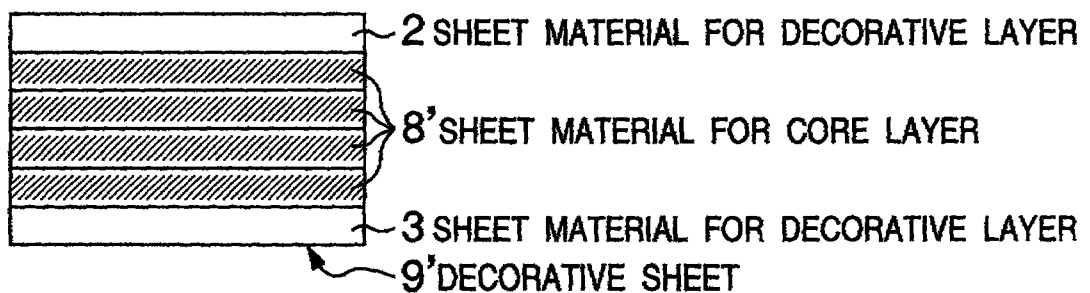
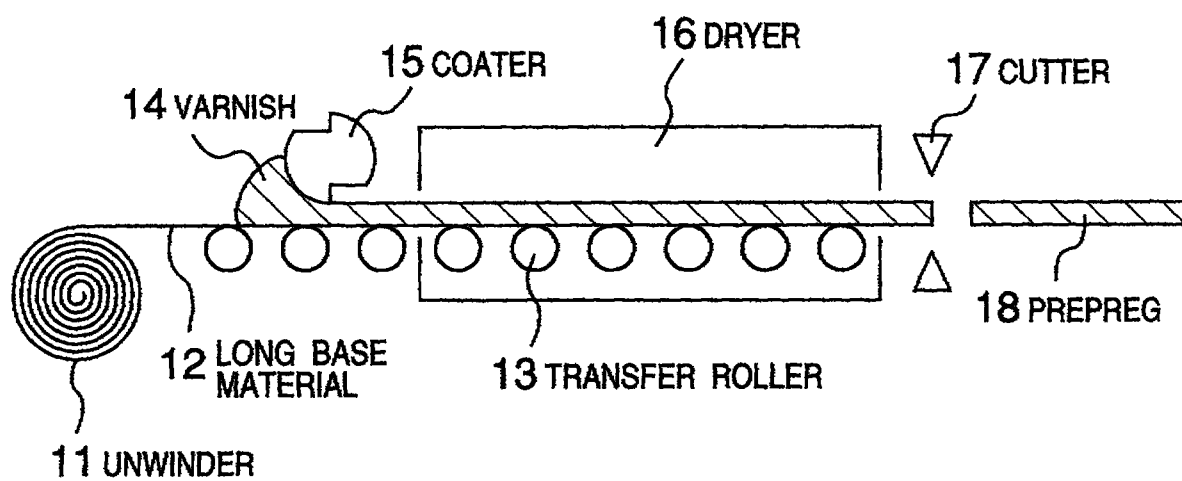
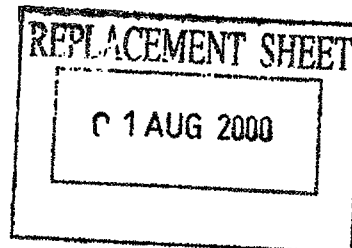


FIG. 7





DISCLOSURE OF THE INVENTION

According to one aspect of the present invention, there is provided a flame-retardant, nonflammable laminate decorative sheet material, comprising:

5 a core layer, comprising at least two layers of a core layer sheet material obtained by impregnating an inorganic fiber nonwoven fabric sheet material with a composition comprising:

10 a resin, being at least one member selected from the group consisting of a phenolic resin and a melamine resin, and

a metal hydroxide, being at least one member selected from the group consisting of aluminum hydroxide and magnesium hydroxide,

15 said resin being present in an amount from 4-15% by weight of said composition, and said hydroxide being present in an amount from 85-96% by weight of said composition;

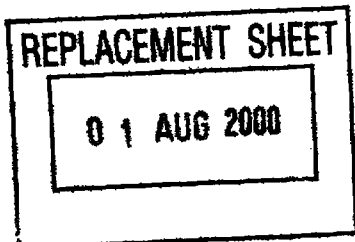
a reinforcing layer, interposed between at least two of said at least two layers of core layer sheet material, said
20 reinforcing layer being obtained by impregnating an inorganic fiber woven fabric sheet material with a thermosetting resin; and

at least one decorative layer, positioned on at least one side of said core layer.

