

MELAMINE DECORATIVE LAMINATES, AND METHOD FOR PRODUCING THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This international application claims the benefit of Japanese Patent Application No. 2020-2083 filed on January 9, 2020 and Japanese Patent Application No. 2020-40463 filed on March 10, 2020 with the Japan Patent Office, and the entire disclosures of Japanese Patent Application No. 2020-2083 and Japanese Patent Application No. 2020-40463 are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a melamine decorative laminate, and a method for producing the melamine decorative laminate.

BACKGROUND ART

[0003] In general, there are types of the melamine decorative laminate: a flat type, finished on a flat surface; and an embossed type, provided with desired unevenness for the purpose of improving the design. Both types are widely employed to serve as interior or exterior materials, for example for horizontal surfaces of desks, tables, and the like, and for vertical surfaces of walls, door surfaces, and the like.

[0004] An embossed-type decorative laminate is called an embossing decorative laminate, and produced using a forming die. In recent years, there has been known a technique for applying unevenness onto the embossing decorative laminate, in which a resin-impregnated decorative paper obtained by impregnating a decorative paper, which is obtained by forming a liquid repellent pattern on a surface of a base paper, with thermosetting resin and drying the impregnated decorative paper is stacked together with a resin-impregnated core paper, and after putting a metal board on them, heat and pressure are applied to

them.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005] Patent Document 1: Japanese Unexamined Patent Application Publication No. 2001-138444

Patent Document 2: Japanese Unexamined Patent Application Publication No. 2002-166501

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] However, there was a problem in a conventional producing method, that a resin on a part where the liquid repellent pattern was formed was transferred and attached to the metal board used in forming the embossing decorative laminate, causing extra work to remove the transferred resin, hence resulting in a poor productivity.

[0007] To solving the problem, even if an attempt is made to transfer a resin on a part where a liquid repellent pattern should be formed to a film interposed between the resin-impregnated decorative paper and the metal board, there has been a problem that the resin is not transferred to the film side and remains as impurities, disturbing synchronization, and that the impurities were whitened, spoiling an appearance of the decorative laminate.

MEANS FOR SOLVING THE PROBLEMS

[0008] One embodiment of the present disclosure is a melamine decorative laminate that comprises a decorative layer and a core layer, and the decorative layer comprises a cured product of a melamine resin composition and a decorative paper having a patterned part containing a substance nonadhesive to the cured product of the melamine resin composition. The melamine resin composition contains 0.1 to 4.0 parts by weight of silane coupling agent with respect to 100 parts by weight of melamine resin in solid content. The melamine decorative laminate comprises a surface in which a recessed part

is formed on an upper portion of the patterned part.

[0009] One embodiment of the present disclosure is a method for producing a melamine decorative laminate, and based on the following steps (A) to (E): (A) step for obtaining a decorative paper that includes a patterned part containing a substance nonadhesive to a cured product of a melamine resin composition; (B) step for obtaining a melamine resin-impregnated decorative paper by impregnating the decorative paper with a resin liquid mainly composed of a melamine resin composition containing 0.1 to 4.0 parts by weight of silane coupling agent with respect to 100 parts by weight of a solid content of melamine resin, as the melamine resin composition, and then drying it; (C) step for obtaining a laminate by stacking the melamine resin-impregnated decorative paper and a core layer, and then putting a plastic film and a metal board on the melamine resin-impregnated decorative paper; (D) step for subjecting the laminate to hot press molding while the laminate is inserted between hot plates of a hot-pressure molding machine; (E) step for, after the hot press molding, taking out the laminate, removing the metal board, peeling off the plastic film, and then transferring the cured product of the melamine resin composition on the patterned part onto the plastic film side, to thereby form a recessed part on an upper portion of the patterned part, as well as to thereby transfer surface characteristic of the plastic film onto the melamine resin-impregnated decorative paper side.

EFFECTS OF INVENTION

[0010] The cured product of the melamine resin composition containing the silane coupling agent on the patterned part is clearly transferred to the plastic film side, an upper portion of the patterned part forms the recessed part, and whitening of the appearance is less likely to occur.

[0011] Also, the melamine decorative laminate has an appearance as if including a recessed part synchronized with the patterned part of decorative patterns of the decorative paper, and by using the plastic film having glossiness different from that of the patterned part, the appearance of the melamine decorative laminate is richer in realism.

[0012] Further, the metal board is less likely to be contaminated with transferred

objects because the hot press molding is performed while the plastic film is interposed between the metal board and the melamine resin-impregnated decorative paper.

[0013] Furthermore, for example, the plastic film may be applied with a composition containing: (a) organosilica sol; and (b) siloxane graft polymer that is a composite of fluororesin or acrylic resin and siloxane. In such cases, the melamine decorative laminate has fingerprint-resistant properties, and adhesion of fingerprints is less conspicuous.

[0014] Moreover, the surface characteristic of the plastic film is transferred onto the melamine resin-impregnated decorative paper side.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a sectional view of a configuration of a melamine decorative laminate in Example 1 of the present disclosure.

FIG. 2 is a sectional view of an exploded configuration showing a method for producing the melamine decorative laminate in Example 1 of the present disclosure.

FIG. 3 is a schematic sectional view in forming unevenness according to the method for producing the melamine decorative laminate in Example 1 of the present disclosure.

FIG. 4 is an enlarged sectional view of principal part in FIG. 3.

FIG. 5 is a sectional view of a configuration of a melamine decorative laminate in Example 3 of the present disclosure.

FIG. 6 is a sectional view of a configuration of a melamine decorative laminate in Example 10 of the present disclosure.

FIG. 7 is a sectional view of a configuration of a melamine decorative laminate in Example 13 of the present disclosure.

FIG. 8 is a photograph showing an appearance of Example 1 of the present disclosure.

FIG. 9 is a photograph showing an appearance of Comparative Example 1.

FIG. 10 is a photograph showing a degree of adhesion between a

melamine decorative laminate and a plastic film in Comparative Example 2.

FIG. 11 is a photograph showing a degree of adhesion between a melamine decorative laminate and a plastic film in Comparative Example 3.

EXPLANATION OF REFERENCE NUMERALS

[0016] 1...decorative layer, 2...phenol resin impregnated core paper, 3...prepreg, 5...core layer, 6...patterned part, 7...plastic film, 8...backer, 9a...melamine decorative laminate, 9b...melamine decorative laminate, 9c...melamine decorative laminate, 9d...melamine decorative laminate, 10a...uncured (in stage B) melamine resin composition, 10b...cured product of melamine resin composition, 20...recessed part, 30...raised part, 32...raised part

MODE FOR CARRYING OUT THE INVENTION

[0017] The decorative paper according to the present disclosure comprises a patterned part formed from a cured product containing ink, the ink being a substance nonadhesive to the cured product of the melamine resin composition. Surface energy of the patterned part largely differs from that of the melamine resin composition, and because the surface energy of the patterned part is small, the melamine resin composition is easily repelled by the patterned part. Examples of substances exerting such an effect include silicone-based resin, fluorine-based resin, acrylic-based resin, urethane-based resin, and preferable examples of the substances include acrylic-based resin such as silicon-containing acrylic-based resin.

[0018] The patterned part can be a desired printed pattern without any specific restriction. Examples of the patterned part can be selected from wood conduit pattern part, stone pattern part, rust pattern part, sand grain pattern part, baking finish pattern part, lattice pattern part, checkered-pattern part, stripe pattern part, and geometric pattern part.

[0019] A basis weight of the decorative paper is preferably within a range of about 80 to 140 g/m², and the decorative paper is impregnated. The resin liquid to be impregnated into the decorative paper is a melamine resin composition mainly composed

of a condensate made by condensation reaction of melamine and formaldehyde. The impregnation rate of the resin liquid defined by Formula 1 is preferably within a range of 70 to 160%.

<Formula 1>

[0020] [Equation 1]

$$\text{Impregnation rate} = \frac{\text{Weight after impregnation} - \text{Weight before impregnation}}{\text{Weight before impregnation}} \times 100$$

(%)

After being impregnated, the decorative paper is coated with melamine resin composition, and the melamine resin composition forms a cured product as being subject to hot press molding. When the plastic film is peeled off after the hot press molding, the cured product that exists on nonadhesive patterned part is transferred onto the plastic film side. Then, a recessed part 20 is formed of the upper portion of the patterned part after the molding as shown in a lower figure in FIG. 3, and a raised part 30 is formed of the cured product of the melamine resin composition other than the patterned part.

[0021] The surface of the raised part comprises the transferred surface characteristic of the plastic film. In the present disclosure, the surface characteristic indicates glossiness of the plastic film itself, for example, mat, semi-gloss, gloss, or a layer comprising a functional substance such as a later-described antifingerprint layer formed on the plastic film.

