

## DESCRIPTION

TITLE OF THE INVENTION: PLATE-LIKE CURED PRODUCT

### TECHNICAL FIELD

5 [0001]

The present invention relates to a novel plate-like cured product which can be used for building materials and the like.

### BACKGROUND ART

10 [0002]

Building materials having excellent design such as those having various concavo-convex patterns or those having a full-bodied texture, which image a genuine stone or a fieldstone and are relatively thick, are being adopted frequently as an interior material for buildings.

[0003]

Recently, there is also increasing interest in a safe, comfortable living space, and interior building materials are required to have various functions such as fire protection property, contamination preventing property, prevention of indoor condensation or mold development prevention and antimicrobial property, and also to have excellent working property due to flexibility, weight saving and the like, in addition to excellent design. Accordingly, many products have been developed.

[0004]

For example, Patent Document 1 discloses a decorative material which is obtained by laminating a spraying material containing a binder such as an acrylic resin emulsion and a natural aggregate, an artificial aggregate or the like on a reinforcement layer, and further forming a transparent sheet on its surface through an adhesive material. Patent Document 2 discloses a building material which contains a moisture absorption and desorption material and a hydraulic substance, and also has fire protection property.

#### PRIOR ART DOCUMENTS

#### PATENT DOCUMENTS

[0005]

Patent Document 1: JP-A-4-347251  
Patent Document 2: JP-A-2003-96930

#### SUMMARY OF THE INVENTION

#### PROBLEMS TO BE SOLVED BY THE INVENTION

[0006]

However, the decorative material as disclosed in Patent Document 1 contains many organic resin components such as a synthetic resin, a textile made of synthetic fibers, an adhesive material and a transparent sheet, and thus fire protection property may become insufficient. Since a transparent sheet

is provided on a surface, ventilation property may be inferior.  
On the other hand, when a hydraulic substance is employed as  
a binder, as in Patent Document 2, the building material can  
exhibit excellent fire protection property but may be inferior  
5 in design property.

[0007]

The present invention has been made in light of such  
circumstances, and an object thereof is to provide a plate-like  
cured product which is excellent in design and also has excellent  
10 performances such as fire protection property and ventilation  
property.

#### MEANS FOR SOLVING THE PROBLEM

[0008]

15 The present inventors intensively studied so as to achieve  
the above object and found a plate-like cured product which  
contains a synthetic resin and a particulate as constituent  
components and also has a dispersion peak of loss tangent ( $\tan\delta$ )  
measured using a dynamic mechanical spectrometer in particular  
20 ranges, and thus the present invention has been completed.

[0009]

Thus, the plate-like cured product of the present invention  
has the following features.

1. A plate-like cured product comprising a synthetic  
25 resin and a particulate, wherein

the plate-like cured product contains 200 to 4,000 parts by weight of the particulate based on 100 parts by weight of the synthetic resin in a weight ratio of the solid content, and

the plate-like cured product has a dispersion peak of loss tangent ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer, in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively.

2. The plate-like cured product according to 1, wherein the synthetic resin has a dispersion peak of loss tangent ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer, in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively.

3. The plate-like cured product according to 1 or 2, wherein the synthetic resin contains an acrylic resin and a silicone resin in a weight ratio of the solid content of 95:5 to 30:70.

4. The plate-like cured product according to any one of 1 to 3, wherein the synthetic resin is a graft polymer of an acrylic resin and a silicone resin.

5. The plate-like cured product according to any one of 1 to 4, wherein the particulate contain a colored aggregate and moisture absorption and desorption powder.

6. The plate-like cured product according to any one of 1 to 5, which further includes a photocatalytic metal oxide as the particulate.

7. The plate-like cured product according to any one of 1 to 6, which further includes a chemical substance adsorbent as the particulate.

8. A plate-like cured product comprising the cured  
5 product according to any one of 1 to 7 and a moisture permeable overcoat layer laminated on the cured product.

9. A method for producing a plate-like cured product comprising a synthetic resin and a particulate, wherein

the synthetic resin has a dispersion peak of loss tangent  
10 ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer, in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively,

the method comprising:

a first step of mixing 200 to 4,000 parts by weight of  
15 the particulate based on 100 parts by weight of the synthetic resin in a weight ratio of the solid content, and molding the mixture, and

a second step of curing the molded product at a temperature higher than the dispersion peak temperature ( $T_1$ ) of the synthetic  
20 resin.

#### EFFECT OF THE INVENTION

[0011]

The present invention is directed to a plate-like cured  
25 product which include a synthetic resin and a particulate as

constituent components, and contains 200 to 4,000 parts by weight of the particulate based on 100 parts by weight of the synthetic resin in a weight ratio of the solid content, and the plate-like cured product has a dispersion peak of loss tangent ( $\tan\delta$ ),  
5 measured using a dynamic mechanical spectrometer, in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$ , respectively, and thus excellent design, fire protection property, ventilation property and the like can be exhibited.

#### 10 MODE FOR CARRYING OUT THE INVENTION

[0012]

The best mode for carrying out the present invention will be described below.

[0013]

15 The plate-like cured product of the present invention includes (A) a synthetic resin and (B) a particulate in a particular ratio, and also has a dispersion peak of loss tangent ( $\tan\delta$ ) ( $\tan\delta$  curve) (hereinafter also referred to as a "dispersion peak"), measured using a dynamic mechanical spectrometer  
20 (hereinafter also referred to as a "DMS"), in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively. Although the action mechanism is not clear, the plate-like cured product can exhibit excellent ventilation property in a conventional environment where the plate-like cured  
25 product is used, by having a dispersion peak in  $T_2$ , in addition

to the  $T_1$  temperature range. By having a dispersion peak in  $T_2$ , in addition to the  $T_1$  temperature range, the plate-like cured product has satisfactory molding property even when the product contains a large amount of particulates, and thus a plate-like  
5 cured product having excellent design and fire protection property can be obtained.

[0014]

The DMS measurement is carried out using a plate-like cured product measuring 40 mm in length  $\times$  10 mm in width  $\times$  2 mm in  
10 thickness as a sample and using a dynamic mechanical spectrometer (DMS6100, manufactured by Seiko Instruments Inc.) under the conditions of a measurement temperature range of  $-150^{\circ}\text{C}$  to  $80^{\circ}\text{C}$ , a temperature rise rate of  $4^{\circ}\text{C}/\text{min}$  and a measurement frequency of 1 Hz.

15 [0015]

(A) Synthetic resin

There is no particular limitation on the synthetic resin (hereinafter also referred to as a "component (A)") of the present invention, and examples thereof include water dispersible type,  
20 water soluble type, NAD type, solvent soluble type and solvent-free type resins, such as an acrylic resin, a silicone resin, an acrylic silicone resin, a fluorine resin, a vinyl acetate resin, a vinyl acetate acrylic resins, a vinyl chloride resin, an urethane resin, an acrylic urethane resin, an epoxy  
25 resin, an alkyd resin, a polyvinyl alcohol resin, a polyester

resin, an ethylene resin, polyvinyl alcohol, cellulose, and derivatives thereof. One-component type, two-component type and other type resins can be used without any particular limitation.

5 [0016]

In the present invention, a synthetic resin having dispersion peaks of loss tangent ( $\tan\delta$ ), measured using DMS, in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively, are preferably used as the  
10 component (A). Inclusion of such component (A) enables exhibition of excellent ventilation property. The synthetic resins may have other dispersion peaks within temperature ranges other than the  $T_1$  and  $T_2$  as long as the effects of the present invention are not impaired.

