

[Description]

[Title of Invention] RESIN COMPOSITION, SURFACE TREATMENT METHOD,
AND METHOD FOR PRODUCING CURED-COATING-FILM-CONTAINING
MATERIAL

5 [Technical Field]

[0001]

The present invention relates to a resin composition, a surface treatment method, and
a method for producing a cured-coating-film-containing material.

This application claims priority based on Japanese Patent Application No. 2022-
10 106215 filed on June 30, 2022, the contents of which are hereby incorporated herein.

[Background Technology]

[0002]

Resin-containing concrete and resin-containing mortar containing resin are used for
lining, paint, putty, adhesives, etc., in applications such as rooftop waterproofing, water
15 supply and sewerage systems, verandas, hallways, pools, roads, and water receiving tanks.

It is desirable that the above resins required for the above applications have the following
characteristics (I) - (III). (I) Maintaining high elongation against vibration of a structure,
cracking of underlying concrete or mortar, and impact from falling objects. (II) Having
alkaline-resistance to Ca(OH)_2 etc., oozing from the underlying concrete to which a
20 waterproofing layer comes into contact, in addition to the waterproofing layer sufficiently
following the underlying concrete. (III) Furthermore, having high adhesion to a base. If
the waterproofing layer cannot sufficiently follow the stress against the elongation of the
underlying concrete, cracks will occur in the waterproofing layer, causing it to peel off from
the underlying concrete or to allow water to enter. When water comes into contact with
25 concrete, Ca(OH)_2 oozes out and further degrades the waterproofing layer.

[0003]

In particular, in the case of sewerage systems, a base part of concrete structures in sewerage treatment facilities is sulfated by hydrogen sulfide produced by sulfur-oxidizing bacteria, and due to long-term use, the surface becomes brittle, which affects the structural strength of the facilities.

[0004]

In a repair method of aging sewerage treatment facilities, the following method is usually used: a cross section repair material is applied to a deteriorated layer thickness of a wall of the existing deteriorated concrete structure, after curing, a primer is applied, and then a base adjustment material is applied to a resin lining material for the purpose of unevenness adjustment. In addition, in the case of new construction of a structure, a method is used in which a primer is applied to a concrete base, then a base adjusting material is applied for the purpose of unevenness adjustment, and then an anticorrosion coating resin lining material is applied.

[0005]

Unsaturated polyester resin compositions have conventionally been used as curable resin compositions used for the above coating-type resin linings. Recently, resin compositions containing epoxy (meth)acrylate (generally referred to as "vinyl ester resin compositions"), which are obtained by reacting an unsaturated monobasic acid, especially acrylic or methacrylic acid, with an epoxy resin, have also been used.

[0006]

Styrene monomer is generally used as a reactive diluent (monomer) in the well-known unsaturated polyester resin composition and vinyl ester resin composition used for coating-type linings. However, this mixture of ester and styrene has a unique odor, which diffuses into the surrounding environment and causing a problem, so a method to adsorb

volatile styrene via activated carbon adsorption equipment has been introduced. In addition, styrene is classified as a Class I Designated Chemical Substance under the PRTR System (Chemical Substance Release and Management Promotion Act), and a system for disclosing the amounts released and transferred is applied. Furthermore, since styrene was designated as a specified chemical substance (the Ministry of Health, Labour and Welfare) on November 1, 2014, it is necessary to control it, and in addition, regulations on styrene concentration in styrene-containing unsaturated polyester resins and vinyl ester resins have become stricter; therefore, countermeasures are required.

[0007]

Furthermore, although unsaturated polyester resins generally have good rigidity and heat resistance, they lack elongation, water resistance, and alkaline resistance, and vinyl ester resins, which have excellent water resistance and alkaline resistance, have low elongation, so it is desirable to improve these properties.

[0008]

As a method for imparting elongation to these unsaturated polyester resins and vinyl ester resins, a flexibility-imparting agent, such as a flexible resin or plasticizer, can be added to the resin. Specifically, the following methods can be used. A method of dispersing liquid polybutadiene copolymers such as terminal-carboxy group-modified butadiene-acrylonitrile copolymers and terminal-vinyl group-modified polybutadiene-acrylonitrile copolymers in resins and modifying them, or a method of dissolving compatible rubber components and curing them can be used. In addition, a method of obtaining an elastic polymer by specifying mol% of unsaturated acid at the main chain and mol% of unsaturated acid at the end of the molecular structure of an unsaturated polyester as disclosed in Patent Document 1 is a well-known technique.

[0009]

However, with these conventional techniques, for example, regarding the method of adding flexible resins or plasticizers, it is difficult to obtain resins with low water absorption; and furthermore, regarding the method of dispersing liquid polybutadiene copolymers, compatibility of two components often becomes a problem, and as a result, the resin tends to become brittle. In addition, the solution in which the liquid polybutadiene copolymer is dispersed is considerably inferior in workability due to its high viscosity. The method of obtaining an elastic polymer by specifying the mol% of the unsaturated acid in the main chain and the mol% of the unsaturated acid at the end in the molecular structure of the unsaturated polyester is also effective in providing elongation and shock resistance at room temperature, but since the crosslinking density of the cured product is reduced, as a result, the water absorption is further increased.

[0010]

In order to solve these problems, the use of a vinyl ester resin with dimeric acid or a dimeric acid derivative in the molecular structure is proposed in Patent Document 2, but even using this method, the water absorption at high temperature is still not sufficient.

[0011]

Meanwhile, with regard to compliance with the aforementioned styrene regulations, a vinyl ester resin obtained by reacting an unsaturated monobasic acid with an epoxy resin and a resin composition containing a mixture of monomers capable of copolymerizing with the vinyl ester resin are publicly known. Examples of the unsaturated monobasic acid include, in particular, acrylic acid and methacrylic acid. Examples of the vinyl ester resin include epoxy acrylate or epoxy methacrylate obtained by reacting epoxy resin with the unsaturated monobasic acid.

[0012]

As for the technology of the low odor resin composition, the technology related to the low odor is disclosed in Patent Documents 3, 4, etc. In addition, examples of a lining material using a photopolymerizable resin composition in which a photopolymerization initiator is added to the curable resin composition and it is cured by ultraviolet irradiation include a light-curable material containing an unsaturated polyester and/or a vinyl ester resin and a bisacylphosphine oxide compound (for example, Patent Document 5).

However, such resin compositions are still not sufficient in performance of low odor, water resistance, chemical resistance, durability, adhesion, and air drying.

[0013]

In addition, technologies related to water-based resin compositions are disclosed in, for example, Patent Document 6 and Patent Document 7. All water-based resin compositions contain active hydrogen-containing compounds, polyisocyanate compounds, hydraulic cement, water, and cement water reducer as basic components.

However, none of the materials had sufficient curing properties or various properties such as strength, waterproofness, and adhesiveness of the cured material.

[0014]

As another water-based lining material, emulsion-type water-based lining materials disclosed in Patent Document 8 and Patent Document 9 have been proposed. However, the technology described in Patent Document 8 makes use of the reaction between the carboxy group in the acrylic resin emulsion and the crosslinking agent having the carboxyimide group, and the reaction between the alcoholic hydroxyl group in the acrylic resin emulsion and the compound containing multiple isocyanato groups. In essence, Patent Document 8, like Patent Document 6 and Patent Document 7, did not have sufficient curing properties or various properties such as strength, waterproofness, and adhesiveness of the cured material.

[0015]

The technology described in Patent Document 9 is a water-based lining material using a radical-curable resin composition. The radical-curable resin composition contains an emulsion obtained by emulsifying a mixture of a vinyl ester resin and a polymerizable unsaturated monomer, water, a curing accelerator, a reactive surfactant, and fibers, and, if necessary, an organic peroxide that is a curing agent. Although the water-based lining material described in Patent Document 9 has developed cold-hot-cycle test resistance with the help of fibers, the cold-hot-cycle test resistance of the cured resin itself was not satisfactory.

10 [Prior Art Documents]

[Patent Documents]

Patent Document 1: Japanese Patent Laid-Open Publication No. 56 -92917

Patent Document 2: Japanese Patent Laid-Open No. H08 -319328

Patent Document 3: Japanese Patent Laid-Open No. 2001-240632

15 Patent Document 4: Japanese Patent Laid-Open No. 2002-60282

Patent Document 5: Japanese Patent Laid-Open No. 2003-33970

Patent Document 6: Japanese Patent Laid-Open No. 2009 -29682

Patent Document 7: Japanese Patent Laid-Open No. 2006 -240919

Patent Document 8: Japanese Patent Laid-Open No. 2018 -83936

20 Patent Document 9: Japanese Patent Laid-Open No. 2019 -38982

SUMMARY

(Problems to Be Solved by Invention)

[0017]

It is an object of the present invention to provide a non-styrene-type vinyl ester resin in which a polymer coated on concrete can prevent swelling and can be kept at a low weight change rate after warm water immersion even after long-term immersion in warm water or the like. Further, it is an object of the present invention to provide a non-styrene-type vinyl ester resin-based polymerizable resin composition having good properties in low odor, crack resistance during cold-hot-cycle tests, chemical resistance, and air drying properties.

It is an object of the present invention to provide an emulsified resin composition using the polymerizable resin composition.

[0018]

Furthermore, it is an object of the present invention to provide a surface treatment material applied to the surfaces of metals, plastics, concrete, mortar, wood, glass, etc., using a resin composition whose essential component is a resin composition having the above characteristics, and a surface treatment method using the surface treatment material. It is also an object of the present invention to provide a method for producing a resin-treated surface of metal, plastic, concrete, mortar, wood, glass, etc., by coating the surface using the resin composition whose essential component is a resin composition having the above characteristics.

[Means to Solve Problems]

[0019]

After careful study, the inventors found that the above problems could be solved by using a resin composition containing the following components (a), (b) and (c), which led to the present invention.

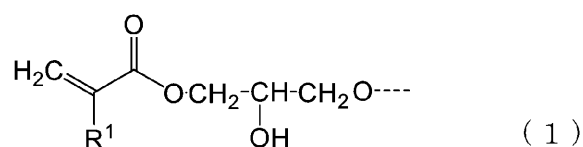
Namely, the present invention is as follows.