[0022] In particular, when the melamine resin composition contains 0.1 to 4.0 parts by weight, more preferably 0.35 to 3.0 parts by weight, and even more preferably 0.1 to 3.0 parts by weight of silane coupling agent with respect to 100 parts by weight of melamine resin in solid content, there is no chance that the plastic film is stuck and can not be peeled off upon an attempt to peel off the plastic film after the hot press molding, and therefore the melamine resin on the patterned part is transferred onto the plastic film side, whereby a melamine decorative laminate in good synchronization can be obtained.

[0023] This is considered that the melamine resin composition containing the silane coupling agent improves adhesiveness to the plastic film and to the functional substance applied onto the plastic film, thus causing the cured product on the patterned part to be clearly transferred onto the plastic film side. Consequently, the surface of the finished melamine decorative laminate comprises a void in the upper portion of the patterned part, and areas other than the patterned part protrudes beyond the patterned part. Specifically, in the surface of the melamine decorative laminate, the recessed part derived from the patterned part is formed, and areas other than the patterned part are the raised part.

[0024] Examples of the above-described silane coupling agent include epoxy-based silane coupling agent, amino-based silane coupling agent, and acrylic-based silane coupling agent. Epoxy-based silane coupling agent is particularly preferable in terms of the adhesiveness between the plastic film, the melamine-formaldehyde resin and the nonadhesive substance.

[0025] Among those examples described above, in a case where the silane coupling agent is a compound formed by bonding a silicon atom with three hydrolyzable groups, particularly a functional group containing an alkoxy group, and an organic functional group, particularly an epoxy group, as bonding groups, the former is strongly adhesive to a plastic film and/or a resin applied onto the plastic film, and the latter is strongly adhesive to a melamine resin, and therefore is preferable. Thus, when the silane coupling agent containing such bonding groups is used, upon the attempt to peel off the plastic film after the hot press molding, the adhesion of the interface between the nonadhesive substance and the cured product of the melamine resin composition is weak, and the cured product of the melamine resin composition on the nonadhesive substance is clearly transferred onto the plastic film side to form the recessed part. Consequently, the cured product of the melamine resin composition is not remained on the recessed part, and thus a whitening phenomenon cannot be observed.

[0026] Examples of compounds having such a function include β -(3, 4-epoxy cyclohexyl) ethyltrimethoxysilane, γ -glycidyoxypropyl trimethoxysilane, γ -glycidyoxypropyl methyl diethoxy silane, and 3-glycidoxypropyltrimethoxysilane.

[0027] In addition to the silane coupling agent, by mixing the epoxy compound in the melamine resin composition, the recessed part derived from the patterned part is more clearly formed on the upper portion of the patterned part, making a degree of synchronization clearer.

[0028] This is assumed that the epoxy group in the epoxy compound improves adhesive force between silane coupling agent and melamine resin, and further strengthens the adhesion between the cured product of the melamine resin composition on the nonadhesive substance and the plastic film when the plastic film is peeled off after the hot press molding, whereby the cured product of the melamine resin composition is clearly transferred onto the plastic film side to form the recessed part.

[0029] When 0.1 to 10 parts by weight of epoxy compound is blended with respect to 100 parts by weight of melamine resin in solid content, the melamine resin on the patterned part can be further easily transferred onto the plastic film side when the plastic film is peeled off after the hot press molding, and thus the melamine decorative laminate in good synchronization can be obtained.

[0030] Examples of the above-described epoxy compound of polyfunctional type include sorbitol polyglycidyl ether, glycerol polyglycidyl ether, diglycerol polyglycidyl ether, polyglycerol polyglycidyl ether, trimethylolpropane polyglycidyl ether, pentaerythritol polyglycidyl ether, and cresol novolac epoxy emulsion. Examples of the above-described epoxy compound of bifunctional type include ethylene glycol diglycidyl ether, polyethylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, resorcinol diglycidyl ether, neopentyl glycol diglycidyl ether, 1, 6-hexanediol diglycidyl ether, dibromoneopentyl glycol diglycidyl ether, bisphenol A diglycidyl ether, terephthalic acid diglycidyl ester, and phthalic acid diglycidyl ester. Examples of the above-described epoxy compound of monofunctional type include 2-ethylhexyl glycidyl ether, phenyl glycidyl ether, p-tert-butyl phenyl glycidyl ether, dibromophenyl glycidyl ether, and N-glycidyl phthalimide. Polyfunctional polyglycidyl ether is particularly preferable.

[0031] Examples of the plastic film include polyester film, polyethylene film, polypropylene film, cellophane, diacetyl cellulose film, triacetyl cellulose film, acetyl

cellulose butyrate film, polyvinyl chloride film, polyvinylidene chloride film, polyvinyl alcohol film, ethylene vinyl alcohol film, polystyrene film, polycarbonate film, polymethylpentene film, polysulfone film, polyether ketone film, polyether sulfone film, polyetherimide film, polyimide film, fluororesin film, nylon film, acrylic film.

[0032] The film thickness is preferably 1 to 200 μm , and more preferably 30 to 90 μm . Due to the thickness being within this range, the film is not broken easily when being peeled off and is good in handleability. Especially in an event of choosing a plastic film, by making a glossiness of the plastic film and a glossiness of the patterned part differ from each other, a glossiness of the patterned part forming the recessed part and a glossiness of the melamine resin layer forming the raised part of the surface can be made different from each other, resulting in improved realism of the pattern of the recessed part. In the present disclosure, the term “synchronization (to be synchronized)” means a state in which positions of the recessed part and the patterned part match each other.

[0033] Glossiness of the decorative laminate is measured in compliance with JIS Z 8741, and difference in glossiness between the patterned part and the cured product of the melamine resin composition is preferably 0.1 to 30, and especially preferably 0.7 to 16. In this case, the difference in glossiness makes the pattern of the recessed part further stand out, and improves the realism.

[0034] Furthermore, by using the plastic film provided with a corona treatment, the resin on the patterned part is likely to be transferred more clearly onto the plastic film side when the plastic film is peeled off after the hot press molding, and the melamine decorative laminate that is much better synchronization can be obtained.

[0035] Furthermore, by applying a composition containing: (a) organosilica sol; and (b) siloxane graft polymer that is composite of fluororesin or acrylic resin and siloxane onto a surface corona treated, the melamine decorative laminate that fingerprints stuck thereto are less conspicuous can be obtained. The layer comprising the composition has a lower refractive index than that of the melamine resin, and a difference in refractive indices between the layer and the fingerprints is less. Thus, the stuck fingerprints are less conspicuous, reflection of light and white blurring can be improved,

making decorative patterns of a printing paper clearer and improving the design effects.

[0036] The organosilica sol is a colloidal solution in which a colloidal silica having a grain diameter of 1 to 40 nm, and preferably 7 to 30 nm is stably dispersed in an organic solvent, and the silica concentration is preferably 1 to 50% by weight and more preferably 40% by weight or less for the purpose of inhibiting gelation. Examples of commercially available organosilica sol include “IPA-ST”, “IPA-ST-ZL”, “methanol silica sol”, “NPC-ST-30”, “MIBK-ST”, “MEK-ST”, “PMA-ST”, “NBAC-ST”, each manufactured by Nissan Chemical Industries, Ltd., “OSCAL” manufactured by JGC Catalysts and Chemicals Ltd., “Quartron” (Registered Trademark) manufactured by Fuso Chemical Co., Ltd., and “Highlink (Registered Trademark) OG silica organo-sol” manufactured by Clariant Japan K.K. However, a hydrophobic solvent species such as paraffin hydrocarbon, chlorofluorocarbon solvent, and silicone oil has a low hydroxyl group content on its particle surface, and thus tends to be less adhesive to the melamine, resulting in inadequate surface durability.

[0037] In an alcohol-based solvent such as methanol, ethanol, acetone, isopropyl alcohol and ethylene dialcohol, a cellosolve-based solvent such as methyl cellosolve, ethyl cellosolve, butyl cellosolve and n-propyl cellosolve, an organosilica sol, which is a type of hydrophilic solvent, such as dimethyl formamide, the hydroxyl group on a silica surface adheres to the melamine. Thus, an adequate adhesiveness can be obtained, and the surface durability is excellent.

[0038] Siloxane graft polymer is a composite of fluororesin or acrylic resin and siloxane. Examples of commercially available solixane graft polymer include ZX-007C, ZX-001, ZX-022, ZX-022H, ZX-028R, and ZX-036 (all manufactured by Fuji Kasei Kogyo Co., Ltd.).

[0039] The blending ratio of siloxane graft polymer, which is a composite of fluororesin or acrylic resin and siloxane, to organosilica sol is preferably 4 to 18 parts by weight of organosilica sol in solid content with respect to 1 part by weight in solid content of siloxane graft polymer, which is a composite of fluororesin or acrylic resin and siloxane. By setting the amount to the aforementioned lower limit or higher, the adhesion between the low refractive index layer and the melamine resin layer can be

sufficient, and the surface durability is excellent. Also, by setting the amount to the aforementioned upper limit or lower, fingerprint-resistant properties and pattern sharpness are excellent. A thickness of a coated film after drying the composition is 0.1 to 100 μm , and preferably 0.5 to 50 μm . Due to the thickness being within this range, the appearance is excellent.