15 [0017]

There is no particular limitation on the component (A) and examples thereof include a mixed resin prepared by mixing a synthetic resin having a dispersion peak of a  $\tan\delta$  curve within The  $T_1$  with a synthetic resin having a dispersion peak of a  $\tan\delta$   
20 curve within  $T_2$ , and a polymer prepared by chemically bonding a synthetic resin having a dispersion peak of a  $\tan\delta$  curve within The  $T_1$  and a synthetic resin having a dispersion peak of a  $\tan\delta$  curve within  $T_2$ .

[0018]

The DMS measurement of the synthetic resins is carried out using a film (40 mm long × 10 mm wide) prepared by drying component (A) up to a film thickness of 0.1 mm as a sample, and using a dynamic mechanical spectrometer (DMS6100 manufactured  
5 by Seiko Instruments Inc.) under conditions of measurement temperature range: -150°C to 80°C, temperature raising rate: 4°C/min, and measurement frequency: 1 Hz.

[0019]

Specifically, in the present invention, a mixture  
10 containing an acrylic resin (a1) having a dispersion peak within the temperature range  $T_1$  (hereinafter also referred to as a "component (a1)") and a silicone resin (a2) having a dispersion peak within the temperature range  $T_2$  (hereinafter also referred to as a "component (a2)") is preferably used as the component  
15 (A). The weight ratio of the solid content of an acrylic resin to a silicone resin in component (A) is usually from 95:5 to 30:70, preferably from 90:10 to 40:60, and more preferably from 85:15 to 60:40. By containing both components in such a ratio, it is possible to improve ventilation property and fire  
20 protection property.

[0020]

The acrylic resin (a1) is a polymer which is prepared using a (meth)acrylic acid ester as a main component, and copolymerized with other monomers as needed. (Meth)acrylic acid alkyl esters  
25 include, for example, methyl (meth)acrylate, ethyl

(meth)acrylate, isopropyl (meth)acrylate, n-butyl  
(meth)acrylate, isobutyl (meth)acrylate, t-butyl  
(meth)acrylate, n-amyl (meth)acrylate, isoamyl (meth)acrylate,  
n-hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, octyl  
5 (meth)acrylate, decyl (meth)acrylate, dodecyl (meth)acrylate,  
octadecyl (meth)acrylate, cyclohexyl (meth)acrylate, phenyl  
(meth)acrylate, benzyl (meth)acrylate and the like. The amount  
of such (meth)acrylic acid alkyl esters used is usually from  
30% by weight or more, preferably from 40 to 99.9% by weight,  
10 and more preferably from 50 to 99.5% by weight, based on the  
total monomers constituting component (A).

[0021]

In the present invention, a (meth)acrylic acid ester having  
6 or more carbon atoms in the alkyl group is preferably contained,  
15 as a (meth)acrylic acid ester, as an essential component. Among  
these, 2-ethylhexyl acrylate is particularly suitable. In the  
present invention, such a (meth)acrylic acid ester having 6 or  
more carbon atoms in the alkyl group is preferably contained  
in an amount of 10% by weight or more, and more preferably 15%  
20 by weight or more and 50% by weight or less, based on the total  
monomers constituting component (A). In this case, it is  
possible to improve fire protection property of the resultant  
plate-like cured product.

[0022]

Other monomers include, for example, carboxyl group-containing monomers, amino group-containing monomers, pyridine-based monomers, hydroxyl group-containing monomers, nitrile group-containing monomers, amide group-containing monomers, epoxy group-containing monomers, carbonyl group-containing monomers, alkoxysilyl group-containing monomers, aromatic monomers and the like. The amount of these monomers used is usually from 0.1 to 60% by weight, and preferably from 0.5 to 50% by weight, based on the total monomers constituting component (A).

[0023]

Among them, when a carboxyl group-containing acrylic resin is prepared by copolymerizing a carboxyl group-containing monomer, it is possible to improve various physical properties of a plate-like cured product by separately adding a compound which can react with the carboxyl group. Carboxyl group-containing monomers include, for example, acrylic acid, methacrylic acid, crotonic acid, maleic acid or its monoalkyl ester, itaconic acid or its monoalkyl ester, fumaric acid or its monoalkyl ester and the like. Among them, one or more monomers selected from acrylic acid and methacrylic acid are particularly suitable. The amount of carboxyl group-containing monomers used is usually from 0.1 to 40% by weight, and preferably from 0.5 to 20% by weight, based on the total monomers constituting component (A).

[0024]

Also, compounds which can react with a carboxyl group include, for example, compounds having one or more functional groups selected from a carbodiimide group, an epoxy group, an  
5 aziridine group, an oxazoline group and the like.

[0025]

The silicone resin (a2) can be obtained by polymerizing a siloxane compound. Siloxane compounds include, for example, cyclic siloxane compounds such as hexamethylcyclotrisiloxane,  
10 octamethylcyclotetrasiloxane, and decamethylcyclopentasiloxane. When such cyclic siloxane compounds are polymerized, it is also possible to use linear siloxane compounds, branched siloxane compounds, alkoxysilane compounds and the like. Among them, a silane compound having  
15 one or more alkoxy groups in the molecule can be used as an alkoxysilane compound. For example, it is possible to use tetramethoxysilane, methyltrimethoxysilane, dimethyldimethoxysilane and the like, as well as silane coupling agents such as vinylmethyldimethoxysilane,  
20  $\gamma$ -(meth)acryloyloxytrimethoxysilane, 3-mercaptopropyltrimethoxysilane. The average molecular weight of silicone resins is usually 10,000 or more, and preferably 50,000 or more.

[0026]

A graft polymer of the acrylic resin (a1) and the silicone resin (a2) is preferably used as the component (A). By using a graft polymer, it is possible to utilize a texture of the below-mentioned particulate, and to improve fire protection property and flexibility. Also, it is possible to obtain advantageous effects in various physical properties such as water resistance, weatherability, and contamination resistance. Moreover, when moisture absorption and desorption powder is contained as particulate, the performance of the powder can be exhibited satisfactorily. Although the action mechanism is not clear, it is considered that component (a2) is moderately mobile in a usual environment where a plate-like cured product is used, and therefore, it is possible to exhibit excellent ventilation property and concomitantly improve other physical properties. Such a graft polymer can be obtained, for example, by copolymerizing the siloxane compound, the (meth)acrylic acid ester, and a grafting agent. Examples of the grafting agent include a polyfunctional alkoxysilane having a vinyl polymerizable functional group and/or a mercapto group.

[0027]

A synthetic resin emulsion (water dispersible resin) can be used as the component (A) in the present invention. By using such a synthetic resin emulsion, it is possible to improve ventilation property. It is also possible to utilize a texture of the below-mentioned particulate and concomitantly obtain a

plate-like cured product having excellent fire protection property and flexibility. For example, a mixture containing an acrylic resin emulsion having a dispersion peak within The temperature range  $T_1$  and a silicone resin emulsion having a dispersion peak within The temperature range  $T_2$  can be used as the component (A).