[1] A resin composition comprising a component (a), a component (b), and a component (c), wherein:

the component (a) is at least one of the compounds comprising,

an organic residue derived from one or more compounds selected from the group consisting of dimeric acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimeric acid, a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates in the molecule, and
 a terminal structure of formula (1);

[Chemical Formula 1]



(in the formula, R^1 represents H or CH_3 ; dashed lines represent bonding sites),

the component (b) is at least one of the compounds, without the organic residue derived from the dimeric acid, the trimeric acid, and their hydrates, which comprises

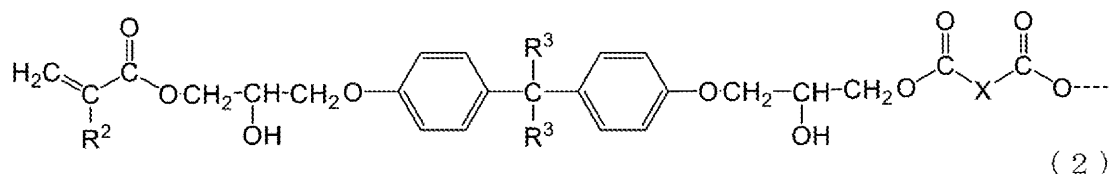
a structure derived from a novolak phenolic resin and a terminal structure of the formula (1) in the molecule; and

the component (c) comprises at least one polymerizable unsaturated group in the molecule, and is at least one type of reactive diluent having a viscosity of 500 mPa·s or less at 25°C.

[2] The resin composition according to [1], wherein the component (a) comprises a compound having a structure derived from at least one selected from the group consisting of bisphenol A and bisphenol F.

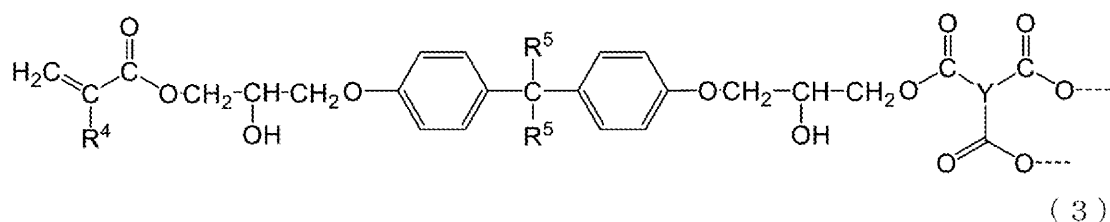
[3] The resin composition according to [1] or [2], wherein the component (a) comprises one or more compounds having at least one structure selected from the group consisting of formula (2) and formula (3),

[Chemical Formula 2]



(in the formula, R^2 and R^3 independently represent H or CH_3 , respectively, and X represents the dimer acid or a hydrocarbon group from which a carboxy group is removed from the hydrate of the dimer acid; dashed lines represent bonding sites),

[Chemical Formula 3]



(in the formula, R^4 and R^5 independently represent H or CH_3 , respectively, and Y represents the hydrocarbon group from which the carboxy group is removed from the trimeric acid or the hydrate of the trimeric acid; dashed lines represent bonding sites).

[4] The resin composition according to any one of [1] to [3], wherein the component (c) comprises 50 mass% or more of a reactive diluent having two polymerizable unsaturated groups in the molecule.

[5] The resin composition according to any one of [1] to [4], wherein the component (c) comprises 50 mass% or more of a reactive diluent having a viscosity of 100 mPa·s or less at 25°C.

[6] The resin composition according to any one of [1] to [5], wherein with respect to a total amount of all polymerizable components, including the component (a), the component (b), and the component (c),

a content of the component (a) is 20 to 60 mass%,

5 a content of the component (b) is 15 to 60 mass%, and

a content of the component (c) is 10 to 50 mass%.

[7] The resin composition according to any one of [1] to [6], further comprising a polymerization accelerator as a component (d).

[8] The resin composition according to any one of [1] to [7], further comprising at
10 least one selected from the group consisting of a short-fiber-like organic compound and a short-fiber-like inorganic compound, as a component (e).

[9] The resin composition according to any one of [1] to [8], further comprising a surfactant as a component (f).

[10] The resin composition according to [9], wherein water, as a component (g), is
15 further added to the resin composition and the resin composition is emulsified.

[11] The resin composition according to any one of [1] to [10], further comprising a methacrylic acid adduct to a bisphenol A-type epoxy resin, as a component (b').

[12] The resin composition according to any one of [1] to [11], further comprising a polymerization initiator as a component (h).

20 [13] The resin composition according to [12], wherein the component (h) comprises at least one organic peroxide.

[14] A polymer of the resin composition according to [12] or [13].

[15] A surface treatment material comprising the resin composition according to [12] or [13],

wherein the surface treatment material is applied to at least one surface selected from the group consisting of metal, plastic, concrete, mortar, wood, and glass.

[16] A surface treatment method of a material selected from the group consisting of metal, plastic, concrete, mortar, wood, and glass, the method comprising:

5 a first step of preparing a coating solution by adding a polymerization initiator as a component (h) to the resin composition according to any one of [1] to [11]; and

a second step of applying the coating solution prepared in the first step to a surface of the material and then curing the coating solution at 0 to 50°C to form a cured coating film on the surface of the material.

10 [17] A method for producing a cured coating-film-containing material, including a step of forming the cured coating film on the surface of the material using the surface treatment method according to [16].

[Effect of Invention]

[0020]

15 According to the present invention, it is possible to solve defects of conventional technology and to provide a polymerizable resin composition which is excellent in terms of low odor, crack resistance during cold-hot-cycle tests, chemical resistance, and air dryness without using a highly regulated copolymer such as styrene. It is also possible to provide an emulsified resin composition using the polymerizable resin composition.

20 [0021]

The polymerizable resin composition of the present invention can be used for various applications such as concrete coating resin composition and lining materials having the above characteristics, and moreover, there is no styrene odor before and after curing, so that there is no environmental pollution in the surrounding environment. In addition, the lining
25 material of the present invention is excellent in terms of environmental preservation because

it can be made into an aqueous system (emulsified oil in water) and does not use an organic solvent, and in addition, it is excellent in handling property because thick film construction using a spatula is possible. Moreover, due to the selection of suitable polymerization accelerators, the lining material is easy to cure at room temperature, and as a result, it is industrially advantageous because it can be used even under conditions without high-temperature drying equipment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0022]

(Resin Composition)

A resin composition (hereafter, it may be referred to as the resin composition of the present embodiment) in one embodiment of the present invention contains at least components (a), (b), and (c).

Each component used in the resin composition of the present embodiment is described in detail below, but the present invention is not limited to this.

[0023]

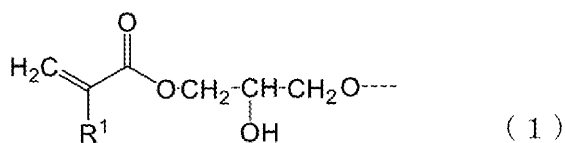
First, a component (a), which is an essential component of the present embodiment, will be described.

<Component (a)>

The component (a) is at least one compound having in the molecule an organic residue derived from one or more compounds selected from the group consisting of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates; and a terminal structure of formula (1).

[0024]

[Chemical Formula 4]



[0025]

R¹ in the formula (1) represents H or CH₃. Dashed lines represent bonding sites.

[0026]

Here, "dimeric acid, dimer of unsaturated fatty acids having 18 carbon atoms" is a dicarboxylic acid having 36 carbon atoms produced by the dimerization of unsaturated fatty acids having 18 carbon atoms from vegetable oils such as linoleic acid, for example, as described in Non-Patent Document 1 (Akira Misono, Anzo Uchida, Oil Chemical, 15, 363-368 (1966)).

[0027]

Here, "trimeric acid, a trimer of unsaturated fatty acids having 18 carbon atoms" is a tricarboxylic acid having 54 carbon atoms formed by the trimerization of unsaturated fatty acids having 18 carbon atoms from vegetable oils such as linoleic acid.

[0028]

Here, the term "hydrate of dimeric acid, dimer of unsaturated fatty acids having 18 carbon atoms" means a dicarboxylic acid in which the carbon-carbon unsaturated bond of the above-mentioned dicarboxylic acid having 36 carbon atoms (namely, dimeric acid) is hydrogenated and reduced to a saturated hydrocarbon by hydrogenation. The term "hydrate of trimeric acid, trimer of unsaturated fatty acids having 18 carbon atoms" refers to a tricarboxylic acid in which the carbon-carbon unsaturated bond of the above-mentioned tricarboxylic acid having 54 carbon atoms (that is, trimeric acid) is hydrogenated and reduced to a saturated hydrocarbon by hydrogenation.

[0029]

The terminal structure of the formula (1) can generally be obtained by addition reaction between acrylic acid or methacrylic acid, and a compound having a glycidyl group. The terminal structure of the formula (1) can generally be obtained by addition reaction between glycidyl acrylate or glycidyl methacrylate, and a compound having a carboxy group.

5 [0030]

Specifically, as a method for obtaining the component (a), for example, the following methods 1 to 4, or methods 1' to 4', can be used.

The component (a) can be obtained by using bisphenol A diglycidyl ether and dimeric acid in such a way that the mol number of the glycidyl group of bisphenol A diglycidyl ether is greater than the mol number of the carboxyl group of dimeric acid, heating and reacting them in the presence of a catalyst, and then reacting methacrylic acid with the glycidyl group which is not used in the reaction of bisphenol A diglycidyl ether and dimeric acid (Method 1).

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Similarly, when trimeric acid is used instead of dimeric acid, the component (a) can be obtained, for example, by heating and reacting 3 mol of bisphenol A diglycidyl ether (6 mol of glycidyl group in bisphenol A diglycidyl ether) and 1 mol of trimeric acid (that is, 3 mol of the carboxy group of trimeric acid) in the presence of a catalyst, and then reacting methacrylic acid with a glycidyl group that was not used in the reaction of bisphenol A diglycidyl ether with trimeric acid (a 100% reaction would leave 3 mol of the glycidyl group unused) (Method 1').