[0040] As a core layer, a prepreg obtained by impregnating a fibrous base material such as an inorganic fiber and an organic fiber with a slurry containing a thermosetting resin and/or a thermoplastic resin, which serves as a binder component (organic binder component), and an inorganic filler, and then drying it, or, a resin-impregnated core paper obtained by impregnating an organic base material such as a bleached kraft paper and an unbleached kraft paper with a resin liquid mainly composed of the thermosetting resin, and then drying it is used. Although the number of the resin-impregnated core paper may be appropriately adjusted as desired, three to eighty sheets of the paper are generally used. The thickness of the decorative laminate suitable for the present disclosure is about 0.5 to 20 mm. Furthermore, a resin-impregnated balancing layer may be additionally used for the purpose of inhibiting warping of the decorative laminate. The impregnation rate for impregnating the resin liquid into the organic base material is preferably within a range of 70 to 160%, and more preferably within a range of 40 to 120% as calculated by a calculation method of Formula 1.

<Formula 1>

[0041] [Equation 1]

$$\text{Impregnation rate} = \frac{\text{Weight after impregnation} - \text{Weight before impregnation}}{\text{Weight before impregnation}} \times 100$$

(%)

Among the above-described fibrous base materials, the use of an inorganic fibrous base material is preferable because it improves flame retardancy of the decorative laminate. Examples of the inorganic fibrous base material include a nonwoven fabric and woven fabric made from inorganic fiber, such as glass fiber, rock wool, carbon fiber,

and ceramic fiber. Preferably, the basis weight of the inorganic fibrous base material is within a range of 10 to 200 g/m². In particular, it is preferable to use glass fiber nonwoven fabric that is advantageous in heat resistance and flame resistance.

[0042] In a case where the inorganic fibrous base material is used for the core layer, a prepreg impregnated with a slurry containing an inorganic filler, for example, an endothermic metal hydroxide or an inorganic substance other than the endothermic metal hydroxide, and an organic resin component as a binder component, for example, a thermosetting resin, such as a phenol-formaldehyde resin or a melamine-formaldehyde resin, a thermoplastic resin emulsion, such as an acrylic resin emulsion or a vinyl chloride resin, or a mixed resin thereof, and then dried may be used.

[0043] The endothermic metal hydroxide contains water of crystallization. The endothermic metal hydroxide decomposes at a high temperature and absorbs heat to release the water of crystallization, which therefore enhances non-combustibility of the decorative laminate of the present disclosure. Examples of the endothermic metal hydroxide include aluminum hydroxide, magnesium hydroxide, and calcium hydroxide. An average particle diameter of the endothermic metal hydroxide can be set to be within a range of, for example, 1 to 50 µm. This average particle diameter is an arithmetic average diameter that is calculated using the particle size distribution (volume distribution) detected by a laser diffraction/scattering method (Microtrac method). Due to the average particle diameter of the endothermic metal hydroxide being within the aforementioned range, dispersibility of the endothermic metal hydroxide in the slurry is improved, and thus the impregnation properties of the slurry into the fibrous base material are improved.

[0044] Examples of the inorganic substance other than the endothermic metal hydroxide include carbonate, such as calcium carbonate, magnesium carbonate, and zinc carbonate, silica, talc, and fly ash. An average particle diameter of the inorganic substance (the arithmetic average diameter calculated using the particle size distribution (volume distribution) detected by the laser diffraction/scattering method (Microtrac method)) can be set to be within a range of, for example, 0.05 to 20 µm. In this case, the impregnatability of the slurry into the inorganic fibrous base material is further

improved.

[0045] In particular, carbonate (for example, calcium carbonate) may be selected. In this case, workability and machinability are further improved during production process of the decorative laminate. Example of the calcium carbonate for use include heavy calcium carbonate and light calcium carbonate (precipitated calcium carbonate). An average particle diameter of the calcium carbonate can be set to be, for example, 0.05 to 10 μm , and more preferably 1 to 5 μm . Due to the average particle diameter of the calcium carbonate being 0.05 μm or more, the calcium carbonate is unlikely to be aggregated in the slurry, which thus improves the impregnation properties of the slurry into the fibrous base material. In addition, due to the average particle diameter of the calcium carbonate being 10 μm or less, the decorative laminate has an even smoother surface, which thus improves appearance of the decorative laminate.

[0046] Preferably, the slurry has an impregnation rate (%) within a range of 700 to 1200% into the inorganic fibrous base material using a calculation method shown in Formula 1. The impregnation rate of 1200% or less of the slurry can reduce fall-off of the solid content of the slurry from the prepreg and thus makes the prepreg easy to handle. The impregnation rate of 700% or more of the slurry causes less separation between layers of the prepreg.

[0047] The blending ratio of the organic resin component in the slurry to the inorganic filler comprising the endothermic metal hydroxide and/or the inorganic substance other than the endothermic metal hydroxide by solid weight is desirably 1: 1 to 25, and more preferably 1: 5 to 20. Due to the blending ratio within these ranges, adhesiveness between the decorative layer and the prepreg and/or between prepreps can be improved. Moreover, non-combustibility of the decorative laminate can be improved.

[0048] Preferably, the organic resin component contained in each prepreg is 30 to 100 g/m^2 and the organic resin component contained in the core layer is 40 to 500 g/m^2 . The organic resin component within these ranges provides excellent non-combustibility, and adhesiveness between the decorative layer and the prepreg and/or between prepreps becomes advantageous.

[0049] The inorganic substance other than the endothermic metal hydroxide and

the endothermic metal hydroxide may be used alone or in combination. In the combined use, the blending ratio is preferably 0.2 to 20 parts by weight, and more preferably 0.5 to 15 parts by weight of the endothermic metal hydroxide with respect to 1 part by weight of the inorganic substance other than the endothermic metal hydroxide. This is preferred because a smooth and good surface appearance can be obtained. Owing to the blended amount of the endothermic metal hydroxide being 0.2 parts by weight or more, non-combustibility is excellent. Owing to the blended amount of the endothermic metal hydroxide being 20 parts by weight or less, sedimentation of the endothermic metal hydroxide in the slurry is unlikely to occur, thus facilitating control of the amount of impregnation of the slurry. Further, owing to the blended amount of the endothermic metal hydroxide being 20 parts by weight or less, wear of a cutter used for cutting the decorative laminate can be reduced.

[0050] As for the above-described inorganic filler, it is particularly preferable to use three types of inorganic fillers each having a different average particle diameter and including the inorganic substance other than the endothermic metal hydroxide and/or the endothermic metal hydroxide. When the amount of the inorganic filler contained in each prepreg forming the core layer is 300 to 1200 g/m², the non-combustibility is excellent. Further, when the amount of the inorganic substance other than the endothermic metal hydroxide contained in each prepreg is 0 to 700 g/m² and the amount of the endothermic metal hydroxide contained in each prepreg is 0 to 1000 g/m², impregnatability, smoothness and non-combustibility are excellent.

[0051] The three types of inorganic fillers each having a different average particle diameter comprise a small particle diameter inorganic filler, a medium particle diameter inorganic filler, and a large particle diameter inorganic filler. The small particle diameter inorganic filler is 0.04 µm or more and less than 4 µm. The medium particle diameter inorganic filler is 4 µm or more and less than 12 µm. The large particle diameter inorganic filler is 12 µm or more and less than 50 µm. These three types of inorganic fillers may be the same substance or different substances. By making the blending ratio 1: 0.1 to 20: 0.1 to equal to or less than 20, and more preferably 1: 0.1 to 10: 0.1 to equal to or less than 10, a decorative laminate excellent in non-combustibility

and smoothness can be obtained.

[0052] The reason is considered to be as follows. The inorganic filler is considered to be uniformly dispersed on the surface of the nonwoven fabric or to have entered gaps between fibers of the nonwoven fabric. Specifically, the nonwoven fabric is an aggregate of fibers in which short fibers of the nonwoven fabric are dispersed one by one and entwined with the binder component, and/or by heat or mechanically. The nonwoven fabric is more porous than a kraft paper used as a core paper for normal decorative laminates, thus having sparse parts, which are so-called voids. Such voids are not uniform in size. The voids may be filled by using the above-described inorganic fillers each having the different average particle diameter. The binder component contained in the nonwoven fabric and the binder component composed of the thermosetting resin contained in the slurry flow much into lower voids during hot pressing. In particular, when the thermoplastic resin emulsion is used as the binder component in the fleece forming process of the nonwoven fabric, binding of the entangled fibers is weakened because thermoplastic resin emulsion easily softens as compared with the thermosetting resin contained in the slurry. In this way, the inorganic filler easily enters the voids in the nonwoven fabric during pressing such as hot pressing, gathers densely and fills the voids. As a result, smoothness of the finished decorative laminate is improved.