[0028]

It is also possible to use an acryl-silicone synthetic resin emulsion (A-1) in which component (a1) and component (a2) are concomitantly present in emulsion particles (hereinafter also referred to as a "component (A-1)"). There is no particular limitation on the form of component (a1) and component (a2) in the component (A-1), and a uniformly mixed form and preferably a form mutually separated by a sea-island structure may be used.

[0029]

Moreover, a synthetic resin emulsion (A-2) in which a graft polymer of the acrylic resin (a1) and silicone resin (a2) is present in emulsion particles is suitable as component (A) in the present invention. The component (A-2) can be obtained, for example, by emulsion polymerization of the siloxane compound, the (meth)acrylic acid ester and a grafting agent in the presence of an emulsifier.

[0030]

Furthermore, the component (A) in the present invention preferably forms a film having a reflection region in which

reflectance at a wavelength of 300 to 500 nm is 10% or more,  
and preferably 15% or more. When a photocatalytic metal oxide  
is contained as particulate, it is possible to improve the  
photocatalytic activity by using such component (A). Although  
5 the action mechanism is not clear, it is considered that this  
is because light irradiated onto the plate-like cured product  
of the present invention diffuses and reflects within the  
plate-like cured product, thereby allowing easy absorption of  
the light by the below-mentioned photocatalytic metal oxide  
10 dispersed in the plate-like cured product.

[0031]

The reflectance is a value measured using a  
spectrophotometer (UV-3100 manufactured by Shimadzu  
Corporation) after preparing a film by drying component (A) up  
15 to a film thickness of 0.1 mm as a sample, and placing a black  
plate at the back of the sample. In this case, the black plate  
placed at the back of the sample serves as a blank, and the value  
is a converted value. Specifically, the value is obtained by  
subtracting reflectance of the black plate from reflectance of  
20 the sample in each wavelength.

[0032]

(B) Particulate

In the present invention, particulate (B) are contained  
in an amount of 200 to 4,000 parts by weight, preferably from  
25 300 to 3,500 parts by weight, and more preferably from 500 to

3,000 parts by weight, based on 100 parts by weight of the component (A). The particulate preferably contains at least a colored aggregate (b1) and moisture absorption and desorption powder (b2).

5 [0033]

The colored aggregate (b1) (hereinafter also referred to as a "component (b1)") confers fine concavity and convexity on a surface of a plate-like cured product, and can represent a steric design having a shade feeling. Also, unlike in the  
10 case of using a colored pigment and the like having a small particle diameter, tone, texture and the like can be changed by mixing colored particles, and small spots of component (b1) present on a surface of a plate-like cured product are visually recognized as a multicolor pattern, thereby providing excellent decorative  
15 property. There is no particular limitation on the component (b1) suited for use in the present invention, and it is possible to use both natural products and artificial products.

Specifically, colored aggregates include, for example, ground products of heavy calcium carbonate, marble powder, kaolin, clay,  
20 pot clay, china clay, talc, aluminum hydroxide, magnesium hydroxide, barite powder, marble, granite powder, serpentine, granite, fluorite, marble powder, feldspar, silica stone, silica sand and the like; ground products of porcelains; ground products of ceramics; glass beads; ground products of glasses; resin

beads; ground products of resins; metal particles; and the like.  
Also, these materials can be used after carrying out coloration.

[0034]

The average particle diameter of component (b1) is  
5 desirably 0.01 to 5 mm. When the size is within such a range,  
excellent design can be represented, and concomitantly, a  
plate-like cured product can be produced stably. The average  
particle diameter of component (b1) is a value obtained by  
screening particles using metallic mesh sieves defined in JIS  
10 Z8801-1: 2,000, and calculating an average value of weight  
distribution of the particles.

[0035]

The amount of component (b1) mixed is preferably from 200  
to 3,400 parts by weight, more preferably from 300 to 2,000 parts  
15 by weight, and still more preferably from 500 to 1,500 parts  
by weight, based on 100 parts by weight of solid content of  
component (A). By containing component (b1) in a large amount  
as shown by the range, based on component (A), it is possible  
to obtain excellent design making use of a texture of aggregate,  
20 and also to improve ventilation property.

[0036]

As moisture absorption and desorption powder (b2)  
(hereinafter also referred to as a "component (b2)"), for example,  
boehmite, silica gel, zeolite, sodium sulfate, alumina,  
25 allophane, diatomaceous earth, siliceous shale, sepiolite,

attapulgit, montmorillonite, xonolite, imogolite, Oya tuff  
stone powder, activated clay, charcoal, bamboo charcoal,  
activated carbon, wood flour, shell flour, porous synthetic resin  
particles and the like can be used. The average particle diameter  
5 of the moisture absorption and desorption particulate is usually  
from 0.001 to 1 mm, preferably from 0.01 to 0.5 mm, more preferably  
from 0.01 to 0.1 mm, and still more preferably from 0.01 to 0.09  
mm. The average particle diameter of the component (b2) is a  
value of 50% particle diameter measured by a sedimentation type  
10 particle diameter distribution measurement device.

[0037]

Such component (b2) has moisture absorptivity of usually  
10% or more and preferably 20% or more, at a temperature of 20°C  
and a relative humidity of 90%. By having such moisture  
15 absorptivity, it is possible to further improve a function such  
as suppression of an uncomfortable feeling by adjustment of  
humidity and to obtain a more comfortable living space. It is  
also possible to prevent condensation, mold development and the  
like on a base material and a back side of the base material.

20 [0038]

The constitution ratio of component (b2) is preferably  
from 1 to 600 parts by weight, more preferably from 5 to 500  
parts by weight, and still more preferably from 10 to 300 parts  
by weight, based on 100 parts by weight (solid content) of  
25 component (A). When the constitution ratio is within such a

range, it is possible to exhibit a sufficient humidity conditioning property, and concomitantly to have excellent strength and flexibility.

[0039]

5           Moreover, in the present invention, particulate (B) preferably contains a photocatalytic metal oxide (b3) (hereinafter also referred to as a "component (b3)"). The photocatalytic substance is a component effective for decomposition and prevention of re-release of a toxic gas. Also, 10 the photocatalytic substance has a capability to decompose a contamination substance (tar of tobacco, etc.) adhered on a plate-like cured product. Furthermore, in the present invention, component (b3) showing a photocatalytic action in a reflection region in which reflectance of a film formed by 15 component (A) is 10% or more at a wavelength of 300 to 500 nm (hereinafter also referred to as a "reflection region" simply) is preferably used. By containing such component (b3), it is possible to exhibit a photocatalytic activity efficiently. The photocatalytic action in the present invention means an action 20 in which a catalyst absorbs and excites light (ultraviolet light and/or visible light) by exposure of the catalyst to the light, hydroxyl radicals and active oxygen are generated by oxidation and reduction of excited electrons and positive holes produced in the step, and the hydroxyl radicals and active oxygen decompose 25 organic substances.

[0040]

Such component (b3) includes metal oxides such as titanium oxide, tin oxide, zinc oxide, ferric oxide, dibismuth trioxide and tungsten trioxide or composite oxides thereof. One or two  
5 or more of these oxides may be used. The average particle diameter of the component (b3) is 0.3  $\mu\text{m}$  or less, and preferably 0.1  $\mu\text{m}$  or more and 0.25  $\mu\text{m}$  or less. When a photocatalytic metal oxide in the range is used, an excellent photocatalytic action is obtained, and a texture of an aggregate of a plate-like cured  
10 product can be utilized. The average particle diameter is obtained by measurement using a centrifugal sedimentation method and the like.