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20

[0031]

As another method, the component (a) can also be obtained, for example, by using a dimer acid and bisphenol A diglycidyl ether, with fewer mol of the glycidyl group of bisphenol A diglycidyl ether than that of the carboxyl group of the dimer acid, heating and reacting them in the presence of a catalyst, and then reacting glycidyl methacrylate with the

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carboxyl group that is not used in the reaction of bisphenol A diglycidyl ether and dimer acid (Method 2).

Similarly, when trimeric acid is used instead of dimeric acid, the component (a) can be obtained, for example, by heating and reacting 2 mol of bisphenol A diglycidyl ether (that is, 4 mol of glycidyl group in bisphenol A diglycidyl ether) and 3 mol of trimeric acid (that is, 9 mol of the carboxy group of trimeric acid) in the presence of a catalyst, and then reacting glycidyl methacrylate with a carboxy group that was not used in the reaction of bisphenol A diglycidyl ether with trimeric acid (a reaction rate of 100% would leave 5 mol of the carboxy group unused) (Method 2').

[0032]

In addition, as another method, the component (a) can be obtained, for example, by using diglycidyl dimer acid ester and bisphenol A so that the mol number of the phenolic hydroxyl group of bisphenol A is less than the mol number of the glycidyl group of diglycidyl dimer acid, and reacting them in the presence of a catalyst, and then reacting methacrylic acid with the glycidyl group derived from diglycidyl dimer acid that is not used in the reaction of diglycidyl dimer acid ester and bisphenol A (Method 3).

Similarly, when trimeric acid triglycidyl ester is used instead of dimeric acid diglycidyl ester, the component (a) can be obtained, for example, by heating and reacting 3 mol (that is, 6 mol of the phenolic hydroxyl group of bisphenol A) of bisphenol A with 5 mol (that is, 15 mol of the glycidyl group of trimeric acid triglycidyl ester) of trimeric acid triglycidyl ester in the presence of a catalyst, and then reacting methacrylic acid with a glycidyl group that was not used in the reaction of bisphenol A and trimeric acid triglycidyl ester (a 100% reaction would leave 9 mol of the glycidyl group unused) (Method 3').

[0033]

As still another method, the component (a) can be obtained, for example, by using diglycidyl dimer acid ester and bisphenol A, using more mol of the phenolic hydroxyl group of bisphenol A than mol of the ester structure of diglycidyl dimer acid, and heating and reacting them in the presence of a catalyst, and then reacting glycidyl methacrylate with the phenolic hydroxyl group not used in the reaction of diglycidyl dimer acid with bisphenol A (Method 4).

Similarly, when trimeric acid triglycidyl ester is used instead of dimeric acid diglycidyl ester, the component (a) can be obtained, for example, by heating and reacting 3 mol of bisphenol A (that is, 6 mol of the phenolic hydroxyl group of bisphenol A) with 1 mol of trimeric acid triglycidyl ester (3 mol glycidyl group of trimeric acid triglycidyl ester) in the presence of a catalyst, and then reacting glycidyl methacrylate with phenolic hydroxyl groups that were not used in the reaction of bisphenol A with trimeric acid triglycidyl ester (a reaction rate of 100% would leave 3 mol of the phenolic hydroxyl group unused) (Method 4').

[0034]

In the component (a), R^1 in the formula (1) represents H or CH_3 , but when the water resistance of the polymer of the resin composition of the present embodiment described later is important, R^1 in the formula (1) in the component (a) is preferably CH_3 .

[0035]

In the case of the component (a), where the rate of curing at an air-contact surface, in which the resin composition is in contact with air when the resin composition is polymerized, is important, it is preferable that the ratio of the hydrocarbon group derived from dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimer acid, and a trimer of unsaturated fatty acids having 18 carbon atoms is preferably 40 mass% or more, and more preferably 60 mass% or more, with respect to the total amount of hydrocarbon

groups derived from the dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimer acid, trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates in the total amount of the component (a). In this specification, "hydrocarbon groups derived from dimeric acid, a dimer of unsaturated fatty acids having 18 carbon atoms, 5 trimeric acid, a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates" refers to hydrocarbon groups in which all the carboxy groups of dimeric acid, which is a dimer of unsaturated fatty acids having 18 carbon atoms, trimeric acid, which is a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates are removed. That is, in the case of the above dimeric acid and its hydrates, "hydrocarbon groups derived from 10 dimeric acid and its hydrates" refers to a hydrocarbon group having 34 carbon atoms, after excluding two carboxy groups in the molecule from the above dimeric acid and its hydrates which is hydrogenated dimeric acid. And in the case of the above trimeric acid and its hydrates, "hydrocarbon groups derived from trimeric acid and its hydrates" refers to a hydrocarbon group having 51 carbon atoms after excluding three carboxy groups in the 15 molecule from the above trimeric acid and its hydrates which is hydrogenated trimeric acid.

[0036]

In addition, when the flexibility, thermal stability, and photostability of the polymer of the resin composition (simply referred to as the "polymer of the present embodiment") described later are important in the component (a), it is preferable that in the total amount 20 of the component (a), the amount of hydrate of dimeric acid, a dimer of unsaturated fatty acids having 18 carbon atoms, the hydrate of trimeric acid, and a trimer of unsaturated fatty acids having 18 carbon atoms is 10 mass% or more, and more preferably 15 mass% or more, with respect to the total amount of the hydrocarbon group derived from dimeric acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimeric acid, and a trimer of unsaturated 25 fatty acids having 18 carbon atoms and their hydrates.

However, if thermal stability and photostability are important, it can be solved by using antioxidants or ultraviolet absorbers.

[0037]

The component (a) is preferably a compound having an aromatic ring structure, more preferably a compound having a structure derived from at least one of bisphenol A and bisphenol F, and still more preferably a compound having a structure of at least one of the following formulae (2) and (3).

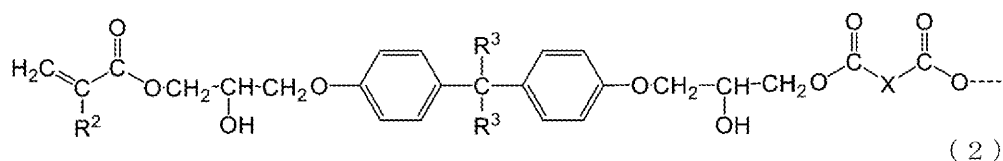
[0038]

One of the favorable factors of containing a compound having a structure of at least one of the formulae (2) and (3) is that when the polymer of the resin composition of the present embodiment is produced, the polymer is unlikely to become opaque and tends to become a uniform transparent film. As a result, the properties of the polymer film are stabilized.

In addition, water resistance can be improved by containing a compound having a structure of at least one of the following formulae (2) and (3).

[0039]

[Chemical Formula 5]

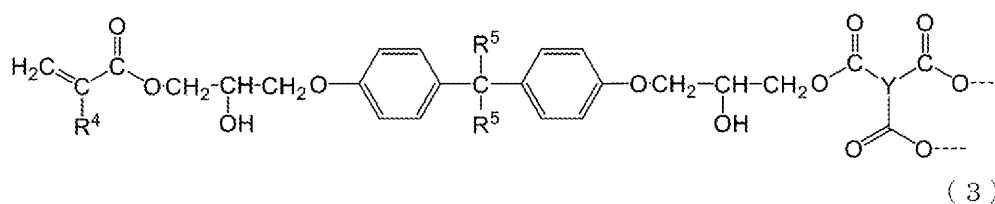


[0040]

(In the formula, R^2 and R^3 independently represent H or CH_3 , respectively, and X represents the above hydrocarbon group obtained by removing the carboxy groups from the dimer acid or the hydrate of the above dimer acid. Dashed lines represent bonding sites.)

[0041]

[Chemical Formula 6]



[0042]

(In the formula, R^4 and R^5 independently represent H or CH_3 , respectively, and Y represents the hydrocarbon group obtained by removing the carboxy groups from the trimeric acid or the hydrate of the trimeric acid. Dashed lines represent bonding sites.)

[0043]

In formula (2), R^2 and R^3 independently represent H or CH_3 . In the formula (2), X represents the hydrocarbon group obtained by removing the carboxy groups from the dimeric acid or the hydrated product of the dimeric acid.

When the water resistance of the polymer is important, R^2 in the formula (2) is preferably CH_3 .

[0044]

In formula (3), R^4 and R^5 independently represent H or CH_3 , respectively. In the formula (3), Y represents a hydrocarbon group obtained by removing carboxy groups from the trimeric acid or the hydrated trimeric acid.

When the water resistance of the polymer is important, R^4 in the formula (3) is preferably CH_3 .

[0045]

As described above, in the case of the component (a), where the rate of curing at the air-contact surface, in which the resin composition is in contact with air when the resin composition is polymerized, is important, in the total amount of the component (a), the amount of the hydrocarbon group derived from dimer acid, a dimer of unsaturated fatty

acids having 18 carbon atoms, trimer acid, and a trimer of unsaturated fatty acids having 18 carbon atoms is preferably 40 mass% or more, and more preferably 60 mass% or more, with respect to the total amount of the hydrocarbon group, including the group belonging to X and the group belonging to Y, which derived from dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates.

[0046]

In the case of the component (a), where flexibility, thermal stability, and photostability of the polymer according to the present embodiment are important, in the total amount of the component (a), the amount of the hydrocarbon group derived from the hydrate of dimeric acid, a dimer of unsaturated fatty acids having 18 carbon atoms, the hydrate of trimer acid, and a trimer of unsaturated fatty acids having 18 carbon atoms is preferably 10 mass% or more, and more preferably 15 mass% or more, with respect to the total amount of the hydrocarbon group, including the group belonging to X and the group belonging to Y, which derived from dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates.

However, if thermal stability and photostability are important, the problem may be solved by using antioxidants or ultraviolet absorbers.

[0047]

Next, a component (b), which is an essential component of the present embodiment, will be described.

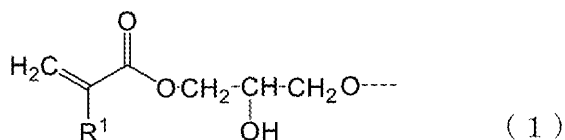
<Component (b)>

The component (b) is at least one of the compounds having in the molecule a structure derived from a novolak-type phenolic resin and a structure of the formula (1)

below and having no organic residues derived from the dimeric acid, the trimeric acid, and their hydrates.