[0053] When the three types of inorganic fillers are mixed together, the volume cumulative particle diameters $D_v(10)$, $D_v(50)$, and $D_v(90)$ of the inorganic filler according to a laser diffraction/scattering-type particle size distribution measurement method are 0.5 μm or more and 40.0 μm or less, and more preferably 0.78 μm or more and 36.9 μm or less. When the volume cumulative particle diameters of the inorganic filler containing three types of inorganic fillers are within these ranges, dispersibility of the inorganic filler into slurry is good, the voids in the nonwoven fabric are densely filled, and smoothness of the decorative laminate is improved.

[0054] Further, when the three type of inorganic fillers are mixed together, a specific surface area according to the laser diffraction/scattering-type particle distribution measurement method is 800 to 4000 m^2/kg , and more preferably 900 to 3500

m²/kg. When the specific surface area of the mixed inorganic filler is within these ranges, a thermosetting binder in the slurry is easily absorbed, and while flowing, the binder enters the voids in the nonwoven fabric, thus contributing improved adhesiveness between the prepregs. As described so far, selection of the inorganic filler having appropriate particle diameter according to the thickness and density of the nonwoven fabric to be used results in a decorative laminate having excellent smoothness and sufficient adhesiveness as compared with conventional ones.

[0055] When the three type of inorganic fillers are used, it is particularly preferred to use calcium carbonate as the small particle diameter inorganic filler. This reduces aggregation of the calcium carbonate in the slurry, and improves impregnatability of the slurry into the fibrous base material, and makes the surface of the decorative laminate even smoother, which results in improvement in appearance of the decorative laminate. Furthermore, the calcium carbonate is preferred because it is available inexpensively.

[0056] When the amount of the inorganic filler contained in each prepreg forming the core layer is 300 to 1200 g/m², the non-combustibility is excellent. Further, when the amount of the inorganic substance other than the endothermic metal hydroxide contained in each prepreg is 0 to 700 g/m² and the amount of the endothermic metal hydroxide contained in each prepreg is 0 to 1000 g/m², the impregnatability, smoothness and non-combustibility are excellent.

[0057] Furthermore, for the purpose of inhibiting warping of the melamine decorative laminate, a backer may be arranged on a side opposite to the decorative layer. As the backer, a resin-impregnated backer paper is appropriate, which is obtained by impregnating a fibrous base material, such as a decorative paper or a core paper for the decorative laminate, with a resin liquid mainly composed of melamine-formaldehyde resin, phenol-formaldehyde resin, or the mixture thereof, and then drying it.

[0058] A surface roughness of the decorative laminate is measured based on JIS B 0601: 2013, and the arithmetic average roughness Ra is preferably 3.00 μm or less, and particularly preferably 1.40 μm or less, or the maximum height roughness Rz is preferably 15.00 μm or less, and particularly preferably 7.22 μm or less, or the ten-point average

roughness R_{zj} is preferably 10.00 μm or less, and particularly preferably 5.31 μm or less. In this case, peeling off of the plastic film after formation of the decorative laminate can be easily done, and whitening of the decorative laminate does not occur. Thus, the decorative laminate is smooth and has a good looking.

[0059] Regarding the thickness of the decorative laminate, although the thickness is applicable for a thin decorative laminate to a thick decorative laminate ranging from 0.50 mm to 20.00 mm, it is preferably 0.86 to 3.20 mm. In this case, the decorative laminate can suppress its warping, and is light-weighted and preferable in handleability and excellent in workability.

[0060] Hereinafter, the details will be described with reference to examples and comparative examples.

[Example 1]

[0061] Decorative Paper

A decorative paper having a basis weight of 80 g/m^2 in wood grain pattern was prepared by printing a wood conduit pattern part using an ink containing silicon-containing acrylic-based resin as the nonadhesive substance, and then curing the ink.

Production of Melamine Resin-impregnated Decorative Paper

The melamine resin-impregnated decorative paper was obtained by impregnating a decorative paper with a resin liquid mainly composed of melamine resin composition in which 0.5 parts by weight of 3-glycidoxypropyltrimethoxysilane (Z-6040, manufactured by Dow Corning Toray Co., Ltd.) as a silane coupling agent was blended with respect to 100 parts by weight of a solid content of melamine-formaldehyde resin (melamine resin) such that the impregnation rate as defined by Formula 1 was 130% and then drying it.

Phenol Resin-impregnated Core Paper

A phenol resin-impregnated core paper was obtained by impregnating a kraft paper having a basis weight of 187 g/m^2 with a resin liquid mainly composed of phenol-formaldehyde resin (phenol resin) so that the impregnation rate as defined by Formula 1 was 50%, and then drying it.

Production of Melamine Decorative Laminate

A laminate was obtained by stacking four sheets of phenol resin-impregnated core papers, one sheet of melamine resin-impregnated decorative paper, one sheet of untreated Oriented Polypropylene (OPP) film (mat, glossiness: 11.8) having a thickness of 40 μm and one sheet of stainless plate in this order from the bottom. After that, the laminate was inserted between hot plates of a hot-pressure molding machine, and a hot press molding was performed under the conditions: temperature of 140 °C, and 70 kg/cm², for 64 minutes. Then the stainless plate was removed, and the OPP film was peeled off to obtain the melamine decorative laminate. In a surface of the obtained decorative laminate, the cured product of the melamine resin composition on the wood conduit pattern part is transferred onto the OPP film side and forms a recessed part, and the glossiness of the OPP film is transferred onto the area other than the wood conduit pattern part and forms a raised part.

[Example 2]

[0062] A procedure was performed in the same manner as in Example 1 except that, instead of the untreated OPP film, a corona-treated OPP film (mat, glossiness: 11.8) having a thickness of 40 μm was used, and stacking was performed in such a manner that the corona-treated surface came into contact with the melamine resin-impregnated decorative paper.

[Example 3]

[0063] 1. Production of Composition

One part by weight (in terms of solid content) of siloxane graft polymer and 10 parts by weight (in terms of solid content) of organosilica sol were mixed. As the siloxane graft polymer, ZX-022H (hydroxyl value: 120, acid value: 0, solvent species: xylene/butyl acetate/isopropanol, manufactured by Fuji Kasei Kogyo Co., Ltd.), which is a composite of fluororesin and siloxane, was used. As the organosilica sol, IPA-ST (isopropanol dispersion silica sol, average particle diameter 10 to 20 nm, SiO₂: 30% by weight, manufactured by Nissan Chemical Industries, Ltd.) was used. IPA-ST is an organosilica sol in which a hydrophilic solvent (isopropanol) is used.

[0064] The aforementioned mixture was diluted with isopropanol so that a total solid content became 20% by weight, and a composition was obtained.

[0065] 2. Production of Transfer Sheet

The aforementioned composition was uniformly applied onto a corona-treated surface of a corona-treated OPP film having a thickness of 40 μm using a bar-coating method so that a dried film thickness was 3 μm , and then dried to obtain a transfer sheet in which an antifingerprint layer composed of dried product of the aforementioned composition was formed on the corona-treated surface.

[0066] 3. Production of Melamine Decorative Laminate

A procedure was performed in the same manner as in Example 2 except that, instead of the corona-treated OPP film, the aforementioned transfer sheet was stacked.

[0067] On the obtained decorative laminate, a layer composed of a dried product of the composition of the transfer sheet was transferred, the cured product of the melamine resin composition on the wood conduit pattern part was transferred onto the OPP film side, whereby the wood conduit pattern part formed a recessed part, and the glossiness of the OPP film was transferred onto the area other than the wood conduit pattern part to form a raised part comprising an antifingerprint layer.

[Example 4]

[0068] A procedure was performed in the same manner as in Example 3 except that the silane coupling agent was 1.0 part by weight.

[Example 5]

[0069] A procedure was performed in the same manner as in Example 3 except that the silane coupling agent was 1.5 parts by weight.

[Example 6]

[0070] A procedure was performed in the same manner as in Example 1 except that, instead of the untreated OPP film, an untreated polyethylene terephthalate (PET, PolyEthylene Terephthalate) film (semi-gloss, glossiness: 20.2) having a thickness of 40 μm was used.

[Example 7]

[0071] A procedure was performed in the same manner as in Example 6 except that, instead of the untreated PET film, a corona-treated PET film having a thickness of

40 μm was used, and the composition in Example 3 was uniformly applied onto the corona-treated surface using a bar-coating method so that the dried film thickness was 3 μm , and then dried to obtain the transfer sheet, and then the transfer sheet was stacked.

[Example 8]

[0072] A procedure was performed in the same manner as in Example 3 except that the silane coupling agent was 3.0 parts by weight.