[0041]

In particular, titanium oxide is preferably used as the  
15 component (b3) of the present invention. The titanium oxide may be either anatase-type titanium oxide or rutile-type titanium oxide, and anatase-type titanium oxide is preferably used in the present invention. When titanium oxide is used as the component (b3), it is superior in photocatalytic action, and  
20 a gross calorific value in case of fire can be suppressed and fire protection property can be improved. It is supposed as the action mechanism that this is because titanium oxide can block radiation heat to suppress temperature increase of a plate-like cured product. Also, use of anatase-type titanium  
25 oxide further improves fire protection property. Although the

action mechanism is not clear, it is considered that this involves improvement of catalytic action of anatase-type titanium oxide by heating. It is also possible to reduce the amount of an exhaust gas by decomposition action of anatase-type titanium oxide.

5 Moreover, anatase-type titanium oxide has a low masking effect of a coated film as compared with rutile-type titanium oxide, and therefore, it is possible to further utilize a texture of an aggregate.

[0042]

10 The amount of component (b3) mixed is preferably from 0.05 to 30 parts by weight, more preferably from 0.1 to 25 parts by weight, and still more preferably from 0.5 to 20 parts by weight, based on 100 parts by weight of solid content of component (A). When the amount is within such a range, it is possible to exert  
15 excellent photocatalytic action and fire protection property.

[0043]

In the present invention, the particulate (B) preferably contains a chemical substance adsorbent (b4). Inclusion of the component (b4) is effective for adsorption and prevention of  
20 re-release of a toxic gas (for example, formaldehyde, ammonia, hydrogen sulfide, methyl mercaptan, trimethylamine, or the like). Examples of the component (b4) includes an amine compound, a urea compound, an amide compound, an imide compound, a hydrazide compound, an azole compounds, an azine compound, a layered  
25 phosphate compound, an aluminosilicate salt and the like. Among

them, one or more compounds selected from a layered phosphate compound and an aluminosilicate salt are suitably used. In particular, aluminosilicate salts are suitably used. The average particle diameter of such a chemical substance adsorbent  
5 is usually from about 0.5 to 100  $\mu\text{m}$  (preferably from 1 to 50  $\mu\text{m}$ ).

[0044]

Examples of the layered phosphate compound include a layered zirconium phosphate, a layered zinc phosphate, a layered  
10 titanium phosphate, a layered aluminum phosphate, a layered magnesium phosphate, layered cerium phosphate and the like. These layered phosphate compounds intercalated with an amine compound are suitably used. Examples of the amine compounds include methylamine, ethylamine, aniline, ethylenediamine,  
15 diethylenetriamine, triethylenetetramine, tetraethylenepentamine, pentaethylenehexamine, propylenediamine, dipropylenetriamine, tripropylenetetramine and the like.

[0045]

20 Examples of the aluminosilicate salt include a composite oxide composed of at least one metal selected from zinc, copper, silver, cobalt, nickel, iron, titanium, barium, tin and zirconium, aluminum and silicon.

[0046]

The amount of component (b4) mixed is preferably from 0.1 to 100 parts by weight, more preferably from 0.5 to 50 parts by weight, and still more preferably from 1 to 25 parts by weight, based on 100 parts by weight of solid content of component (A).

5 When the amount is within such a range, the component (b4) is effective for adsorption of a toxic gas.

[0047]

In the present invention, the component (b3) is particularly preferably used in combination with the component  
10 (b4). By using these components in combination, practical performances can be obtained in adsorption, decomposition and prevention of re-release of a toxic gas, and a toxic gas filtering effect can be imparted to a plate-like cured product. In the present invention, adsorption, decomposition and re-release  
15 preventing properties of an invading toxic gas can be obtained, in particular, in both sides of the indoor and base material.

[0048]

In the plate-like cured product of the present invention, it is also possible to mix or spread an aggregate (C) having  
20 an average particle diameter of more than 5 mm (hereinafter referred to as a component "(C)"), for the purpose of improving decorative property and the like. Examples of the component (C) suited for the present invention include ground products of genuine stone, silica stone, silica sand and the like, ground  
25 products of porcelains, ground products of ceramics, mica, shells,

ground products of glasses, glass beads, ground products of resins, resin beads, rubbers, plastics, plant fibers, plants such as plant pieces, metals such as alumina flakes, as well as products obtained by coloration coating of a surface of the materials.

[0049]

Known additives may be contained as needed, unless the effects of the present invention are remarkably impaired. Examples of the additive include a thickener, a film-forming auxiliary, a leveling agents, a wetting agent, a plasticizer, an antifreezing agent, a pH adjuster, an antiseptic agent, an anti-mold agent, an anti-algae agent, an antimicrobial agent, a deodorants, a dispersing agent, an antifoaming agent, an adsorbent, a flame retardants, a colored pigment, a extender pigments, a fiber, a water repellent, a cross-linkers, an ultraviolet absorbers, an antioxidants, a catalysts and the like.

[0050]

The plate-like cured product of the present invention may be laminated on a base material. There is no particular limitation on the base material, and examples thereof include gypsum boards, plywoods, concrete, mortar, tile, fiber mixing cement boards, cement calcium silicate boards, slag cement perlite boards, resin plates or sheets (film), woven fabrics, unwoven fabrics, paper and the like. In particular, a woven fabric or an unwoven fabric containing inorganic fibers, which

has a thickness of 0.05 to 1.5 mm (preferably from 0.1 to 1 mm, and more preferably from 0.25 to 0.5 mm) and a basis weight of 5 to 300 g/m<sup>2</sup> (preferably from 10 to 200 g/m<sup>2</sup>, and more preferably from 20 to 100 g/m<sup>2</sup>), is preferably used in the present invention.

5 Examples of the fabric include a woven fabric, an unwoven fabric or the like composed of inorganic fibers such as mineral fibers and glass fibers. In particular, in the present invention, a fabric having flexibility is preferably used, and an unwoven fabric having a structure in which fibers are overlaid  
10 three-dimensionally is further preferably used.

[0051]

It is also possible to use a base material prepared by laminating glass mesh, glass cloth or the like on a woven fabric or an unwoven fabric. When a base material within the range  
15 is used, contact interface with a plate-like cured product becomes larger, thereby giving excellent adhesion. Moreover, when applied on a wall surface and the like, a plate-like cured product can be supported stably because the base material contains inorganic fibers. Therefore, properties preventing  
20 peeling, warpage and dropout of a plate-like cured product in case of fire are improved, resulting in excellent fire protection property and flameproof property. Since the base material and a particular plate-like cured product are laminated, it is possible to easily cut the laminate in any shape in case of

application, and to appropriately carry out small treatment of a cut surface.

[0052]

There is no particular limitation on a method for producing the plate-like cured product of the present invention. For example, the product can be produced by a production method including the following steps. According to the method, an objective plate-like cured product can be produced stably, and the method is also suitable from the viewpoint of expression of effects.

[0053]

The method includes the first step of molding a composition for a cured product prepared by mixing 200 to 4,000 parts by weight of particulate (B) based on 100 parts by weight of synthetic resin (A) in a weight ratio of the solid content (hereinafter also referred to as a "composition for cured product") in the form of a plate-like shape, and the second step of curing the molded product at a temperature ( $T_3$ ) higher than a dispersion peak temperature ( $T_1$ ) of the component (A). (The component (A) has a dispersion peak of loss tangent ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer, in at least two temperature ranges of  $-20^\circ\text{C}$  to  $80^\circ\text{C}$  ( $T_1$ ) and  $-150^\circ\text{C}$  to  $-100^\circ\text{C}$  ( $T_2$ ), respectively.)