[0048]

[Chemical Formula 7]



[0049]

(In the formula, R^1 represents H or CH_3 . Dashed lines represent bonding sites.)

R^1 in the formula (1) represents H or CH_3 . In view of the water resistance of the polymer, R^1 is preferably CH_3 .

[0050]

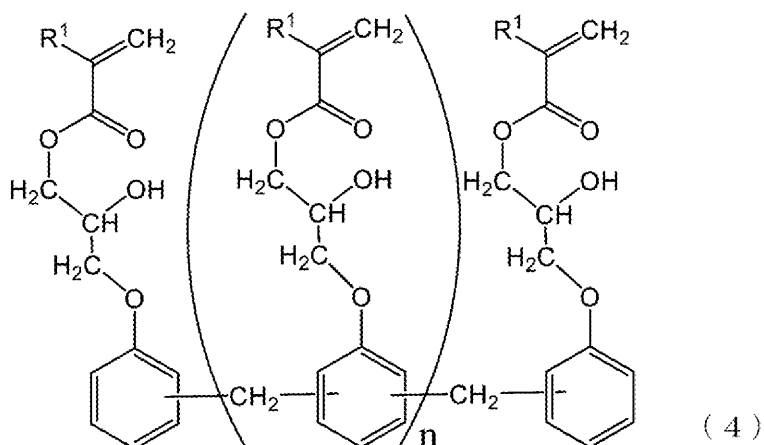
The term "novolak-type phenolic resin" as used herein means a solvent-soluble or fusible phenolic resin obtained by condensing phenols such as phenols, cresols, and alkylphenols with formaldehyde in the presence of acid catalysts such as sulfuric acid, hydrochloric acid, and oxalic acid under heating (at a temperature close to 100°C). A structure derived from a novolak-type phenolic resin means a structure in which at least one hydrogen atom of the phenolic hydroxyl group of the novolak-type phenolic resin is removed. An example is shown in the chemical structure formula below.

[0051]

Examples of compounds having the terminal structure of the formula (1) and having a structure derived from a novolak-type phenolic resin include compounds represented by formula (4).

[0052]

[Chemical Formula 8]



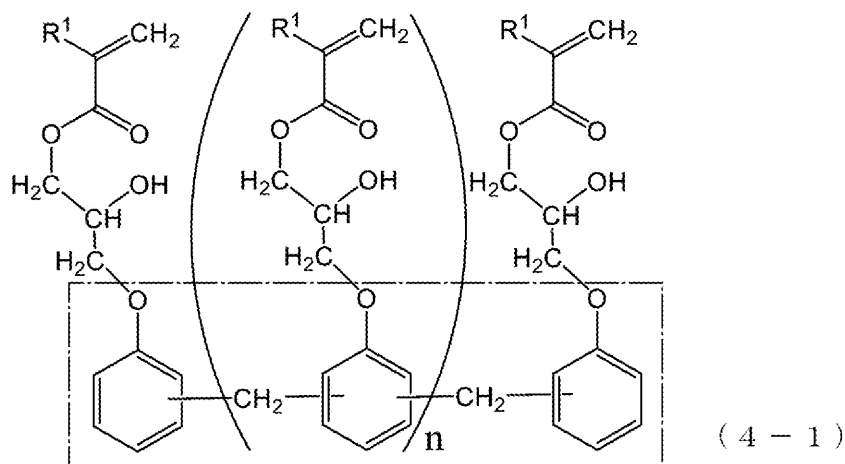
[0053]

In the compound represented by formula (4-1), the part enclosed by a square is a structure derived from a novolak-type phenolic resin.

5

[0054]

[Chemical Formula 9]



[0055]

A method for producing a compound having the terminal structure of the formula (1) and having a structure derived from a novolak-type phenolic resin can generally be obtained by the addition reaction between acrylic or methacrylic acid and the glycidyl group of a novolak-type epoxy resin. It is also obtained by reacting glycidyl (meth)acrylate with the phenolic hydroxyl group of novolak-type phenolic resin. The novolak-type epoxy

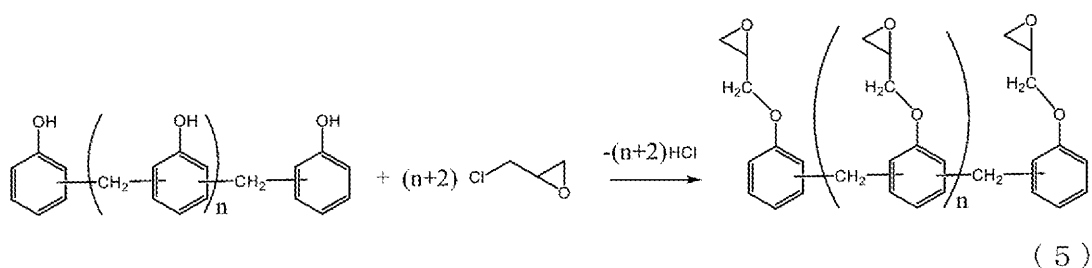
resin can be obtained by reacting -OH of the novolak-type phenolic resin with epichlorohydrin to form glycidyl ether.

[0056]

A scheme for synthesizing a novolak-type epoxy resin from a novolak-type phenolic resin is shown, for example, in formula (5) below.

[0057]

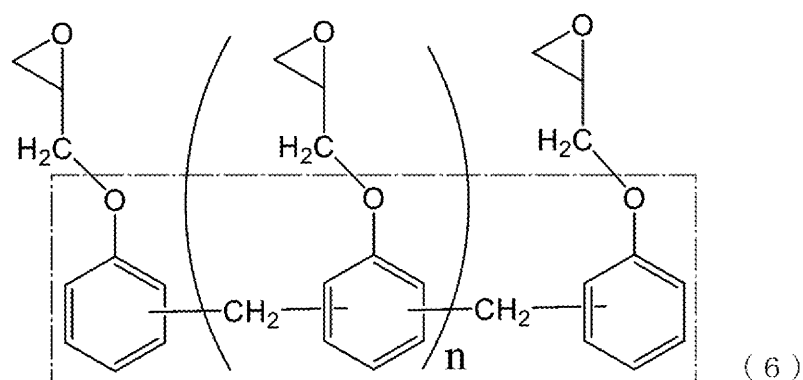
[Chemical Formula 10]



When a novolak-type epoxy resin is used to produce a compound having the terminal structure of the the formula (1) and having a structure derived from the novolak-type phenolic resin, the part enclosed by a square in the novolak-type epoxy resin represented by formula (6) is the structure derived from the novolak-type phenolic resin.

[0058]

[Chemical Formula 11]



[0059]

As a specific method for producing a compound having the terminal structure of the formula (1) and having a structure derived from a novolak-type phenolic resin, for example, a novolak-type epoxy resin can be obtained by heating and reacting acrylic acid or methacrylic acid in the presence of a catalyst (method α).

5 Alternatively, it can be obtained by reacting a novolak-type phenolic resin with glycidyl methacrylate (method β).

However, it is more common to manufacture using method α than method β .

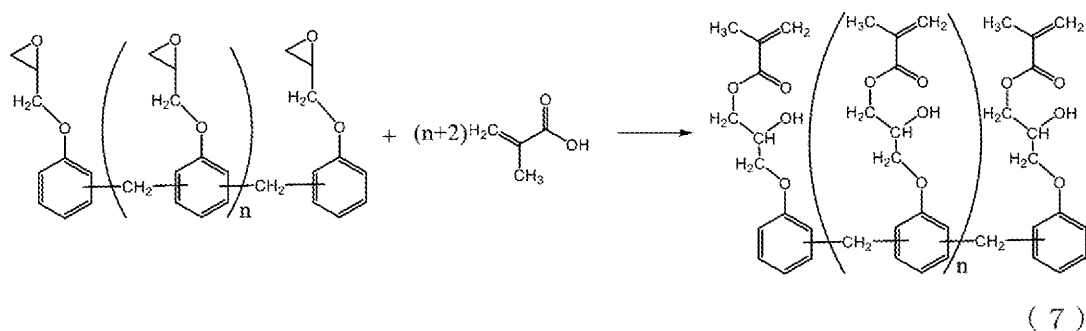
[0060]

<Method α >

10 As a method for producing a compound having the terminal structure of the formula (1) and having a structure derived from a novolak-type phenolic resin, a production method using an addition reaction between methacrylic acid and the glycidyl group of a novolak-type epoxy resin as shown in formula (7) below can be used.

[0061]

15 [Chemical Formula 12]



[0062]

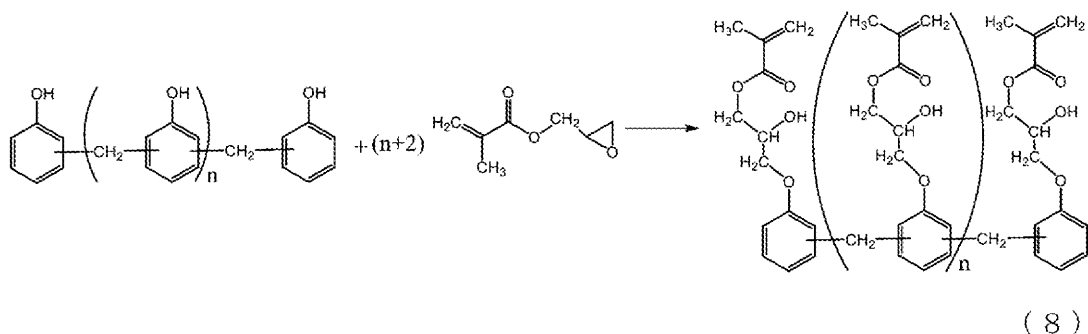
<Method β >

20 As a method for producing a compound having the terminal structure of the formula (1) and having a structure derived from a novolak-type phenolic resin, a production method

using the addition reaction of a phenolic hydroxyl group of a novolak-type phenolic resin with glycidyl methacrylate as shown in the following formula (8) can be used.

[0063]

[Chemical Formula 13]



5

[0064]

When a novolak-type epoxy resin is used as a raw material in method α , the resin composition containing a compound with multiple end structures of the formula (1) in one molecule can be obtained, and as a result, a polymer with excellent water resistance, chemical resistance, heat resistance, and solvent resistance can be obtained.