25 According to another aspect of the invention there is provided a nonflammable laminate decorative sheet material, comprising:

a core layer, comprising at least two layers of a core layer sheet material obtained by impregnating an inorganic
30 fiber nonwoven fabric sheet material with a composition comprising:

a phenolic resin in an amount of 4-8% by weight, based on the weight of the composition; and
aluminum hydroxide in an amount of 92-96% by



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weight, based on the weight of the composition;

a reinforcing layer, interposed between at least two of said at least two layers of core layer sheet material, said reinforcing layer being obtained by impregnating an
5 inorganic fiber woven fabric sheet material with a melamine resin; and

at least one decorative layer having a thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the decorative layer being positioned on at least one
10 side of said core layer.

There is also provided a process for producing a flame-retardant, nonflammable laminate decorative sheet as described in either one of the two immediately preceding paragraphs comprising coating one side of a long base sheet
15 material made of an inorganic fiber nonwoven fabric with a composition comprising a resin including at least one member selected from the group consisting of a phenolic resin and a melamine resin, and a metal hydroxide including at least one member from the group consisting of aluminum hydroxide and
20 magnesium hydroxide, to impregnate the long base sheet material to a core layer sheet material;

placing, on two or more layers of the core layer sheet material, a reinforcing layer and at least one decorative layer; and

25 molding the layers into a one piece laminate.

BRIEF DESCRIPTION OF THE DRAWINGS

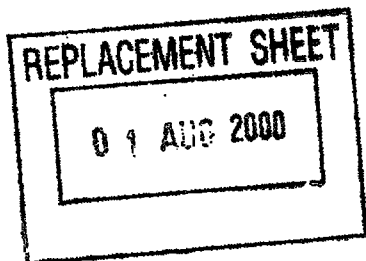
Fig. 1 is a sectional view of a nonflammable decorative sheet 4 comprising a sheet material 1 for core layer and sheet materials 2 and 3 for decorative layer, laminated on
30 the both sides of the sheet material 1 for core layer.

Fig. 2 is a sectional view of a nonflammable decorative sheet 4' comprising a sheet material 1' for core layer and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 1' for core layer.

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Fig. 3 is a sectional view of a nonflammable decorative sheet 7 comprising a sheet material 5 for core layer, a sheet material 6 for reinforcing layer, interposed between the sheet material 5 for core layer, and sheet materials 2 and 3 for decorative layer, laminated on the both sides of the sheet material 5 for core layer.

Fig. 4 is a sectional view of a nonflammable decorative sheet 7' comprising a sheet material 5' for



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material made of an inorganic fiber, with a composition comprising a phenolic resin and aluminum hydroxide, the proportions of the former and the latter in the composition being 4-8% by weight and 96-92% by weight, respectively,

5 a sheet material for a reinforcing layer, obtained by impregnating a base sheet material made of an inorganic fiber, with a melamine resin, the sheet material being interposed between the two or more layers of the sheet material for the core layer, and

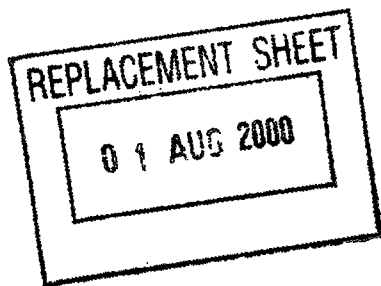
10 a sheet material for decorative layer having a thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the sheet material being placed on at least one side of the sheet material for the core layer. These decorative sheets pass the above-mentioned
15 noncombustibility tests and have excellent nonflammability.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiments of the present invention will now be described by way of Examples and Comparative Examples. However, the following Examples should not be construed as
20 limiting on the invention in any way.

Example 1 (Fig. 1)

A glass fiber nonwoven fabric having a basis weight of 75 g/m², a specific gravity of 0.23 g/cm³ and an organic binder content of 11% was impregnated with a composition of
25 92% by weight of aluminum hydroxide (a mixture of 46% by weight of aluminum hydroxide having an



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CLAIMS

1. A flame-retardant, nonflammable laminate decorative sheet material, comprising:

5 a core layer, comprising at least two layers of a core layer sheet material obtained by impregnating an inorganic fiber nonwoven fabric sheet material with a composition comprising:

10 a resin, being at least one member selected from the group consisting of a phenolic resin and a melamine resin, and

a metal hydroxide, being at least one member selected from the group consisting of aluminum hydroxide and magnesium hydroxide,

15 said resin being present in an amount from 4-15% by weight of said composition, and said hydroxide being present in an amount from 85-96% by weight of said composition;

20 a reinforcing layer, interposed between at least two of said at least two layers of core layer sheet material, said reinforcing layer being obtained by impregnating an inorganic fiber woven fabric sheet material with a thermosetting resin; and

at least one decorative layer, positioned on at least one side of said core layer.