[0054]

By curing the molded product at a temperature ( $T_3$ ) higher than a dispersion peak temperature ( $T_1$ ) of component (A) in the second step, effects of the plate-like cured product of the present invention become easier to be expressed. Although the  
5 action mechanism is not clear, when curing at the temperature ( $T_3$ ), a resin component having a dispersion peak within temperature range ( $T_2$ ) becomes easier to orient toward a surface of a plate-like cured product. It is considered that effects superior in fire protection property, contamination resistance  
10 and the like are exhibited as a result of the action.

[0055]

In the first step, there is no particular limitation on the method for molding a plate-like cured product. For example, the product may be molded using a mold having releasability and  
15 the like. When the base material is laminated on a plate-like cured product, the lamination may be carried out, for example, by the following methods:

(1) a method in which a composition for a plate-like cured product is laminated on a base material, and then dried and cured,  
20 and

(2) a method in which a plate-like cured product is molded using a mold and a base material is laminated.

[0056]

When a composition for a cured product is laminated in  
25 the (1), for example, methods using means such as spray, roller,

trowel, brush coating, reciprocating, coater and pouring can be employed. In this case, when the viscosity of a composition for a cured product is set within a range from about 5 to 100 Pa·s, the objective laminated product can be obtained easily.

5 The viscosity is that measured using a BH-type viscosimeter at 20 rpm and a measurement temperature of 23°C.

[0057]

Molds used in (2) include, for example, those produced using a silicone resin, a urethane resin, a metal and the like  
10 or those provided with a release paper. Examples of the method for laminating a base material include:

(I) a method in which a composition for a cured product is poured into a mold, dried and demolded to form a plate-like cured product, and a base material is then laminated using an  
15 adhesive and the like;

(II) a method in which a composition for a cured product is poured into a mold, a base material is laminated before the composition for a plate-like cured product is dried, and the composite is then dried and demolded.

20 When a composition for a cured product is poured in (I) and (II), a method similar to a laminating method in (1) can be adopted.

[0058]

In (1) and (2), the thickness of a plate-like cured product  
25 is preferably 1.0 mm or more and 5.0 mm or less. In such a case,

it is also possible to form a concavo-convex pattern which is superior in fire protection property and has deep incisions, and therefore, excellent design having shades and a full-bodied texture can be obtained. The thickness of a plate-like cured product does not contain that of a base material.

[0059]

For example, a reinforcement material (ceramic paper, synthetic paper, glass cloth or mesh, etc.) can be laminated, a concavo-convex pattern can be formed and a decorative material can be spread for the purpose of improving decorative property and the like, unless effects of the present invention are inhibited. Examples of the decorative materials include colored aggregates, mica, shells, plants, alumina flakes, glass flakes, metals, or rubbers, plastics and the like.

[0060]

For example, when production is carried out using a method of the (1), forming of a concavo-convex pattern and spreading of a decorative material may be carried out before curing of a composition for a cured product. The forming of a concavo-convex pattern can be carried out by a method using trowel, embossing, roller and the like, and the spreading of a decorative material can be carried out using a known or commercially available spreader and the like. When production is carried out using a method of the (2), the forming of a concavo-convex pattern can be carried out by conditioning the shape of the inside

of a mold since a mold side becomes a surface of a plate-like cured product. When a decorative material is spread, a decorative material may be scattered on the bottom in a mold using a known or commercially available spreader and the like, and subsequently, a composition for a plate-like cured product may be poured.

[0061]

Moreover, it is also possible to laminate an overcoat layer for the purpose of improving surface protection property and the like of a plate-like cured product, unless effects of the present invention are remarkably inhibited. The overcoat layer may be a layer (clear layer) having moisture permeability and transparency. In such a case, a design (hue) of the plate-like cured product can be utilized as it is, and effects such as ventilation property and fire protection property can be exerted. The overcoat layer may be a colored clear layer in which various pigments are added within a range having transparency. Such an overcoat layer can be formed by application of a known aqueous type or solvent-type coating material. In the present invention, an emulsion-type coating material containing colloidal silica is preferably used. In this case, it is possible to improve surface strength, contamination resistance and the like. Inclusion of colloidal silica is also effective for the improvement of fire protection property, as compared with a known overcoating material.

[0062]

Examples of the emulsion containing the colloidal silica include a mixture of a synthetic resin emulsion and colloidal silica, a composite colloidal silica emulsion in which a synthetic resin emulsion and colloidal silica are chemically bonded, and the like. In the present invention, a composite colloidal silica emulsion is preferably used. There is no particular limitation on the synthetic resin emulsion, and an emulsion which does not impair effects of the present invention can be used suitably. The ratio of a synthetic resin component to colloidal silica in an emulsion containing colloidal silica is preferably from 95:5 to 40:60 in a weight ratio of the solid content. The particle diameter of colloidal silica is preferably from 10 nm to 100 nm. When the particle diameter is within the above range, it is possible to improve surface protection property and fire protection property of a plate-like cured product without inhibiting the effects of the present invention.

[0063]

The coating may be carried out by a known coating method, and coating instruments such as spray, coater, roller and brush can be used.

[0064]

The plate-like cured product of the present invention can be applied mainly as an interior material for buildings. Thus,

interior finishing can be carried out by attaching the product to various sites of interior surfaces of buildings.

Specifically, the product can be applied to walls, partitions, doors, ceilings and the like in houses, apartments, schools, hospitals, shops, offices, factories, warehouses, dining rooms and the like. Grounds constituting such sites include, for example, gypsum boards, plywoods, concrete, mortar, tile, fiber mixing cement boards, cement calcium silicate boards, slag cement pearlite boards and the like. These grounds may be those having an existing coated film on their surfaces, those already having a wallpaper attached. The plate-like cured product of the present invention is applied to such grounds so that the plate-like cured product is directed toward an indoor side.

[0065]

When the plate-like cured product of the present invention is applied, the product may be attached to a base material using an adhesive, a sticking agent, an adhesive tape, nails, tacks and the like. Alternatively, it is also possible to immobilize using pins, fasteners, rails and the like. Among these, the plate-like cured product of the present invention is preferably attached to a ground using an adhesive.

[0066]

There is no particular limitation on the adhesive, and known adhesives may be used. There is no particular limitation on the synthetic resin used in the adhesives, and examples thereof

include water soluble and water dispersible type resins, such as an ethylene resin, a vinyl acetate resin, a polyester resin, an alkyd resin, a vinyl chloride resin, an epoxy resin, an acrylic resin, a urethane resin, a phenol resin, a melamine resin, an amino resin, a polycarbonate resin, an acrylic silicone resin, a vinyl acetate acrylic resin, an acrylic styrene resin, an acrylic urethane resin, a silicone resin and a fluorine resin. These resins can be used alone, or two or more kinds can be used in combination.

10 [0067]

In order to confer various properties such as working property, finishing property, adhesive strength and fire protection property, powder components, hollow particles, porous particles, fibers and the like may be added, and as needed, usually used additives such as coloration materials, extender pigments, dispersing agents, viscosity adjusters, antifoaming agents, anti-mold agents, antiseptic agents and anti-algae agents may be appropriately added.