10

[0065]

The component (b) is a compound having a structure derived from a novolak-type phenolic resin and a structure of the formula (1) in the molecule and having no organic residues derived from the dimer acid, the trimer acid, and their hydrates.

15

[0066]

In the component (b), R^1 in the formula (1) represents H or CH_3 . In view of the water resistance of the polymer, R^1 is preferably CH_3 .

[0067]

Next, another component (b') of the present embodiment will be described.

20

<Component (b')>

Another component (b') includes, for example, a methacrylic acid adduct to a bisphenol A-type epoxy resin which is contained in "resin 1 containing component (a)" obtained in Synthetic Example 1 described later, or a methacrylic acid adduct to a bisphenol F-type epoxy resin contained in "resin 4 containing component (a)" obtained in Synthetic Example 4 described later.

[0068]

Next, a component (c), which is an essential component of the present embodiment, will be described.

<Component (c)>

10 The component (c) is at least one of the reactive diluents. The reactive diluent has at least one polymerizable unsaturated group in the molecule and has a viscosity of 500 mPa·s or less at 25°C.

[0069]

15 The component (c) is not particularly restricted as long as the compound has at least one polymerizable unsaturated group in the molecule and has a viscosity of 500 mPa·s or less at 25°C.

[0070]

The "viscosity at 25°C" for the compound belonging to the component (c) described herein is the viscosity at 25°C when measured using a BL-type viscometer (model 20 manufactured by TOKI INDUSTRIES, INC.; model number of RB80L; rotor: No. 1 rotor).

Specific examples of the component (c) include, for example, the following:

[0071]

25 A reactive diluent having one acryloyl group, which is a polymerizable unsaturated group, such as methacrylic acid, lauryl acrylate (viscosity at 25°C: 4 to 5 mPa·s), ethoxy-diethylene glycol acrylate (viscosity at 25°C: 5 to 6 mPa·s), 2-ethylhexyloxyethyloxyethyl

acrylate (viscosity at 25°C: 4 to 10 mPa·s), methoxypolyethylene glycol (average number of additions of ethylene oxide: 9 mol) acrylate (viscosity at 25°C: 20 to 30 mPa·s), methoxydipropylene glycol acrylate (viscosity at 25°C: 2 to 3 mPa·s), phenoxyethyl acrylate (viscosity at 25°C: 10 to 15 mPa·s), phenoxy ethoxyethyl acrylate (viscosity at 25°C: 10 to 12 mPa·s), tetrahydrofurfuryl acrylate (viscosity at 25°C: 4 to 5 mPa·s), isobornyl acrylate (viscosity at 25°C: 5 to 10 mPa·s), 2-hydroxy-3-phenoxypropyl acrylate (viscosity at 25°C: 150 to 200 mPa·s), 2-hydroxyethyl acrylate (viscosity at 25°C: 6 mPa·s), 2-hydroxypropyl acrylate (viscosity at 25°C: 4 mPa·s), 2-hydroxybutyl acrylate (viscosity at 25°C: 6 mPa·s), n-octyl acrylate (viscosity at 25°C: 2 mPa·s), isostearyl acrylate (viscosity at 25°C: 10 to 20 mPa·s), dicyclopentenyl acrylate (viscosity at 25°C: 8 to 18 mPa·s), dicyclopentenyl oxyethyl acrylate (viscosity at 25°C: 15 to 20 mPa·s), dicyclopentanyl acrylate (viscosity at 25°C: 7 to 17 mPa·s), benzyl acrylate (viscosity at 25°C: 3 to 8 mPa·s), nonylphenoxy polyethylene glycol (average number of adducts with ethylene oxide: 4) acrylate (viscosity at 25°C: 70 to 130 mPa·s), or nonylphenoxy polyethylene glycol (average number of adducts with ethylene oxide: 8) acrylate (viscosity at 25°C: 20 to 180 mPa·s).

[0072]

A reactive diluent having two acryloyl groups, which are polymerizable unsaturated groups, such as diethylene glycol dimethacrylate (viscosity at 25°C: 3 to 8 mPa·s), 1,4 butanediol diacrylate (viscosity at 25°C: 5 mPa·s), 1,6 hexanediol diacrylate (viscosity at 25°C: 7 mPa·s), 1,10 nonanediol diacrylate (viscosity at 25°C: 8 mPa·s), neopentyl glycol diacrylate (viscosity at 25°C: 5 mPa·s), 3-methyl-1,5-pentanediol diacrylate (viscosity at 25°C: 8 mPa·s), tricyclo [5.2.1.0 (2, 6)] decanedimethanol diacrylate (viscosity at 25°C: 130 to 170 mPa·s), diethylene glycol diacrylate (viscosity at 25°C: 3 to 9 mPa·s), triethylene glycol diacrylate (viscosity at 25°C: 9 to 11 mPa·s), tetraethylene glycol diacrylate (viscosity at 25°C: 10 to 15 mPa·s), polyethylene glycol ($M_n = 400$) diacrylate (viscosity at

25°C: 22 to 25 mPa·s), polyethylene glycol (Mn = 600) diacrylate (viscosity at 25°C: 50 to 70 mPa·s), polytetramethylene glycol (Mn = 250) diacrylate (viscosity at 25°C: 15 to 20 mPa·s), polytetramethylene glycol (Mn = 650) diacrylate (viscosity at 25°C: 120 to 160 mPa·s), tripropylene glycol diacrylate (viscosity at 25°C: 9 to 19 mPa·s), polypropylene glycol (Mn = 400) diacrylate (viscosity at 25°C: 32 to 37 mPa·s), polypropylene glycol (Mn = 700) diacrylate (viscosity at 25°C: 65 to 75 mPa·s), 3-(acryloyloxy)-2,2-dimethylpropyl-3-(acryloyloxy)-2,2-dimethylpropanoate (viscosity at 25°C: 40 to 80 mPa·s), etc.

[0073]

A reactive diluent having three acryloyl groups, which are polymerizable unsaturated groups, such as trimethylolpropane triacrylate (viscosity at 25°C: 70 to 110 mPa·s), trimethylolpropane ethylene oxide adduct (average number of additions: 9 mol), triacrylate (viscosity at 25°C: 90 to 110 mPa·s), trimethylolpropane ethylene oxide adduct (average number of additions: 20 mol), triacrylate (viscosity at 25°C: 210 to 230 mPa·s), glycerine ethylene oxide adduct (average number of additions: 3 mol), triacrylate (viscosity at 25°C: 90 to 110 mPa·s), glycerine ethylene oxide adduct (average number of additions: 9 mol), triacrylate (viscosity at 25°C: 90 to 110 mPa·s), glycerine ethylene oxide adduct (average number of additions: 20 mol), triacrylate (viscosity at 25°C: 180 to 210 mPa·s), and pentaerythritol triacrylate (viscosity at 25°C: 600 to 1000 mPa·s).

[0074]

A reactive diluent having one methacryloyl group, which is a polymerizable unsaturated group, such as dicyclopentenylmethoxyethyl methacrylate (viscosity at 25°C: 15 to 20 mPa·s), dicyclopentanyl methacrylate (viscosity at 25°C: 7 to 17 mPa·s), pentamethylpiperidyl methacrylate (viscosity at 25°C: 11 to 14 mPa·s), tetramethylpiperidyl methacrylate (viscosity at 25°C: 3 to 6 mPa·s), methoxypolyethylene glycol (average number of additions of ethylene oxide: 9 mol) methacrylate (viscosity at 25°C: 20 to 30

mPa·s), benzyl methacrylate (viscosity at 25°C: 2 to 4 mPa·s), 2-ethylhexyl methacrylate (viscosity at 25°C: 2 mPa·s), lauryl methacrylate (viscosity at 25°C: 5 mPa·s), cyclohexyl methacrylate (viscosity at 25°C: 3 mPa·s), phenyl methacrylate (viscosity at 25°C: 3 mPa·s), benendyl methacrylate (viscosity at 25°C: 3 mPa·s), isobornyl methacrylate (viscosity at 25°C: 13 mPa·s), tetrahydrofurfuryl methacrylate (viscosity at 25°C: 3 mPa·s), 2-hydroxyethyl methacrylate (viscosity at 25°C: 7 mPa·s), 2-hydroxypropyl methacrylate (viscosity at 25°C: 8 to 10 mPa·s), or 2-methoxyethyl methacrylate (viscosity at 25°C: 3 to 4 mPa·s).

[0075]

10 A reactive diluent having two methacryloyl groups, which are polymerizable unsaturated groups, such as ethylene glycol dimethacrylate (viscosity at 25°C: 2 to 5 mPa·s), diethylene glycol dimethacrylate (viscosity at 25°C: 3 to 8 mPa·s), triethylene glycol dimethacrylate (viscosity at 25°C: 7 to 12 mPa·s), polyethylene glycol dimethacrylate (viscosity at 25°C: 12 to 17 mPa·s), polyethylene glycol (Mn = 600) dimethacrylate
 15 (viscosity at 25°C: 60 to 70 mPa·s), polypropylene glycol (average addition number: 7 mol) dimethacrylate (viscosity at 25°C: 100 mPa·s or less), 1,3 butylene glycol dimethacrylate (viscosity at 25°C: 3 to 5 mPa·s), 1,6-Hexanediol dimethacrylate (viscosity at 25°C: 4 to 6 mPa·s), 1,9-nonanediol dimethacrylate (viscosity at 25°C: 5 to 10 mPa·s), 1,10- decanediol dimethacrylate (viscosity at 25°C: 7 to 12 mPa·s), neopentyl glycol dimethacrylate
 20 (viscosity at 25°C: 3 to 8 mPa·s), tricyclo [5.2.1.0 (2, 6)] decanedimethanol dimethacrylate (viscosity at 25°C: 100 to 120 mPa·s), (viscosity at 25°C: 40 to 80 mPa·s), 2-hydroxy-3-methacryloyloxypropyl methacrylate (viscosity at 25°C: 100 mPa·s or less); a reactive diluent having one acryloyl group and one methacryloyl group, which are polymerizable unsaturated groups, such as 2-hydroxy-3-acryloyloxypropyl methacrylate, and a reactive

diluent having three methacryloyl groups, which are polymerizable unsaturated groups such as trimethylolpropane trimethacrylate (viscosity at 25°C: 45 mPa·s).