[Example 9]

[0073] A procedure was performed in the same manner as in Example 1 except that, instead of the OPP film having a thickness of 40 μm , an OPP film (mat, glossiness: 12.0) having a thickness of 80 μm was used.

[Example 10]

[0074] Decorative Paper

A decorative paper in wood grain pattern having a basis weight of 80 g/m^2 was prepared by printing the wood conduit pattern part using an ink containing acrylic-based resin as a nonadhesive substance, and then curing the ink.

Production of Melamine Resin Impregnated Decorative Paper

The melamine resin-impregnated decorative paper was obtained by impregnating a decorative paper in wood grain pattern with a resin liquid mainly composed of a melamine resin composition in which 0.5 parts by weight of 3-glycidoxypropyltrimethoxysilane (Z-6040, manufactured by Dow Corning Toray Co., Ltd.) as a silane coupling agent was blended with respect to 100 parts by weight of melamine-formaldehyde resin (melamine resin) in solid content so that the impregnation rate as defined by Formula 1 was 130%, and then drying it.

Production of Prepreg

The prepreg was obtained by impregnating a glass fiber nonwoven fabric (binder component: thermoplastic resin emulsion, thickness: 0.585 mm, density: 0.130 g/cm^3) having a basis weight of 75 g/m^2 with a slurry containing 4.5 parts by weight of phenol-formaldehyde resin, 3.5 parts by weight of melamine-formaldehyde resin, 16.5 parts by weight of calcium carbonate having an average particle diameter of 1.4 μm as measured using an electron microscope as a small particle diameter inorganic filler,

37.5 parts by weight of aluminum hydroxide having an average particle diameter of 8 μm as measured using a laser diffraction/scattering method as a medium particle diameter inorganic filler, and 37.5 parts by weight of aluminum hydroxide having an average particle diameter of 20 μm as measured using the laser diffraction/scattering method as a large particle diameter inorganic filler, so that the impregnation rate as defined by Formula 1 was 1200%.

[0075] Production of Backer

The melamine resin-impregnated backer in wood grain pattern was obtained by impregnating a decorative paper for decorative laminate having a basis weight of 80 g/m^2 with a resin liquid mainly composed of melamine-formaldehyde resin composition so that the impregnation rate as defined by Formula 1 was 150%, and then drying it.

Production of Melamine Decorative Laminate

A procedure was performed in the same manner as in Example 1 except that one sheet of melamine resin-impregnated backer in wood grain pattern, five sheets of prepregs, one sheet of melamine resin-impregnated decorative paper in wood grain pattern, and an OPP film (mat, glossiness: 11.8) having a thickness of 40 μm were stacked in this order from the bottom such that the OPP film came into contact with the melamine resin-impregnated decorative paper.

[Example 11]

[0076] A procedure was performed in the same manner as in Example 10 to obtain a melamine decorative laminate, except that a decorative paper in stone grain texture having a basis weight of 80 g/m^2 in which the patterned part was in stone pattern part was used, the melamine resin composition containing 1.0 parts by weight of silane coupling agent was used, and an OPP film (high gloss, glossiness: 98.3) having a thickness of 40 μm was used.

[Example 12]

[0077] A procedure was performed in the same manner as in Example 10 to obtain a melamine decorative laminate, except that a decorative paper in rust texture having a basis weight of 80 g/m^2 in which the patterned part was in rust pattern part was

used, the melamine resin composition containing 3.0 parts by weight of silane coupling agent was used, and an OPP film (high gloss, glossiness: 98.3) having a thickness of 40 μm was used.

[Example 13]

[0078] A procedure was performed in the same manner as in Example 3 except that instead of four sheets of phenol resin-impregnated core paper, five sheets of prepreg in Example 10 were used, and one sheet of the melamine resin-impregnated backer in Example 10 and one sheet of the melamine resin-impregnated decorative paper in wood grain pattern in Example 1 were respectively disposed on back and front sides, and then they were stacked to form the melamine decorative laminate.

[Example 14]

[0079] A procedure was performed in the same manner as in Example 13 to obtain a melamine decorative laminate, except that a decorative paper in stone grain texture having a basis weight of 80 g/m^2 in which the patterned part was in stone pattern part was used, the melamine resin composition containing 1.0 part by weight of silane coupling agent was used, and an OPP film (high gloss, glossiness: 98.3) having a thickness of 40 μm was used.

[Example 15]

[0080] A procedure was performed in the same manner as in Example 13 to obtain a melamine decorative laminate, except that a decorative paper in rust texture having a basis weight of 80 g/m^2 in which the patterned part was in rust pattern part was used, the melamine resin composition containing 3.0 parts by weight of silane coupling agent was used, and an OPP film (high gloss, glossiness: 98.3) having a thickness of 40 μm was used.

[Example 16]

[0081] A procedure was performed in the same manner as in Example 13 except that the melamine resin composition contained 0.1 part by weight of sorbitol polyglycidyl ether as an epoxy compound with respect to 100 parts by weight of melamine resin in solid content.

[Example 17]

[0082] A procedure was performed in the same manner as in Example 13 except that the melamine resin composition contained 5 parts by weight of sorbitol polyglycidyl ether as an epoxy compound with respect to 100 parts by weight of melamine resin in solid content.

[Example 18]

[0083] A procedure was performed in the same manner as in Example 13 except that the melamine resin composition contained 10 parts by weight of sorbitol polyglycidyl ether as an epoxy compound with respect to 100 parts by weight of melamine resin in solid content.

[Example 19]

[0084] A procedure was performed in the same manner as in Example 17 except that the silane coupling agent was 1.0 part by weight, and bifunctional ethylene glycol diglycidyl ether was used instead of sorbitol polyglycidyl ether as an epoxy compound.

[Example 20]

[0085] A procedure was performed in the same manner as in Example 17 except that the silane coupling agent was 1.0 part by weight, and as for the prepreg, a glass fiber nonwoven fabric (binder component: thermoplastic resin emulsion, thickness: 0.405 mm, density: 0.121 g/cm³) having a basis weight of 53 g/m² and a slurry containing 16.5 parts by weight of calcium carbonate having an average particle diameter of 1.4 μm, 37.5 parts by weight of calcium carbonate having an average particle diameter of 8 μm and 37.5 parts by weight of calcium carbonate having an average particle diameter of 17 μm as inorganic fillers were used.

[Example 21]

[0086] A procedure was performed in the same manner as in Example 20 except that a slurry containing 16.5 parts by weight of aluminum hydroxide having the average particle diameter of 1.0 μm, 37.5 parts by weight of aluminum hydroxide having the average particle diameter of 8 μm, 37.5 parts by weight of aluminum hydroxide having the average particle diameter of 20 μm as inorganic fillers for the prepreg was used.

[Example 22]

[0087] A procedure was performed in the same manner as in Example 20 except

that 0 part by weight of phenol-formaldehyde resin and 8 parts by weight of melamine-formaldehyde resin were used as binder components for the prepreg.

[Example 23]

[0088] A procedure was performed in the same manner as in Example 20 except that 8 parts by weight of phenol-formaldehyde resin and 0 part by weight of melamine-formaldehyde resin were used as binder components for the prepreg.

[Example 24]

[0089] A procedure was performed in the same manner as in Example 21, except that 0 part by weight of phenol-formaldehyde resin and 8 parts by weight of melamine-formaldehyde resin were used as binder components for the prepreg.

[Example 25]

[0090] A procedure was performed in the same manner as in Example 21 except that 8 parts by weight of phenol-formaldehyde resin and 0 part by weight of melamine-formaldehyde resin were used as binder components for the prepreg.

[Example 26]

[0091] A procedure was performed in the same manner as in Example 20 except that the epoxy compound was not used.

[Example 27]

[0092] A procedure was performed in the same manner as in Example 21 except that the epoxy compound was not used.

[Example 28]

[0093] A procedure was performed in the same manner as in Example 22 except that the epoxy compound was not used.

[Example 29]

[0094] A procedure was performed in the same manner as in Example 23 except that the epoxy compound was not used.

[Example 30]

[0095] A procedure was performed in the same manner as in Example 24 except that the epoxy compound was not used.

[Example 31]

[0096] A procedure was performed in the same manner as in Example 25 except that the epoxy compound was not used.

[Example 32]

[0097] A procedure was performed in the same manner as in Example 26 except that a slurry containing 6.5 parts by weight of aluminum hydroxide having an average particle diameter of 1.0 μm , 42.5 parts by weight of aluminum hydroxide having an average particle diameter of 8 μm and 42.5 parts by weight of aluminum hydroxide having an average particle diameter of 20 μm as inorganic fillers for the prepreg was used.

[Example 33]

[0098] A procedure was performed in the same manner as in Example 26 except that a slurry containing 51.5 parts by weight of aluminum hydroxide having an average particle diameter of 1.0 μm , 20 parts by weight of aluminum hydroxide having an average particle diameter of 8 μm and 20 parts by weight of aluminum hydroxide having an average particle diameter of 20 μm as inorganic fillers for the prepreg was used.