[0068]

20 When a plate-like cured product is attached using an adhesive, adjacent plate-like cured products may be attached with each other in a butted manner, or joints may be provided between the plate-like cured products. When the products are attached in a butted manner, it is preferable to prevent  
25 protrusion of an adhesive. When joints are provided, there is

no limitation on interval in case of attachment of plate-like cured products, and the interval may be about 1 mm to 30 mm. When the interval is within the above range, an interior finishing utilizing joint patterns can be carried out. An adhesive can be exposed between plate-like cured products, and joint portions can be formed easily. An adhesive in joint portions may be subjected to a smoothing treatment using a paddle and the like, as needed. Atmospheric temperature in case of curing of an adhesive can be appropriately set, and may be usually a normal temperature.

#### EXAMPLES

[0069]

Examples are shown below, and the features of the present invention are further described.

[0070]

<Synthetic resin A>

(Synthetic resin 1 to synthetic resin 3)

Graft copolymerization was carried out using t-butyl methacrylate, n-butyl acrylate, 2-ethylhexyl acrylate, methyl methacrylate,  $\gamma$ -methacryloyloxypropyltrimethoxysilane, hexamethylcyclotrisiloxane, octamethylcyclotetrasiloxane, and decamethylcyclopentasiloxane as constituent components to prepare acryl-silicone graft copolymerization type of synthetic

resin emulsions. These were designated as synthetic resins 1 to 3. Each synthetic resin has the following characteristics.

Synthetic resin 1:

Weight ratio of solid content of acryl component to  
5 silicone component: 80:20

DMS dispersion peak temperature: 55°C, -130°C

Solid content: 50% by weight

Synthetic resin 2:

Weight ratio of solid content of acryl component to  
10 silicone component: 80:20

DMS dispersion peak temperature: 75°C, -130°C

Solid content: 50% by weight

Synthetic resin 3:

Weight ratio of acryl component to silicone component:  
15 90:10

DMS dispersion peak temperature: 55°C, -130°C

Solid content: 50% by weight

[0071]

(Synthetic resin 4 to synthetic resin 6)

20 An acrylic resin emulsion and a silicone resin emulsion  
as shown below were mixed to obtain synthetic resins 4 to 6.

Acrylic resin emulsion (constituent components: t-butyl methacrylate, n-butyl acrylate, 2-ethylhexyl acrylate, methyl methacrylate), solid content: 50% by weight

Silicone resin emulsion (emulsified dispersion of dimethylsiloxane compound), solid content: 50% by weight

Synthetic resin 4: Acrylic resin emulsion: silicone resin emulsion (weight ratio of solid content) = 80:20, DMS dispersion

5 peak temperature: 55°C, -130°C

Synthetic resin 5: Acrylic resin emulsion: silicone resin emulsion (weight ratio of solid content) = 50:50, DMS dispersion peak temperature: 55°C, -130°C

Synthetic resin 6: Acrylic resin emulsion: silicone resin  
10 emulsion (weight ratio of solid content) = 90:10, DMS dispersion peak temperature: 55°C, -130°C

[0072]

Synthetic resin 7:

Acrylic resin emulsion (constituent components: t-butyl  
15 methacrylate, n-butyl acrylate, 2-ethylhexyl acrylate, methyl methacrylate),

Solid content: 50% by weight

DMS dispersion peak temperature: 55°C

[0073]

20 The synthetic resins 1 to 7 were coated on a release paper and dried to prepare films having a thickness of 0.1 mm. The films were used as a sample and film reflectance was measured. The film reflectance was measured using a spectrophotometer (UV-3100 manufactured by Shimadzu Corporation). The results  
25 are shown in Table 1.

[0074]

As a result, it was found that synthetic resins 1, 2, 4, 5 and 6 have a region in which ultraviolet light reflectance is 10% or more, in a wavelength region of 300 nm to 500 nm. Also, it was found that synthetic resin 3 has a region in which ultraviolet light reflectance is 10% or less, in a wavelength region of 400 nm or more, and a region in which ultraviolet light reflectance is 10% or more, in a wavelength region of less than 400 nm. On the other hand, synthetic resin 7 had ultraviolet reflectance of less than 10% in the wavelength region. As representative values, ultraviolet reflectance values at a wavelength of 380 nm, 400 nm and 500 nm are shown in Table 1.

[0075]

[Table 1]

| Synthetic resin |        | 1    | 2    | 3    | 4    | 5    | 6    | 7   |
|-----------------|--------|------|------|------|------|------|------|-----|
| Reflectance (%) | 380 nm | 23.9 | 23.8 | 11.8 | 30.6 | 38.8 | 24.6 | 8.7 |
|                 | 400 nm | 20.3 | 20.2 | 8.2  | 27.0 | 33.9 | 20.7 | 6.8 |
|                 | 500 nm | 15.1 | 15.3 | 6.9  | 22.7 | 27.4 | 16.2 | 6.6 |

15

[0076]

(Production of Plate-Like Cured Product)

According to the formulations as shown in Table 2 and Table 3, compositions 1 to 14 for cured product were prepared by mixing and stirring raw materials using a conventional method. The following substances were used as raw materials.

20

[0077]

(B) Particulate

Component (b1)

Aggregate 1: colored silica sand (pale yellow, average particle diameter: 80 to 120  $\mu\text{m}$ )

5        Aggregate 2: heavy calcium carbonate (average particle diameter: 50 to 150  $\mu\text{m}$ )

Component (b2)

Moisture absorption and desorption powder: silica gel (average particle diameter: 20  $\mu\text{m}$ , bulk specific gravity: 0.30 g/ml, moisture absorptivity: 80% (20°C, 90% RH atmosphere))

Component (b3)

Photocatalytic oxide 1: ultraviolet-responsive anatase-type titanium oxide (exciting wavelength: 200 to 380 nm, average particle diameter: 0.2  $\mu\text{m}$ )

15        Photocatalytic oxide 2: visible light-responsive anatase-type titanium oxide (exciting wavelength: 400 to 650 nm, average particle diameter: 15 nm)

Component (b4)

Chemical substance adsorbent: zinc aluminosilicate (average particle diameter: 3  $\mu\text{m}$ )

(Additive)

Thickener (hydroxyethyl cellulose, urethane associative thickener), water

[0078]

25    [Table 2]

| Composition for cured product                                |                                           | 1                 | 2                 | 3                 | 4                 | 5                 | 6                 | 7                 |
|--------------------------------------------------------------|-------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Synthetic resin                                              |                                           | Synthetic resin 1 | Synthetic resin 2 | Synthetic resin 3 | Synthetic resin 4 | Synthetic resin 5 | Synthetic resin 6 | Synthetic resin 1 |
|                                                              |                                           | 100               | 100               | 100               | 100               | 100               | 100               | 100               |
| Particulate                                                  | Aggregate 1                               | 1100              | 1100              | 1100              | 1100              | 1100              | 1100              | 300               |
|                                                              | Aggregate 2                               | 200               | 200               | 200               | 200               | 200               | 200               | 100               |
|                                                              | Moisture absorption and desorption powder | 60                | 60                | 60                | 60                | 60                | 60                | 60                |
|                                                              | Photocatalytic metal oxide 1              | 5                 | 5                 | 5                 | 5                 | 5                 | 5                 | 5                 |
|                                                              | Photocatalytic metal oxide 2              | -                 | -                 | -                 | -                 | -                 | -                 | -                 |
|                                                              | Chemical substance adsorbent              | 10                | 10                | 10                | 10                | 10                | 10                | 10                |
| Additive                                                     |                                           | 20                | 20                | 20                | 20                | 20                | 20                | 20                |
| Synthetic resin: particulate (weight ratio of solid content) |                                           | 100: 1375         | 100: 1375         | 100: 1375         | 100: 1375         | 100: 1375         | 100: 1375         | 100: 475          |