[0076]

In the component (c), in order to satisfy both the polymerizability of the resin composition according to the present embodiment and the crack resistance of the polymer according to the cold-hot-cycle test described later, it is preferable to contain a reactive diluent having two polymerizable unsaturated groups in the molecule at least 50 mass% of the total amount of compounds belonging to the component (c).

[0077]

In addition, from the standpoint of dilution efficiency with respect to the component (a) and the component (b), it is preferable that the component (c) contains at least 50 mass% of a reactive diluent having a viscosity of 100 mPa·s or less at 25°C, with respect to the total amount of compounds belonging to the component (c).

In addition, the component (c) affects curability, especially surface curability, during polymerization.

[0078]

In consideration of the above point of view, the following reactive diluents with two polymerizable unsaturated groups in the molecule belonging to the component (c) are preferred.

A reactive diluent having an aliphatic ether bond and two polymerizable unsaturated groups with a viscosity of 100 mPa·s or less at 25°C, such as diethylene glycol diacrylate (viscosity at 25°C: 3 to 9 mPa·s), triethylene glycol diacrylate (viscosity at 25°C: 9 to 11 mPa·s), tetraethylene glycol diacrylate (viscosity at 25°C: 10 to 15 mPa·s), polyethylene glycol (Mn = 400) diacrylate (viscosity at 25°C: 22 to 25 mPa·s), polyethylene glycol (Mn = 600) diacrylate (viscosity at 25°C: 50 to 70 mPa·s), polytetramethylene glycol (Mn = 250)

diacrylate (viscosity at 25°C: 15 to 20 mPa·s), polytetramethylene glycol (Mn = 650) diacrylate (viscosity at 25°C: 120 to 160 mPa·s), tripropylene glycol diacrylate (viscosity at 25°C: 9 to 19 mPa·s), polypropylene glycol (Mn = 400) diacrylate (viscosity at 25°C: 32 to 37 mPa·s), polypropylene glycol (Mn = 700) diacrylate (viscosity at 25°C: 65 to 75 mPa·s),
 5 diethylene glycol dimethacrylate (viscosity at 25°C: 3 to 8 mPa·s), triethylene glycol dimethacrylate (viscosity at 25°C: 7 to 12 mPa·s), tetraethylene glycol dimethacrylate (viscosity at 25°C: 12 to 17 mPa·s), polyethylene glycol (Mn = 600) dimethacrylate (viscosity at 25°C: 60 to 70 mPa·s), or polypropylene glycol (average addition number: 7 mol) dimethacrylate (viscosity at 25°C: 100 mPa·s or less).

10 [0079]

Among the reactive diluents having two polymerizable unsaturated groups in the molecule belonging to the component (c), the following are more preferable:

diethyleneglycol diacrylate, triethyleneglycol diacrylate, tetraethyleneglycol diacrylate, diethyleneglycol dimethacrylate, triethyleneglycol dimethacrylate, and
 15 tetraethyleneglycol dimethacrylate.

[0080]

Among the reactive diluents having two polymerizable unsaturated groups in the molecule belonging to the component (c), diethylene glycol dimethacrylate is still more preferred.

20 [0081]

When a reactive diluent having one polymerizable unsaturated group is used, it is preferable to use one that has good surface curability or that does not adversely affect surface curability. Examples of the reactive diluents having one such preferred polymerizable unsaturated group include dicyclopentenylxyethyl methacrylate (viscosity

at 25°C: 15 to 20 mPa·s), benzyl methacrylate (viscosity at 25°C: 2 to 4 mPa·s) and, more preferably, dicyclopentenylloxyethyl methacrylate.

[0082]

<Resin Component That Does Not Belong to Any of Components (a), (b), (b'), and

5 (c)>

Resin components that do not belong to any of the components (a), (b), (b'), and (c) may be used in the resin composition of the present embodiment to the extent that physical properties are not impaired.

[0083]

10 These components include, for example, the following:

compounds with a viscosity higher than 500 mPa·s at 25°C which is urethane (meth)acrylate; compounds with a viscosity higher than 500 mPa·s at 25°C which is polyester (meth)acrylate; compounds with a viscosity higher than 500 mPa·s at 25°C which is polycarbonate (meth)acrylate; compounds with a viscosity higher than 500 mPa·s at 25°C
15 which is ethylene oxide adduct to bisphenol A di(meth)acrylate, such as ethylene oxide adducts to bisphenol A (average addition number: 3 mol) diacrylate (viscosity at 25°C: 1400 to 1500 mPa·s), ethylene oxide adducts to bisphenol A (average addition number: 4 mol) diacrylate (viscosity at 25°C: 1000 to 1300 mPa·s), ethylene oxide adducts to bisphenol A (average addition number: 10 mol) diacrylate (viscosity at 25°C: 550 to 700 mPa·s),
20 ethylene oxide adducts to bisphenol A (average addition number: 10 mol) diacrylate (viscosity at 25°C: 550 to 750 mPa·s), ethylene oxide adducts to bisphenol A (average addition number: 2.3 mol) diacrylate (viscosity at 25°C: 1100 to 1500 mPa·s), ethylene oxide adduct of bisphenol A (average addition number: 2.6 mol) dimethacrylate (viscosity at 25°C: 900 to 1450 mPa·s), and ethylene oxide adduct of bisphenol A (average addition
25 number: 4 mol) dimethacrylate (viscosity at 25°C: 600 to 700 mPa·s).

[0084]

Total polymerizable components according to the present embodiment include the components (a), (b), and (c), which are essential components of the resin composition of the present embodiment; and polymerizable components that do not belong to any of the components (a), (b), and (c). The ranges of preferred amounts of the components (a), (b), and (c) with respect to the total amount of the above polymerizable components are 20 to 60 mass%, 15 to 60 mass%, and 10 to 50 mass%, respectively. The more preferred usage ranges for the component (a), the component (b), and the component (c) are 25 to 50 mass%, 18 to 55 mass%, and 10 to 40 mass%, respectively. The still more preferred amounts of the component (a), the component (b), and the component (c) are 30 to 50 mass%, 20 to 50 mass%, and 12 to 40 mass%, respectively.

[0085]

If the amount of the component (a) used is 20 to 60 mass% with respect to the total amount of the above total polymerizable components, cracks are less likely to occur during the cold-hot-cycle test and the water absorbency can be kept low. If the amount of the component (b) used is 15 to 60 mass% with respect to the total amount of the above total polymerizable components, there is no shortage of surface curing performance, cracks are less likely to occur during a cold-hot-cycle test, and defects such as swelling are less likely to occur when immersed in water at a temperature above room temperature. If the amount of the component (c) used is 10 to 50 mass% with respect to the total amount of the above total polymerizable components, the component (a) and the component (b) can be dissolved, and the viscosity can be reduced, cracking is less likely to occur during a cold-hot-cycle test, water absorbency can be kept low, and defects such as swelling are less likely to occur when immersed in water at a temperature above room temperature. The above total

polymerizable components include the components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c).

[0086]

The acid value of the total polymerizable resin composition containing the components (a), (b), and (c), which are essential components of the resin composition of the present embodiment, is preferably 10 mg KOH/g or less. If the acid value of the total polymerizable resin composition is 10 mg KOH/g or less, the polymer of the resin composition of the present embodiment can be expected to improve water resistance and resistance to alkaline aqueous solution.

[0087]

<Component (d)>

Furthermore, the resin composition of the present embodiment may contain a polymerization accelerator (component (d)). It is preferable to use a polymerization accelerator in cases where the storage stability is good even if it contains a polymerization accelerator, or in applications where a polymerization accelerator can be added just before the resin composition is polymerized.

[0088]

As the polymerization accelerator used for the resin composition of the present embodiment, a compound having a reducing effect on polymerization initiator, specifically, organic peroxide, when the resin composition of the present embodiment is polymerized at room temperature, is used.

[0089]

Specific examples of polymerization accelerators (component (d)) include the following:

metal acetylacetonate-based polymerization accelerators such as copper acetylacetonate, vanadium acetylacetonate, cobalt acetylacetonate, manganese acetylacetonate, iron acetylacetonate, and the like;

aromatic amine-based polymerization accelerators such as N,N-dimethylaniline, N,N-diethylaniline, N,N-dimethyl-p-toluidine, and the like; and

polyvalent metal salt-based polymerization accelerators such as calcium naphthenate, copper naphthenate, manganese naphthenate, cobalt naphthenate, vanadium naphthenate, calcium octylate, copper octylate, manganese octylate, cobalt octylate, vanadium octylate, and the like.

[0090]

One of these polymerization accelerators may be used, or more of these polymerization accelerators may be used in combination.

[0091]

Examples of these polymerization accelerators preferably include cobalt acetylacetonate, cobalt naphthenate, and cobalt octylate, and more preferably include cobalt naphthenate and cobalt octylate.

[0092]

The amount of these polymerization accelerators used is usually 0.1 to 10 parts by mass, preferably 0.15 to 8 parts by mass, and still more preferably 0.2 to 5 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components. When the amount of these polymerization accelerators is in the range of 0.1 to 10 parts by mass, with respect to the total amount of 100 parts by mass of all the polymerizable components described above, the polymer has a suitable polymerization rate, can maintain pot life after adding the polymerization initiator (organic peroxide described below), which is used when polymerizing the polymerizable components at room temperature, and the polymerization

accelerator to the polymerizable resin composition, and can also achieve sufficient surface curability. The above total polymerizable components include the components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c).

5 [0093]

<Component (e)>

Furthermore, the resin composition of the present embodiment can use at least one kind selected from short-fiber-like organic compounds and short-fiber-like inorganic compounds (component (e)). When the resin composition is used as a surface treatment
10 material for materials selected from metals, plastics, concrete, mortar, wood, and glass described later, the resin composition of the present embodiment preferably contains the component (e). This is because sag from a coating surface of the surface treatment material can be prevented.

[0094]

15 The average fiber length of short-fiber-like organic and/or short-fiber-like inorganic compounds is preferably 0.2 mm or less in average fiber length, and the fiber diameter is preferably 30 micrometers or less in average.