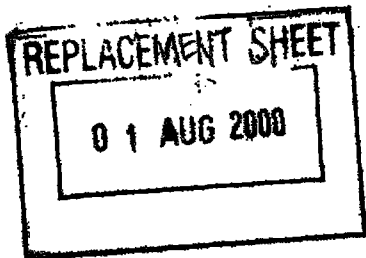
25 2. The flame-retardant, nonflammable laminate decorative sheet material according to claim 1,

wherein said metal hydroxide comprises two kinds of particles having different particle diameters:

30 a first kind of said metal hydroxide particles having an average particle diameter of from 50-200 μm , and

a second kind of metal hydroxide particles having an average particle diameter of from 1-30 μm ;

wherein a ratio of the average particle diameter of the



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first kind with respect to the average particle diameter of the second kind is at least 6;

wherein a compounding ratio of the first kind of particles with respect to the second kind of particles is
5 between 25:75 and 75:25; and

wherein a total amount of said two kinds of particles comprises at least 50% by weight of a total amount of said metal hydroxide present.

3. The flame-retardant, nonflammable laminate decorative
10 sheet material according to claim 1, wherein said inorganic fiber sheet material which forms a core layer sheet material comprises a glass fiber nonwoven fabric having a basis weight of 30-100 g/m².

4. The flame-retardant, nonflammable laminate decorative
15 sheet material according to claim 1, wherein said inorganic fiber sheet material which forms a reinforcing layer comprises a glass fiber nonwoven fabric having a basis weight of 30-100 g/m².

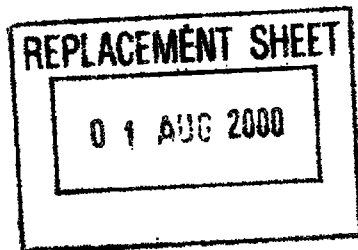
5. The flame-retardant, nonflammable laminate decorative
20 sheet material according to claim 1, wherein said inorganic fiber sheet material which forms a reinforcing layer comprises a glass fiber woven fabric having a basis weight of 45-220 g/m².

6. The flame-retardant, nonflammable laminate decorative
25 sheet material according to claim 1, wherein said thermosetting resin is comprised of at least one member selected from the group consisting of a melamine resin and a phenolic resin.

7. A nonflammable laminate decorative sheet material,
30 comprising:

a core layer, comprising at least two layers of a core layer sheet material obtained by impregnating an inorganic





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fiber nonwoven fabric sheet material with a composition comprising:

- a phenolic resin in an amount of 4-8% by weight, based on the weight of the composition; and
- 5 aluminum hydroxide in an amount of 92-96% by weight, based on the weight of the composition;
- a reinforcing layer, interposed between at least two of said at least two layers of core layer sheet material, said reinforcing layer being obtained by impregnating an
- 10 inorganic fiber woven fabric sheet material with a melamine resin; and

at least one decorative layer having a thickness of 0.5 mm or less and an organic substance content of 300 g/m² or less, the decorative layer being positioned on at least one

15 side of said core layer.

8. The nonflammable laminate decorative sheet material according to claim 7, wherein said aluminum hydroxide comprises two kinds of particles having different particle diameters:

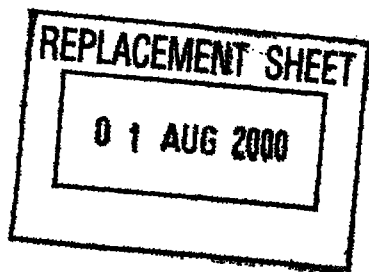
- 20 a first kind of aluminum hydroxide particles having an average particle diameter of from 50-200 μm , and
- a second kind of aluminum hydroxide particles having an average particle diameter of from 1-30 μm ;

wherein a ratio of the average particle diameter of the first kind with respect to the average particle diameter of

25 the second kind is at least 6;

wherein a compounding ratio of the first kind of particles with respect to the second kind of particles is between 25:75 and 75:25; and

- 30 wherein a total amount of said two kinds of particles comprises at least 50% by weight of a total amount of said aluminum hydroxide present.



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9. A process for producing a flame-retardant, nonflammable laminate decorative sheet according to claim 1 or 7, comprising:

coating one side of a long base sheet material made of
5 an inorganic fiber nonwoven fabric with a composition comprising a resin including at least one member selected from the group consisting of a phenolic resin and a melamine resin, and a metal hydroxide including at least one member from the group consisting of aluminum hydroxide and
10 magnesium hydroxide, to impregnate the long base sheet material to a core layer sheet material;

placing, on two or more layers of the core layer sheet material, a reinforcing layer and at least one decorative layer; and

15 molding the layers into a one piece laminate.

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