[0079]

[Table 3]

| Composition for cured product                                |                                           | 8                 | 9                 | 10                | 11                | 12                | 13                | 14                |
|--------------------------------------------------------------|-------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Synthetic resin                                              |                                           | Synthetic resin 1 | Synthetic resin 1 | Synthetic resin 3 | Synthetic resin 1 | Synthetic resin 1 | Synthetic resin 7 | Synthetic resin 1 |
|                                                              |                                           | 100               | 100               | 100               | 100               | 100               | 100               | 100               |
| Particulate                                                  | Aggregate 1                               | 180               | 1100              | 1100              | 1100              | 1100              | 1100              | 70                |
|                                                              | Aggregate 2                               | 40                | 200               | 200               | 200               | 200               | 200               | 50                |
|                                                              | Moisture absorption and desorption powder | 60                | 60                | 60                | 60                | 60                | 60                | 60                |
|                                                              | Photocatalytic metal oxide 1              | 5                 | -                 | -                 | 0.1               | -                 | 5                 | 5                 |
|                                                              | Photocatalytic metal oxide 2              | -                 | 5                 | 5                 | -                 | -                 | -                 | -                 |
|                                                              | Chemical substance adsorbent              | 10                | 10                | 10                | 10                | 10                | 10                | 10                |
| Additive                                                     |                                           | 20                | 20                | 20                | 20                | 20                | 20                | 20                |
| Synthetic resin: particulate (weight ratio of solid content) |                                           | 100: 295          | 100: 1375         | 100: 1375         | 100: 1370.1       | 100: 1370         | 100: 1375         | 100: 195          |

[0080]

(Test Examples 1 to 14)

5 Compositions 1 to 14 for cured product were poured into a silicone mold so as to give a dried film thickness of 2 mm, dried at 100°C for 30 minutes and demolded to obtain plate-like cured products 1 to 14.

[0081]

10 Then, 40 mm × 10 mm (thickness: 2 mm) samples were cut out from each of the plate-like cured products, and used as a test sample for DMS measurement. Dispersion peak temperature

of loss tangent ( $\tan\delta$ ) was measured using DMS6100 manufactured by Seiko Instruments Inc. under conditions of measurement temperature range:  $-150^{\circ}\text{C}$  to  $80^{\circ}\text{C}$ , temperature raising rate:  $4^{\circ}\text{C}/\text{min}$ , and measurement frequency: 1 Hz, and the measurement results are shown in Table 4.

[0082]

[Table 4]

| Test Example                                           | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13 | 14   |
|--------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|----|------|
| Composition for cured product                          | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13 | 14   |
| DMS dispersion peak temperature ( $^{\circ}\text{C}$ ) | 60   | 80   | 60   | 60   | 60   | 60   | 60   | 60   | 60   | 60   | 60   | 60   | 60 | 60   |
|                                                        | -120 | -120 | -120 | -120 | -120 | -120 | -120 | -120 | -120 | -120 | -120 | -120 | -  | -120 |

[0083]

## 10 Evaluation A

The compositions 1 to 14 for plate-like cured products were applied on a base material (glass unwoven fabric: thickness  $0.4\text{ mm}$ , basis weight  $50\text{ g}/\text{m}^2$ ) so as to give a thickness of a dried plate-like cured product of  $2\text{ mm}$ , and dried at  $100^{\circ}\text{C}$  for 30 minutes to obtain laminated products 1A to 14A of the plate-like cured products.

[0084]

Evaluation of design, fire protection property, flexibility and ventilation property was carried out on each laminated product. The results are shown in Table 5.

[0085]

<Evaluation of Design>

Texture and concealing property by an aggregate of plate-like cured products of laminated products 1A to 14A were visually evaluated. Four-grade evaluation was carried out.

- 5 Test samples with satisfactory texture and concealing property of the aggregate are rated "A", while test samples with insufficient texture and concealing property of the aggregate are rated "D" (excellent: A > B > C > D: Poor).

[0086]

10 <Evaluation of Fire Protection Property>

A gypsum board measuring 100 mm × 100 mm × 12.5 mm was used as a base material for testing, an adhesive material was applied on the base material, each of laminated products 1A to 14A was attached thereonto, and curing was carried out at 23°C

- 15 under 50 ± 10%RH for 24 hours to obtain test samples.

[0087]

Regarding test samples, gross calorific value was measured using a cone calorimeter prescribed in ISO5660 after 20 minutes.

- The cone calorimeter used was "CONE2A" (manufactured by Atlas  
20 Electric Devices Company), and heating strength was 50 kW/m<sup>2</sup>.

Evaluation criteria of a pyrogenetic test are as follows.

A: Total calorie for heating time of 20 minutes is 6.0 MJ/m<sup>2</sup> or less

- B: Total calorie for heating time of 20 minutes is more  
25 than 6.0 MJ/m<sup>2</sup> and 8.0 MJ/m<sup>2</sup> or less

C: Total calorie for heating time of 20 minutes is more than  $8.0 \text{ MJ/m}^2$  and  $10.0 \text{ MJ/m}^2$  or less

D: Total calorie for heating time of 20 minutes is more than  $10.0 \text{ MJ/m}^2$  and  $12.0 \text{ MJ/m}^2$  or less

5 E: Total calorie for heating time of 20 minutes is more than  $12.0 \text{ MJ/m}^2$

[0088]

#### <Evaluation of Flexibility>

10 An aluminum plate measuring  $70 \text{ mm} \times 150 \text{ mm} \times 0.8 \text{ mm}$  was used as a base material for testing, an adhesive material was applied on the base material, each of laminated products 1A to 14A was attached on it, and curing was carried out at  $23^\circ\text{C}$  under  $50 \pm 10\% \text{RH}$  for 24 hours to obtain test samples. A copper bar having a diameter of 10 mm was placed roughly on the center of

15 the back side of a test sample, the piece was bent so that the surface of a plate-like cured product faced outward, and an angle at which cracks were generated on the surface was evaluated.

[0089]

#### <Evaluation of Moisture Absorbency 1>

20 A gypsum board measuring  $100 \text{ mm} \times 100 \text{ mm} \times 12.5 \text{ mm}$  was used as a base material for testing, an adhesive material was applied on the base material, each of laminated products 1A to 14A was attached on it, and curing was carried out at  $23^\circ\text{C}$  under  $50 \pm 10\% \text{RH}$  for 24 hours to obtain test samples. Each test sample

25 was left to stand at  $23^\circ\text{C}$  under 90% RH atmosphere, and the amount

of moisture absorbed after 24 hours was evaluated ( $\text{g/m}^2$ ).  
Evaluation criteria of moisture absorbency are as follows.