[0095]

Specific examples of short-fiber-like organic and/or short-fiber-like inorganic
20 compounds include, for example, short-fiber-like glass fibers such as Cut fiber (registered trademark) manufactured by Nitto Boseki Co., Ltd. "product name: SS 05C-404" (average fiber length about 0.1 mm, average fiber diameter about 10 micrometers) and KEMIBESTO (registered trademark) "product name: FDSS-5", a polyolefin fine fiber manufactured by Mitsui Chemicals Fine Co., Ltd. (average fiber length of 0.1 mm or less, average fiber
25 diameter of about 10 micrometers).

The short-fiber-like organic and/or inorganic compounds may be used in one form or in combination of two or more.

[0096]

The amount of the short-fiber-like organic and/or short-fiber-like inorganic compound used is preferably 0.1 to 10 parts by mass, more preferably 0.3 to 8 parts by mass, and still more preferably 0.5 to 7 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components. The above total polymerizable components include the components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c).

[0097]

When the short-fiber-like organic and/or inorganic compounds are used in a range of 0.1 to 10 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components, sag from the coating surface of the surface treatment material described later can be prevented. The above total polymerizable components include the components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c).

[0098]

In addition, these short-fiber-like organic and/or short-fiber-like inorganic compounds can express thixotropic viscosity of the resin composition and prevent sag from the coating surface due to relatively simple mixing dispersion compared to fumed silica.

[0099]

<Component (f)>

In addition, it is possible and preferable to use a surfactant (component (f)) when emulsifying the resin composition of the present embodiment to obtain the emulsified resin composition of the present embodiment.

[0100]

The above component (f) is generally used together with water, which is a component (g), when emulsifying the resin composition of the present embodiment and obtaining the emulsified resin composition of the present embodiment.

5 [0101]

In polymerizing all polymerizable components, surfactants (that is, component (f)) include nonreactive and reactive surfactants. The above total polymerizable components include the components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c). Non-reactive surfactants are surfactants that do
10 not themselves have radical reactivity. Reactive surfactants are surfactants that themselves have radical reactivity.

Each of the non-reactive and reactive surfactants have ionic surfactants and nonionic (nonionic) surfactants.

The component of "reactive surfactants" are not to be included in the "total
15 polymerizable components".

[0102]

Examples of non-reactive surfactants include well-known anionic surfactants, cationic surfactants, amphoteric surfactants, and nonionic surfactants, each of which is non-reactive.

20 [0103]

Examples of non-reactive anionic surfactants include higher alcohol sulfate esters salts such as sodium lauryl sulfate; alkylbenzene sulfonates such as sodium dodecylbenzene sulfonate; alkyl naphthalene sulfonate; potassium alkenyl succinate; dialkyl sulfosuccinate salts; semi-cured beef fatty acid salt such as potassium semi-cured beef fatty acid; alkyl
25 diaryl ether disulfonate salts such as sodium alkyl diphenylether disulfonates; sulfate salts

of polyoxyalkylene alkyl ethers such as sulfate salts of polyoxyethylene alkyl ethers; sulfate salts of polyoxyalkylene alkyl aryl ethers such as sulfate salts of polyoxyethylene alkyl phenyl ethers; polyoxyalkylene alkyl ether acetate such as sodium polyoxyethylene lauryl ether acetate; and sodium lauroyl sarcosine, sodium N-lauroyl methyl taurine, sodium N-cocoyl methyl taurine, and sodium β -naphthalenesulfonate formalin condensate.

Examples of nonreactive cationic surfactants include alkylammonium salts such as dodecylammonium chloride.

[0104]

Examples of non-reactive nonionic surfactants include polyoxyethylene alkyl ethers, polyoxyethylene alkyl allyl ethers, polyoxyethylene alkyl phenyl ethers, polyoxyethylene sorbitan fatty acid esters, polyoxyethylene sorbit fatty acid esters, polyoxyethylene fatty acid esters, polyoxyethylene acyl esters, polyoxyethylene hydrogenated sterols, polyoxyethylene polyoxypropylene alkyl ethers, polyoxyethylene lanolin, polyoxyethylene lanolin alcohol, polyoxyethylene lanolin alcohol ethers, and polyoxyethylene lanolin fatty acid esters.

[0105]

The reactive surfactants are classified into ionic reactive surfactants and nonionic (nonionic) reactive surfactants, and it is preferable to use at least one selected from these. Either ionic or nonionic reactive surfactants may be used, but it is more preferable to use them together.

[0106]

Any of anionic reactive surfactants, cationic reactive surfactants, and amphoteric reactive surfactants may be used as the ionic reactive surfactants, but from the standpoint of emulsifiability, anionic reactive surfactants are preferred.

[0107]

Examples of anionic reactive surfactants include, but are not limited to, α -sulfo- ω -(1-alkoxymethyl-2-(2-propenyloxy) ethoxy)-poly(oxy-1,2-ethanediyl) ammonium salt [ADEKA REASOAP (registered trademark) SR-10, SR-1025, etc., manufactured by ADEKA, Inc.], α -sulfo- ω -(1-(nonylphenoxy) methyl-2-(2-propenyloxy) ethoxy)-poly(oxy-1,2-ethanediyl) ammonium salt [ADEKA REASOAP (registered trademark) SE-10, SE-1025A, etc., manufactured by ADEKA, Inc.], polyoxyethylene alkyl propenyl phenyl ether sulfate ammonium salt [Aqualon (registered trademark) HS-10, HS-5, BC-10, BC-5, etc., manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.], α -sulfonato- ω -{1-(allyloxymethyl)-alkyloxy} polyoxyethylene ammonium salt (Aqualon (registered trademark) KH-10, etc., manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.), polyoxyalkylene alkenyl ether ammonium sulfate salt (LATEMUL (registered trademark) PD-104, etc., manufactured by Kao Corporation), alkylallyl sulfosuccinates [LATEMUL (registered trademark) S-180 A, S-180, etc., manufactured by Kao Corporation, and ELEMNOL (registered trademark) JS-20, manufactured by Sanyo Chemical Industries, Ltd.].

[0108]

Among these, α -sulfo- ω -(1-alkoxymethyl-2-(2-propenyloxy) ethoxy)-poly(oxy-1,2-ethanediyl) ammonium salt [ADEKA REASOAP (registered trademark) SR-10, SR-1025, etc., manufactured by ADEKA, Inc.] is preferred from the viewpoint of water resistance, acid resistance, and base resistance of the cured coating film. ADEKA REASOAP (registered trademark) SE-10, SE-1025A, etc., manufactured by ADEKA, Inc.

[0109]

Examples of nonionic reactive surfactants include, but are not limited to, α -hydro- ω -(1-alkoxymethyl-2-(2-propenyloxy) ethoxy)-poly(oxy-1,2-ethanediyl) [ADEKA REASOAP (registered trademark) ER-10, ER-20, ER-30, ER-40 manufactured by ADEKA, Inc.], polyoxyalkylene alkenyl ether [LATEMUL (registered trademark) PD-420, PD-430,

PD-450 manufactured by Kao Corporation], and polyoxyethylene alkyl propenyl phenyl ether [Aqualon (registered trademark) RN20, RN30, RN50 manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.].

[0110]

5 Among these, α -hydro- ω -(1-alkoxymethyl-2-(2-propenyloxy) ethoxy)-poly(oxy-1,2-ethanediyl) [ADEKA Soap Co., Ltd. (registered trademark) ER-10, ER-20, ER-30, ER-40] is preferred from the viewpoint of water resistance, acid resistance, and base resistance of the cured coating film.

[0111]

10 In addition, well-known anionic or nonionic reactive surfactants described in Japanese Unexamined Patent Publication No. S62-104802, Japanese Unexamined Patent Publication No. 63-23725, and Japanese Unexamined Patent Publication No. S63-240931 may be used.

[0112]

15 In polymerizing the total polymerizable component, the component (f) is itself preferably a radical reactive surfactant so that the surfactant (that is, component (f)) does not separate from the polymer of the total polymerizable component and does not deteriorate the water resistance, acid resistance, and base resistance of the cured coating film. The above total polymerizable components include the components (a), (b), and (c) and
20 polymerizable components that do not belong to any of the components (a), (b), or (c).

[0113]

As the reactive surfactants, there are ionic reactive surfactants and nonionic (nonionic) reactive surfactants, and it is preferable to use at least one selected from these, but it is particularly preferable to use both ionic and nonionic reactive surfactants together.

25 [0114]

When ionic reactive surfactants (especially anionic reactive surfactants) are used in combination with nonionic reactive surfactants, the content of the nonionic reactive surfactants in the total amount of the ionic reactive surfactants (especially anionic reactive surfactants) and nonionic reactive surfactants is preferably at least 80 mass%, and more preferably at least 90 mass%.

[0115]

When a non-reactive surfactant is used together with a reactive surfactant as a component (f), the amount of the non-reactive surfactant is preferably not more than 80 parts by mass, more preferably not more than 50 parts by mass, still more preferably not more than 30 parts by mass, and even still more preferably not more than 10 parts by mass, with respect to a total amount of 100 parts by mass of the reactive surfactant.

[0116]

The amount of the reactive surfactant is preferably 1 to 40 parts by mass, more preferably 1.5 to 30 parts by mass, and still more preferably 2 to 20 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components. The above total polymerizable components include the components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c). As long as the content of the reactive surfactants is in the range of 1 to 40 parts by mass with respect to the total amount of 100 parts by mass of all polymerizable components, the water resistance, acid resistance, and base resistance of the cured coating film cannot be reduced without decreasing the stability of the emulsified product over time.

The "reactive surfactants" are not to be included in the "total polymerizable components".

[0117]

However, it is acceptable to use known anionic, cationic, and nonionic surfactants that are non-reactive to the extent that the water resistance, acid resistance, and base resistance of the coating film are not impaired.

[0118]

5 <Component (g)>

The emulsified resin composition contains water as a component (g). It contains water, preferably 6 to 200 parts by mass, more preferably 10 to 100 parts by mass, and still more preferably 10 to 50 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components. The above total polymerizable components include the
10 components (a), (b), and (c) and polymerizable components that do not belong to any of the components (a), (b), or (c). An emulsified resin composition can be made into an oil-in-water type if the water content is in the range of 6 to 200 parts by mass, with respect to 100 parts by mass of all polymerizable components. Therefore, the stability of the emulsified resin composition can be maintained, and the water can be evaporated by applying the
15 emulsified resin composition to maintain the water and acid resistance of the polymerized polymer.