[Example 34]

[0099] A procedure was performed in the same manner as in Example 26 except that a slurry containing 6.5 parts by weight of calcium carbonate having an average particle diameter of 1.4 μm , 42.5 parts by weight of calcium carbonate having an average particle diameter of 8 μm and 42.5 parts by weight of calcium carbonate having an average particle diameter of 17 μm as inorganic fillers for the prepreg was used.

[Example 35]

[0100] A procedure was performed in the same manner as in Example 26 except that a slurry containing 51.5 parts by weight of calcium carbonate having an average particle diameter of 1.4 μm , 20 parts by weight of calcium carbonate having an average particle diameter of 8 μm and 20 parts by weight of calcium carbonate having an average particle diameter of 17 μm as inorganic fillers for the prepreg was used.

[Example 36]

[0101] A procedure was performed in the same manner as in Example 26 except that, instead of 3-glycidoxypropyltrimethoxysilane, 3-glycidoxypropyltriethoxysilane (KBE-403, manufactured by Shin-Etsu Chemical Co., Ltd.) was used as the silane

coupling agent.

[Example 37]

[0102] A procedure was performed in the same manner as in Example 26 except that, instead of 3-glycidoxypropyltrimethoxysilane, 3-glycidoxypropylmethyl dimethoxysilane (KBM-402, manufactured by Shin-Etsu Chemical Co., Ltd.) was used as the silane coupling agent.

[Example 38]

[0103] A procedure was performed in the same manner as in Example 1 except that the melamine resin composition contained 1 part by weight of silane coupling agent, and 5.0 parts by weight of sorbitol polyglycidyl ether as an epoxy compound with respect to 100 parts by weight of melamine resin in solid content.

[Example 39]

[0104] A procedure was performed in the same manner as in Example 3 except that the melamine resin composition contained 1 part by weight of silane coupling agent, and 5.0 parts by weight of sorbitol polyglycidyl ether as an epoxy compound with respect to 100 parts by weight of melamine resin in solid content.

[0105] Comparative Example 1

A procedure was performed in the same manner as in Example 3 to obtain a decorative laminate except that the silane coupling agent was not used. In the decorative laminate in Comparative Example 1, the wood conduit pattern part was whitened as shown in FIG. 9.

[0106] Comparative Example 2

A procedure was performed in the same manner as in Example 6 except that the silane coupling agent was 4.5 parts by weight. In the decorative laminate in Comparative Example 2, the plastic film was stuck, and the film was broken and could not be peeled off as shown in FIG. 10.

[0107] Due to large amount of the added silane coupling agent and too much improvement of the adhesive force between the plastic film and the melamine-formaldehyde resin of the decorative paper, the plastic film was stuck.

[0108] Comparative Example 3

1. Production of Composition

The composition was obtained by mixing 50 parts by weight of KAYARAD PET-30 (manufactured by Nippon Kayaku Co., Ltd.) as an acrylic monomer, 5 parts by weight of Nipsil E220A (manufactured by Tosoh Silica Corporation) as a silica, 45 parts by weight of methyl ethyl ketone as a solvent, 5 parts by weight of IRGACURE184 (1-hydroxy-cyclohexyl-phenyl-ketone; manufactured by BASF SE) as a photopolymerization initiator.

[0109] 2. Production of Transfer Sheet

A transfer sheet was obtained by uniformly applying the aforementioned composition onto a PET film having a thickness of 40 μm using a bar-coating method so that the dried film thickness was 5 μm , irradiating ultraviolet ray with a metal halide lamp so that the irradiation intensity was 400m J/cm^2 to form a layer composed of cured product of the aforementioned composition on the film surface. Application quantity of the composition after drying was 5 g/m^2 .

[0110] 3. Production of Melamine Decorative Laminate

A procedure was performed in the same manner as in Comparative Example 1 except that the aforementioned transfer sheet was stacked.

[0111] In the decorative laminate in Comparative Example 3, as similarly to the case of Comparative Example 2, the plastic film was stuck, and the film was broken and could not be peeled off as shown in FIG. 11.

[0112] The melamine-formaldehyde resin was present at both the non-sticky patterned part and the other areas in the decorative paper. Due to too much improvement of the adhesive force between such resin and the layer composed of the cured product of the composition on the film surface, the plastic film was stuck. Hydroxyl group derived from the acrylic monomer in the composition further improved the adhesiveness with the melamine-formaldehyde resin.

[0113] Table 1 shows components of the decorative paper and plastic film in Examples and Comparative Examples.

[0114] [Table 1]

	Decorative Paper	Plastic Film, Transfer Sheet				
	Pattern	Type	Thickness	Corona Treatment	Glossiness	Antifingerprint Layer
Example 1	Wood grain, Wood conduit pattern part	OPP	40	Not Applied	11.8	Not Provided
Example 2	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Not Provided
Example 3	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 4	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 5	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 6	Wood grain, Wood conduit pattern part	PET	40	Not Applied	20.2	Not Provided
Example 7	Wood grain, Wood conduit pattern part	PET	40	Applied	20.2	Provided
Example 8	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 9	Wood grain, Wood conduit pattern part	OPP	80	Not Applied	12.0	Not Provided
Example 10	Wood grain, Wood conduit pattern part	OPP	40	Not Applied	11.8	Not Provided
Example 11	Stone pattern part	OPP	40	Not Applied	98.3	Not Provided
Example 12	Rust pattern part	OPP	40	Not Applied	98.3	Not Provided
Example 13	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 14	Stone pattern part	OPP	40	Applied	98.3	Provided
Example 15	Rust pattern part	OPP	40	Applied	98.3	Provided
Example 16	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 17	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 18	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 19	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 20	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 21	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 22	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 23	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 24	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 25	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 26	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 27	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 28	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 29	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 30	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 31	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 32	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 33	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 34	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 35	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 36	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 37	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Example 38	Wood grain, Wood conduit pattern part	OPP	40	Not Applied	11.8	Not Provided
Example 39	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Comparative Example 1	Wood grain, Wood conduit pattern part	OPP	40	Applied	11.8	Provided
Comparative Example 2	Wood grain, Wood conduit pattern part	PET	40	Not Applied	20.2	Not Provided
Comparative Example 3	Wood grain, Wood conduit pattern part	PET	40	Not Applied	20.2	UV Cured Product

Table 2 shows contents of additives in the melamine resin composition of the decorative layer and the material of the core layer in Examples and Comparative Examples. The values in Table 2 are in part by weight in terms of a solid content.

[0115]

[Table 2]

	Decorative Layer		Core Layer
	Silane Coupling Agent [parts by weight]	Epoxy Compound [parts by weight]	-
Example 1	0.5	-	Resin-impregnated core paper
Example 2	0.5	-	Resin-impregnated core paper
Example 3	0.5	-	Resin-impregnated core paper
Example 4	1.0	-	Resin-impregnated core paper
Example 5	1.5	-	Resin-impregnated core paper
Example 6	0.5	-	Resin-impregnated core paper
Example 7	0.5	-	Resin-impregnated core paper
Example 8	3.0	-	Resin-impregnated core paper
Example 9	0.5	-	Resin-impregnated core paper
Example 10	0.5	-	Prepreg
Example 11	1.0	-	Prepreg
Example 12	3.0	-	Prepreg
Example 13	0.5	-	Prepreg
Example 14	1.0	-	Prepreg
Example 15	3.0	-	Prepreg
Example 16	0.5	0.1	Prepreg
Example 17	0.5	5.0	Prepreg
Example 18	0.5	10.0	Prepreg
Example 19	1.0	5.0	Prepreg
Example 20	1.0	5.0	Prepreg
Example 21	1.0	5.0	Prepreg
Example 22	1.0	5.0	Prepreg
Example 23	1.0	5.0	Prepreg
Example 24	1.0	5.0	Prepreg
Example 25	1.0	5.0	Prepreg
Example 26	1.0	Not Used	Prepreg
Example 27	1.0	Not Used	Prepreg
Example 28	1.0	Not Used	Prepreg
Example 29	1.0	Not Used	Prepreg
Example 30	1.0	Not Used	Prepreg
Example 31	1.0	Not Used	Prepreg
Example 32	1.0	Not Used	Prepreg
Example 33	1.0	Not Used	Prepreg
Example 34	1.0	Not Used	Prepreg
Example 35	1.0	Not Used	Prepreg
Example 36	1.0	Not Used	Prepreg
Example 37	1.0	Not Used	Prepreg
Example 38	1.0	5.0	Resin-impregnated core paper
Example 39	1.0	5.0	Resin-impregnated core paper
Comparative Example 1	-	-	Resin-impregnated core paper
Comparative Example 2	4.5	-	Resin-impregnated core paper
Comparative Example 3	-	-	Resin-impregnated core paper

Table 3 shows contents of the slurry composition. The values in Table 3 are in part by weight in terms of a solid content.