A:  $100 \text{ g/m}^2$  or more

B:  $90 \text{ g/m}^2$  or more and less than  $100 \text{ g/m}^2$

5 C: less than  $90 \text{ g/m}^2$

The adhesive material was prepared by uniformly stirring and mixing synthetic resin 1, titanium oxide, heavy calcium carbonate, a dispersing agent, a thickener, an antifoaming agent, and water.

10 [0090]

[Table 5]

| Test Example                  | 1A | 2A | 3A | 4A | 5A | 6A | 7A | 8A | 9A | 10A | 11A | 12A | 13A | 14A |
|-------------------------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|
| Composition for cured product | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10  | 11  | 12  | 13  | 14  |
| Design                        | A  | A  | A  | A  | B  | A  | B  | C  | A  | A   | A   | A   | A   | D   |
| Fire protection property      | A  | A  | B  | C  | B  | C  | C  | D  | A  | B   | B   | B   | E   | E   |
| Flexibility ( $^\circ$ )      | 40 | 40 | 30 | 40 | 50 | 30 | 50 | 60 | 40 | 40  | 40  | 40  | 30  | 40  |
| Moisture absorbency 1         | A  | A  | A  | A  | A  | A  | B  | B  | A  | A   | A   | A   | B   | C   |

[0091]

Next, the following evaluations were carried out.

15 [0092]

Evaluation B

The compositions 1 to 14 for cured product were applied on a base material (glass unwoven fabric: thickness  $0.4 \text{ mm}$ , basis weight  $50 \text{ g/m}^2$ ) so as to give a thickness of a dried plate-like

cured product of 2 mm, and dried at a temperature as shown in Tables 6 and 7 for 30 minutes to obtain laminated products 1B to 16B of the plate-like cured products.

[0093]

5 <Evaluation of Staining Property 1>

Coffee was brush-coated on the surface of laminated products 1B to 16B, the surface was wiped off with a wetted waste after 5 minutes, and staining property was visually evaluated. Four-grade evaluation was carried out. Test samples where stains were removed are rated "A", while test samples where stains remarkably remained are rated "D" (excellent: A > B > C > D: Poor).

[0094]

<Evaluation of Moisture Absorbency 2>

15 Test pieces were prepared in the same manner as in evaluation of moisture absorbency 1, except that each laminated product after evaluation in "evaluation of staining property 1" was used. Each test sample was allowed to stand at 23°C under 90% RH atmosphere, and the amount of moisture absorbed after 20 24 hours was evaluated ( $\text{g/m}^2$ ). Evaluation criteria of moisture absorbency are the same as in "evaluation of moisture absorbency 1".

[0095]

[Table 6]

| Test Example                              | 1B  | 2B  | 3B  | 4B  | 5B  | 6B  | 7B  | 8B  |
|-------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Composition for cured product             | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   |
| Drying temperature (°C)                   | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Staining property 1                       | A   | A   | B   | C   | D   | C   | A   | A   |
| Moisture absorbency 2 (g/m <sup>2</sup> ) | A   | A   | A   | B   | C   | B   | B   | B   |

[0096]

[Table 7]

| Test Example                              | 9B  | 10B | 11B | 12B | 13B | 14B | 15B | 16B |
|-------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Composition for cured product             | 9   | 10  | 11  | 12  | 1   | 1   | 13  | 14  |
| Drying temperature (°C)                   | 100 | 100 | 100 | 100 | 23  | 5   | 100 | 100 |
| Staining property 1                       | A   | A   | A   | A   | B   | C   | C   | A   |
| Moisture absorbency 2 (g/m <sup>2</sup> ) | A   | A   | A   | A   | B   | B   | B   | C   |

5

[0097]

Next, the following evaluations were carried out.

[0098]

## Evaluation C

10 The compositions 1 to 6 and 9 to 13 for cured product were applied on a base material (glass unwoven fabric: thickness 0.4 mm, basis weight 50 g/m<sup>2</sup>) so as to give a thickness of a dried

plate-like cured product of 2 mm, and dried at 100°C for 30 minutes to obtain laminated products 1C to 11C of the plate-like cured products.

[0099]

#### 5 <Photocatalytic Action Test>

Each laminated product was used as a test sample, and a solution prepared by adding 2% of sodium hydroxide to an ethanol solution containing 1.0 wt% phenolphthalein applied on the surface of the test sample. Subsequently, the test sample was  
10 exposed to sunlight (wavelength region: 305 to 4,045 nm) for 36 hours in total, and color difference before and after the exposure was measured. Decomposition of phenolphthalein by the action of a photocatalyst was evaluated on the basis of a color difference  $\Delta E$ . In this regard, measurement of color difference  
15 was carried out using a colorimeter (CM-3700d, manufactured by Minolta Co., Ltd.).

Evaluation criteria of a photocatalytic action test are as follows.

A:  $6 \leq \Delta E$

20 B:  $5 < \Delta E < 6$

C:  $\Delta E \leq 5$

[0100]

[Table 8]

| Test Example                  | 1C | 2C | 3C | 4C | 5C | 6C | 7C | 8C | 9C | 10C | 11C |
|-------------------------------|----|----|----|----|----|----|----|----|----|-----|-----|
| Composition for cured product | 1  | 2  | 3  | 4  | 5  | 6  | 9  | 10 | 11 | 12  | 13  |
| Photocatalytic action         | A  | A  | A  | A  | A  | A  | A  | B  | B  | C   | C   |

## CLAIMS

1. A plate-like cured product comprising a synthetic resin and a particulate, wherein

5 the plate-like cured product contains 200 to 4,000 parts by weight of the particulate based on 100 parts by weight of the synthetic resin in a weight ratio of the solid content, and

the plate-like cured product has a dispersion peak of loss tangent ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer,  
10 in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively.

2. The plate-like cured product according to claim 1, wherein the synthetic resin has a dispersion peak of loss tangent  
15 ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer, in at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively.

3. The plate-like cured product according to claim 1 or  
20 2, wherein the synthetic resin contains an acrylic resin and a silicone resin in a weight ratio of the solid content of 95:5 to 30:70.

4. The plate-like cured product according to any one of claims 1 to 3, wherein the synthetic resin is a graft polymer of an acrylic resin and a silicone resin.

5 5. The plate-like cured product according to any one of claims 1 to 4, wherein the particulate contains a colored aggregate and moisture absorption and desorption powder.

10 6. The plate-like cured product according to any one of claims 1 to 5, which further includes a photocatalytic metal oxide as the particulate.

15 7. The plate-like cured product according to any one of claims 1 to 6, which further includes a chemical substance adsorbent as the particulate.

8. A plate-like cured product comprising the cured product according to any one of claims 1 to 7 and a moisture permeable overcoat layer laminated on the cured product.

20

9. A method for producing a plate-like cured product comprising a synthetic resin and a particulate, wherein the synthetic resin has a dispersion peak of loss tangent ( $\tan\delta$ ), measured using a dynamic mechanical spectrometer, in

at least two temperature ranges of  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  ( $T_1$ ) and  $-150^{\circ}\text{C}$  to  $-100^{\circ}\text{C}$  ( $T_2$ ), respectively,

the method comprising:

5 a first step of mixing 200 to 4,000 parts by weight of the particulate based on 100 parts by weight of the synthetic resin in a weight ratio of the solid content, and molding the mixture, and

a second step of curing the molded product at a temperature higher than the dispersion peak temperature ( $T_1$ ) of the synthetic  
10 resin.