[0116] [Table 3]

	(A) Organic resin component		(B) Inorganic filler					
	Phenol-formaldehyde resin	Melamine-formaldehyde resin	(b1) Inorganic substance other than endothermic metal hydroxide			(b2) Endothermic metal hydroxide		
			Small particle diameter	Medium particle diameter	Large particle diameter	Small particle diameter	Medium particle diameter	Large particle diameter
Example 1	-	-	-	-	-	-	-	-
Example 2	-	-	-	-	-	-	-	-
Example 3	-	-	-	-	-	-	-	-
Example 4	-	-	-	-	-	-	-	-
Example 5	-	-	-	-	-	-	-	-
Example 6	-	-	-	-	-	-	-	-
Example 7	-	-	-	-	-	-	-	-
Example 8	-	-	-	-	-	-	-	-
Example 9	-	-	-	-	-	-	-	-
Example 10	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 11	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 12	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 13	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 14	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 15	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 16	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 17	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 18	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 19	4.5	3.5	16.5	-	-	-	37.5	37.5
Example 20	4.5	3.5	16.5	37.5	37.5	-	-	-
Example 21	4.5	3.5	-	-	-	16.5	37.5	37.5
Example 22	0	8	16.5	37.5	37.5	-	-	-
Example 23	8	0	16.5	37.5	37.5	-	-	-
Example 24	0	8	-	-	-	16.5	37.5	37.5
Example 25	8	0	-	-	-	16.5	37.5	37.5
Example 26	4.5	3.5	16.5	37.5	37.5	-	-	-
Example 27	4.5	3.5	-	-	-	16.5	37.5	37.5
Example 28	0	8	16.5	37.5	37.5	-	-	-
Example 29	8	0	16.5	37.5	37.5	-	-	-
Example 30	0	8	-	-	-	16.5	37.5	37.5
Example 31	8	0	-	-	-	16.5	37.5	37.5
Example 32	4.5	3.5	-	-	-	6.5	42.5	42.5
Example 33	4.5	3.5	-	-	-	51.5	20	20
Example 34	4.5	3.5	6.5	42.5	42.5	-	-	-
Example 35	4.5	3.5	51.5	20	20	-	-	-
Example 36	4.5	3.5	16.5	37.5	37.5	-	-	-
Example 37	4.5	3.5	16.5	37.5	37.5	-	-	-
Example 38	-	-	-	-	-	-	-	-
Example 39	-	-	-	-	-	-	-	-
Comparative Example 1	-	-	-	-	-	-	-	-
Comparative Example 2	-	-	-	-	-	-	-	-
Comparative Example 3	-	-	-	-	-	-	-	-

Table 4 and Table 5 show the evaluation results.

[0117] [Table 4]

	Appearance	Decorative Laminate Thickness [mm]	Arithmetic Average Roughness Ra [μm]	Maximum Height Roughness Rz [μm]	Ten-Point Average Roughness Rzjs [μm]
Example 1	○	0.88	1.402	7.221	5.310
Example 2	○	0.86	1.322	7.096	5.111
Example 3	○	0.90	1.332	7.100	5.198
Example 4	○	0.90	1.299	6.534	4.889
Example 5	○	0.91	1.289	6.498	4.861
Example 6	○	0.89	1.301	6.801	4.982
Example 7	○	0.90	1.299	6.704	4.891
Example 8	○	0.90	1.330	7.098	5.199
Example 9	○	0.89	1.309	6.932	5.044
Example 10	○	2.99	1.271	6.432	4.733
Example 11	○	2.97	1.088	5.210	3.965
Example 12	○	3.01	0.827	4.472	3.096
Example 13	○	3.00	1.220	6.289	4.666
Example 14	○	3.10	1.071	5.222	4.026
Example 15	○	3.20	0.960	4.610	3.473
Example 16	○	2.99	1.300	7.023	5.101
Example 17	○	3.01	1.377	7.194	5.285
Example 18	○	3.01	1.213	6.271	4.532
Example 19	○	3.00	1.387	7.200	5.201
Example 20	○	2.10	1.399	7.119	5.298
Example 21	○	2.08	1.377	6.991	4.996
Example 22	○	2.11	1.299	6.523	4.872
Example 23	○	2.09	1.304	6.831	4.932
Example 24	○	2.09	1.311	6.954	4.943
Example 25	○	2.30	1.311	6.942	4.955
Example 26	○	2.29	1.394	7.005	5.118
Example 27	○	2.11	1.333	6.961	4.893
Example 28	○	2.28	1.251	6.339	4.628
Example 29	○	2.28	1.309	6.944	5.102
Example 30	○	2.25	1.332	6.996	5.016
Example 31	○	2.16	1.388	7.198	5.229
Example 32	○	2.25	1.222	6.321	4.550
Example 33	○	2.19	1.290	6.601	4.876
Example 34	○	2.20	1.301	6.899	4.894
Example 35	○	2.29	1.313	6.903	4.964
Example 36	○	2.28	1.271	6.509	4.794
Example 37	○	2.19	1.261	6.498	4.666
Example 38	○	0.90	1.361	6.908	4.891
Example 39	○	0.89	1.359	6.878	4.779
Comparative Example 1	×	0.91	-	-	-
Comparative Example 2	×	-	-	-	-
Comparative Example 3	×	-	-	-	-

[0118]

[Table 5]

	Fingerprint-resistant Property	Product Glossiness Raised Part	Product Glossiness Recessed Part (Patterned Part)	Non-combustibility
Example 1	-	3.2	2.2	-
Example 2	-	3.0	2.1	-
Example 3	○	3.2	2.3	-
Example 4	○	3.1	2.2	-
Example 5	○	3.1	2.3	-
Example 6	-	10.0	2.2	-
Example 7	○	12.3	2.3	-
Example 8	○	3.1	2.3	-
Example 9	-	3.0	2.1	-
Example 10	-	3.8	2.3	○
Example 11	-	16.2	2.3	○
Example 12	-	16.8	2.2	○
Example 13	○	3.4	2.4	○
Example 14	○	16.9	2.0	○
Example 15	○	17.9	1.9	○
Example 16	○	3.0	2.3	○
Example 17	○	3.1	2.1	○
Example 18	○	3.0	2.0	○
Example 19	○	3.0	2.2	○
Example 20	○	3.1	2.3	○
Example 21	○	3.0	2.2	○
Example 22	○	3.0	2.3	○
Example 23	○	3.2	2.3	○
Example 24	○	3.1	2.3	○
Example 25	○	3.3	2.3	○
Example 26	○	3.1	2.2	○
Example 27	○	3.4	2.1	○
Example 28	○	3.3	2.1	○
Example 29	○	3.3	2.2	○
Example 30	○	3.1	2.2	○
Example 31	○	3.0	2.1	○
Example 32	○	3.0	2.2	○
Example 33	○	3.1	2.1	○
Example 34	○	3.3	2.2	○
Example 35	○	3.0	2.2	○
Example 36	○	3.0	2.2	○
Example 37	○	3.0	2.1	○
Example 38	-	3.1	2.2	-
Example 39	○	3.0	2.3	-
Comparative Example 1	○	-	-	-
Comparative Example 2	-	-	-	-
Comparative Example 3	-	-	-	-

Table 6 shows the volume cumulative particle diameters.

[0119] [Table 6]

	Volume cumulative particle diameter			Specific surface area
	Dv(10)	Dv(50)	Dv(90)	
	[μm]	[μm]	[μm]	m^2/kg
Example 14	2.49	12.6	31.8	991.1
Example 20	1.48	10.8	36	1612
Example 21	1.53	10.7	30.9	1510
Example 32	2.5	13.6	36.6	980
Example 33	0.78	3.48	25.9	2973
Example 34	1.84	12.8	30.6	1322
Example 35	1.12	5.72	31	2072

Methods for evaluation are as described below.

(1) Appearance: A mark $\bigcirc$ (good) was given when the decorative laminate showed no abnormalities as inspected visually.

(2) Decorative laminate thickness: The thickness was measured using a micrometer.

(3) Glossiness: The glossiness was measured using a glossmeter GMX-102 type (PORTABLE GROSS METER) from Murakami Color Research Laboratory Co., Ltd. (Black-colored BK glass was used as a standard calibration plate, and both an angle of incidence and an acceptance angle were set at 60°) under conditions in accordance with JIS Z 8741.

(4) Arithmetic Average Roughness Ra

Arithmetic average roughness Ra of the decorative laminate was measured along a fiber direction of the decorative laminate in accordance with JIS B 0601: 2013 “Geometrical Product Specifications (GPS)-Surface texture: Profile method-Terms, definitions and surface texture parameters” by using a surface roughness contour tester (Model No.: SURFCOM FLEX-50A; TOKYO SEIMITSU CO., LTD.). The evaluated length was 20mm, and the unit of the value is μm .

(5) Maximum Height Roughness Rz

Maximum height roughness Rz of the decorative laminate was measured along the fiber direction of the decorative laminate in a similar manner to that in (4).

The evaluated length was 20mm, and the unit of the value is μm .

(6) Ten-Point Average Roughness Rzjis

Ten-point average roughness Rzjis of the decorative laminate was measured along the fiber direction of the decorative laminate in a similar manner to that in (1). The evaluated length was 20mm, and the unit of the value is μm .

(7) Evaluation on fingerprint-resistant properties with real fingerprints

Fingerprints were actually attached to the surface of the melamine decorative board, and how conspicuous the fingerprints were visually evaluated. Criteria for the evaluation are shown as below.

○ (good): fingerprint is less conspicuous.

× (poor): fingerprint is conspicuous.

(8) Non-combustibility

A 20-minute heat release test with a cone calorimeter conforming to ISO5660 was performed. In the evaluation method, a mark ○ (good) was given when the total heat release was 8 MJ/m^2 or less, the maximum heat release rate did not exceed 200 kW/m^2 continuously for 10 seconds or more, and no breakages or fractures or the like penetrating to a rear face of the tested specimen were observed. A mark × (poor) was given when any one of these three conditions was not satisfied.

(9) Volume Cumulative Particle Diameter

Three types of inorganic fillers were measured using a laser diffraction particle size analyzer (manufactured by Malvern Instruments Ltd., model number: Mastersizer 3000).

CLAIMS

1. A melamine decorative laminate comprising:

a decorative layer; and

a core layer,

the decorative layer comprising a cured product of a melamine resin composition and a decorative paper having a patterned part containing a substance nonadhesive to the cured product of the melamine resin composition,

the melamine resin composition containing 0.1 to 4.0 parts by weight of silane coupling agent with respect to 100 parts by weight of melamine resin in solid content,

the melamine decorative laminate comprising a surface in which a recessed part is formed on an upper portion of the patterned part.

2. The melamine decorative laminate according to claim 1, wherein difference in glossiness between the recessed part formed of the upper portion of the patterned part and the cured product of the melamine resin composition as measured in compliance with JIS Z 8741 is 0.7 to 16.

3. The melamine decorative laminate according to claim 1 or 2, wherein the melamine resin composition contains an epoxy compound.

4. The melamine decorative laminate according to claim 3, wherein 0.1 to 10 parts by weight of the epoxy compound is contained with respect to 100 parts by weight of melamine resin in solid content.

5. The melamine decorative laminate according to any one of claims 1 to 4, wherein the core layer comprises: a fibrous base material; an organic binder component; and an inorganic filler.

6. The melamine decorative laminate according to claim 5, wherein a ratio of the organic binder component to the inorganic filler by solid weight is 1:1 to 25.

7. The melamine decorative laminate according to claim 5 or 6, wherein the inorganic filler is an endothermic metal hydroxide and/or an inorganic substance other than the endothermic metal hydroxide.

8. The melamine decorative laminate according to any one of claims 5 to 7, wherein the inorganic filler comprises three types of inorganic fillers each having a different average particle diameter.

9. The melamine decorative laminate according to any one of claims 5 to 8, wherein the average particle diameter of the inorganic filler is 0.04 μm or more to less than 50 μm .

10. The melamine decorative laminate according to claim 8, wherein the three types of inorganic fillers each having a different average particle diameter comprise:

- a small particle diameter inorganic filler;
- a medium particle diameter inorganic filler; and
- a large particle diameter inorganic filler,

wherein the small particle diameter inorganic filler is 0.04 μm or more and less than 4 μm ,

wherein the medium particle diameter inorganic filler is 4 μm or more and less than 12 μm , and

wherein the large particle diameter inorganic filler is 12 μm or more and less than 50 μm .

11. The melamine decorative laminate according to claim 10, wherein a blending ratio of the small particle diameter inorganic filler to the medium particle

diameter inorganic filler to the large particle diameter inorganic filler is 1: 0.1 to 20: 0.1 to 20.

12. The melamine decorative laminate according to any one of claims 1 to 11, wherein a cured product of a composition is formed on the decorative layer,

the composition containing: (a) organosilica sol; and (b) siloxane graft polymer being a composite of fluororesin or acrylic resin and siloxane.

13. The melamine decorative laminate according to any one of claims 1 to 12, wherein arithmetic average roughness Ra is 1.40 μm or less, or maximum height roughness Rz is 7.22 μm or less, or ten-point average roughness Rzjis is 5.31 μm or less in accordance with JIS B 0601: 2013 “Geometrical Product Specifications (GPS)-Surface texture: Profile method-Terms, definitions and surface texture parameters”.

14. The melamine decorative laminate according to any one of claims 1 to 13, wherein a thickness of the melamine decorative laminate is 0.50 mm to 20.00 mm.

15. The melamine decorative laminate according to any one of claims 1 to 14, wherein the cured product of the melamine resin composition is a cured product of the melamine resin composition with which the decorative paper is impregnated.

16. A method for producing a melamine decorative laminate, based on the following steps (A) to (E):

(A) step for obtaining a decorative paper that includes a patterned part containing a substance nonadhesive to a cured product of a melamine resin composition;

(B) step for obtaining a melamine resin-impregnated decorative paper by impregnating the decorative paper with a resin liquid mainly composed of a melamine resin composition containing 0.1 to 4.0 parts by weight of silane coupling agent with respect to 100 parts by weight of a solid content of melamine resin, as the melamine resin composition, and then drying it;

(C) step for obtaining a laminate by stacking the melamine resin-impregnated decorative paper and a core layer and then putting a plastic film and a metal board on the melamine resin-impregnated decorative paper;

(D) step for subjecting the laminate to hot press molding while the laminate is inserted between hot plates of a hot-pressure molding machine; and

(E) step for, after the hot press molding, taking out the laminate, removing the metal board, peeling off the plastic film, and then transferring the cured product of the melamine resin composition on the patterned part onto the plastic film side, to thereby form a recessed part on an upper portion of the patterned part, as well as to thereby transfer surface characteristics of the plastic film onto the melamine resin-impregnated decorative paper side.

17. The method for producing the melamine decorative laminate according to claim 16, wherein the surface characteristic is glossiness.

18. The method for producing the melamine decorative laminate according to claim 16, wherein the surface characteristic is an antifingerprint layer.

19. The method for producing the melamine decorative laminate according to claim 16, wherein the glossiness of the nonadhesive substance and the glossiness of the plastic film are different from each other.

20. The method for producing the melamine decorative laminate according to claim 18, wherein the antifingerprint layer is a composition containing: (a) organosilica sol; and (b) siloxane graft polymer being a composite of fluororesin or acrylic resin and siloxane.

21. The method for producing the melamine decorative laminate according to any one of claims 16 to 20, wherein a surface of the plastic film on the melamine resin-impregnated decorative paper side has been previously provided with a corona treatment.

22. The method for producing the melamine decorative laminate according to any one of claims 16 to 21, wherein the melamine resin composition contains an epoxy compound.

23. The method for producing the melamine decorative laminate according to claim 22, wherein 0.1 to 10 parts by weight of the epoxy compound is contained with respect to 100 parts by weight of melamine resin in solid content.

24. The method for producing the melamine decorative laminate according to any one of claims 16 to 23, wherein the core layer comprises: a fibrous base material; an organic binder component; and an inorganic filler.

25. The method for producing the melamine decorative laminate according to claim 24, wherein a ratio of the organic binder component to the inorganic filler by solid weight is 1: 1 to 25.

26. The method for producing the melamine decorative laminate according to claim 24 or 25, wherein the inorganic filler is an endothermic metal hydroxide and/or an inorganic substance other than the endothermic metal hydroxide.

27. The method for producing the melamine decorative laminate according to any one of claims 24 to 26, wherein the inorganic filler comprises three types of inorganic fillers each having a different average particle diameter.

28. The method for producing the melamine decorative laminate according to any one of claims 24 to 27, wherein the average particle diameter of the inorganic filler is 0.04 μm or more to less than 50 μm .

29. The method for producing the melamine decorative laminate according to

claim 27,

wherein the three types of inorganic fillers each having a different average particle diameter comprise:

a small particle diameter inorganic filler;

a medium particle diameter inorganic filler; and

a large particle diameter inorganic filler,

wherein the small particle diameter inorganic filler is 0.04 μm or more and less than 4 μm ,

wherein the medium particle diameter inorganic filler is 4 μm or more and less than 12 μm , and

wherein the large particle diameter inorganic filler is 12 μm or more and less than 50 μm .

30. The method for producing the melamine decorative laminate according to claim 29, wherein a blending ratio of the small particle diameter inorganic filler to the medium particle diameter inorganic filler to the large particle diameter inorganic filler is 1: 0.1 to 20: 0.1 to 20.