The water component (g) is preferably pure water such as ion exchange water or distilled water.

[0119]

20 The emulsified resin composition may contain various additives such as dispersants, if necessary. For example, adding a water-soluble polymer such as polyvinyl alcohol, polyester, polyethylene glycol, or polyvinylpyrrolidone to the emulsified resin composition may improve the stability of the emulsified resin composition.

The content of these components is usually used at 10 parts by mass or less with respect to 100 parts by mass of the total polymerizable components in the resin composition of the present embodiment.

[0120]

5 The emulsified resin composition of the present embodiment is prepared, for example, by a method in which water, which is the component (g), is dropped into a mixture of the components (a), (b), (c), (d), and (f) to cause phase-change emulsification. At this time, by adding water dropwise without adding it all at once, a water-in-oil (W/O) emulsified resin composition is converted into a so-called oil-in-water type (O/W)

10 emulsified resin composition in which the continuous phase is water. In addition, by dropping water, the dispersed phase becomes more finely dispersed, the emulsion stability of the emulsified resin composition increases, and the water resistance, acid resistance, and base resistance of the polymerized coating film are improved. The rate of water dripping is usually around 10 to 300 ml/h, and preferably 50 to 150 ml/h.

15 [0121]

<Component (h)>

When polymerizing the resin composition of the present embodiment, it is possible and preferable to add a polymerization initiator (component (h)) before starting the polymerization to carry out the polymerization.

20 [0122]

As the polymerization initiator, an azo-based polymerization initiator, an organic peroxide-based polymerization initiator, a photopolymerization initiator, or the like can be used. For applications where it is preferable to proceed with polymerization at room temperature, such as the lining material applications described below, it is preferable to use

25 an organic peroxide-based polymerization initiator. This is because, when used together

with the component (d) (namely, a polymerization accelerator), excellent polymerizability at room temperature can be developed.

[0123]

One or more of the following known organic peroxide polymerization initiators can be selected for use:

ketone peroxides such as methyl ethyl ketone peroxide, cyclohexanone peroxide, 3,3,5-trimethylcyclohexanone peroxide, and methyl cyclohexanone peroxide;

hydroperoxides such as tert-butyl hydroperoxide, cumene hydroperoxide, diisopropylbenzene hydroperoxide, and 2,5-dimethylhexanone-2,5-hydroperoxide;

peroxy esters such as t-butyl peroxy octoate, t-butyl peroxy benzoate, and t-butyl peroxy laurate; and

diacyl peroxides such as lauroyl peroxide and benzoyl peroxide.

[0124]

Among these organic peroxide-based polymerization initiators, at least one selected from ketone peroxides, hydroperoxides, and peroxy esters is preferably used.

Preferably, the organic peroxide polymerization initiator has a 10 hour half-life temperature of 30 to 170°C.

One component (h) may be used alone or in combination with two or more components.

[0125]

The amount of the component (h) used is preferably in the range of 0.1 to 20 parts by mass, more preferably 0.3 to 17 parts by mass, and still more preferably 0.5 to 15 parts by mass, with respect to a total of 100 parts by mass of the polymerizable component in the resin composition of the present embodiment. If the amount of the component (h) used is

in the range of 0.1 to 20 parts by mass with respect to 100 parts by mass of the polymerizable

component, it is possible to obtain a sufficient polymerization rate and sufficient hardness, and it is possible to have a sufficient usable time (pot life) after the addition of the component (h), and the ease of forming a paint film is not reduced.

The resin composition of the present embodiment is characterized by excellent surface curability, but paraffin and/or waxes may be used in combination, if necessary, for the purpose of improving the dryness of the contact surface with air.

[0126]

As the above paraffin and/or waxes, one or more kinds selected from waxes such as paraffin wax and polyethylene wax and higher fatty acids such as stearic acid and 1,2-hydroxystearic acid can be used, but paraffin wax is preferably used. Paraffins and/or waxes are added for the purpose of air-blocking action during the curing reaction on the surface of the coating film, as well as improving stain resistance. When paraffins and/or waxes are used, the addition amount is 0.1 to 5 parts by mass, and preferably 0.2 to 2 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components.

[0127]

<Inorganic Materials in Fine Particles>

To the resin composition of the present embodiment, fine particulate inorganic materials other than the component (e) can be further added. Examples of such inorganic materials include sand, silica powder, crushed rock, calcium carbonate, alumina powder, fly ash, clay, silica powder, talc, glass powder, silica powder, glass powder, mica, aluminum hydroxide, silica sand, aluminum silicate, magnesium silicate, cement, marble, and the like.

[0128]

The average particle size of the fine particles is preferably about 0.5 to 20 μm . The addition rate of the fine particulate inorganic material is preferably 100 parts by mass or less, if necessary, with respect to 100 parts by mass of the total polymerizable component.

One type of particulate inorganic material may be used alone, or two or more types may be used in combination.

[0129]

In addition, when the resin composition of the present embodiment contains fine
5 particulate inorganic materials other than the component (e), the total amount of the components (a) to (h) is preferably 60 mass% or more, more preferably 80 mass% or more, and still more preferably 95 mass% or more, based on the total amount of the resin composition.

[0130]

10 (Preparation Method of Resin Composition)

Next, a method for preparing the resin composition of the present embodiment will be described.

There are no particular limits on the method for preparing the emulsified resin composition of the present embodiment as long as the emulsified resin composition is
15 obtained. For example, it is preferable to mix the above components (a) to (f) and, if necessary, other components to obtain a mixed solution, and to drop water into the mixed solution for phase-change emulsification. In this case, by "dropping" water rather than adding water all at once, the resin composition changes cleanly from a so-called W/O (water in oil) emulsified resin composition in which the continuous phase is an oil phase to an O/W
20 (oil in water) emulsified resin composition in which the continuous phase is water. In addition, by dropping water, the dispersed phase becomes more finely dispersed, and the stability of the emulsified substance is enhanced, and the water resistance, acid resistance, and base resistance of the cured coating film are enhanced.

The rate at which water is dropped is not particularly limited unless it is too fast, but
25 for example, about 10 to 300 ml/h is preferable, and 50 to 150 ml/h is more preferable.

[0131]

<Polymer of Resin Composition>

Next, the obtained polymer (the polymer of the resin composition of the present embodiment) will be described using the resin composition of the present embodiment.

5 The polymer of the resin composition of the present embodiment is obtained by mixing the resin composition of the present embodiment and, if necessary, other components and polymerizing the mixture with the component (h). When a photopolymerization initiator is used as the component (h), the polymer is obtained by irradiation with ultraviolet or visible light. When an azo-based polymerization initiator is
10 used as the component (h), the polymer is obtained by heating. Similarly, when an organic peroxide-based polymerization initiator is used, the polymer is also obtained by heating. In addition, when there is a case for polymerizing at room temperature, such as the surface treatment materials described later, the polymer of the resin composition of the present embodiment can be obtained even at room temperature by using organic peroxide together
15 with the component (d).

[0132]

<Surface Treatment Material and Surface Treatment Method>

Next, an example of a surface treatment material containing a resin composition and a surface treatment method using the treatment material will be described.

20 By using a composition obtained by adding a known anti-sag additive into the resin composition of the present embodiment containing the component (h), as a surface treatment material, the surface of each various materials such as metal, plastic, concrete, wood, and glass is treated, and as a result, the improvement effect of water resistance, acid resistance, and base resistance of various materials can be imparted.

25 [0133]

More specifically, a method includes a first step of preparing a coating solution by adding the component (h) to a resin composition of the present embodiment which is obtained by blending the components other than the component (h), and a second step of forming a cured coating film on the surface of the material by applying the coating solution to the surface of the material and curing at 0 to 50°C.

[0134]

As the component (h), an organic peroxide-based polymerization initiator is generally preferably used. Specific examples of organic peroxide-based polymerization initiators are as described above and include, but are not particularly limited to, the following.

[0135]

Ketone peroxides such as methyl ethyl ketone peroxide, cyclohexanone peroxide, 3,3,5-trimethylcyclohexanone peroxide, and methyl cyclohexanone peroxide;

[0136]

hydroperoxides such as t-butyl hydroperoxide, cumene hydroperoxide, diisopropylbenzene hydroperoxide, and 2,5-dimethylhexanone-2,5-hydroperoxide; and peroxy esters such as t-butyl peroxybenzoate and t-butyl peroxy laurate.

[0137]

Preferably, the organic peroxide has a 10 hour half-life temperature of 30 to 170°C. One curing agent may be used alone or in combination with two or more curing agents.

Preferably, the organic peroxide polymerization initiator has a 10 hour half-life temperature of 30 to 170°C.

One component (h) may be used alone or in combination with two or more components.

[0138]

The amount of the component (h) used is preferably in the range of 0.1 to 20 parts by mass, more preferably 0.3 to 17 parts by mass, and still more preferably 0.5 to 15 parts by mass, with respect to a total of 100 parts by mass of all polymerizable components in the resin composition of the present embodiment. If the amount of the component (h) used is in the range of 0.1 to 20 parts by mass for 100 parts by mass of the prepolymerizable component, a sufficient polymerization rate and sufficient hardness can be obtained, and the component (h) can have sufficient usable time (pot life) after addition, and the ease of forming a paint film is not reduced.

[0139]

When the resin composition of the present embodiment contains a short-fiber-like organic and/or short-fiber-like inorganic compound as the component (e), and when the resin composition and the component (h) of the present embodiment are used as a surface treatment material, it is easy to cure at a temperature near room temperature. Therefore, it is a surface treatment method that can be carried out even in an environment without drying equipment and that is industrially useful. The temperature for curing is preferably 5 to 50°C, more preferably 10 to 50°C, still more preferably 15 to 45°C, and even still more preferably 15 to 40°C from the viewpoint of curing rate, etc.

[0140]

The thickness of the cured coating film formed is preferably 0.1 to 2 mm, more preferably 0.3 to 2 mm, still more preferably 0.5 to 2 mm, and even still more preferably 0.5 to 1.5 mm. This is because it is generally desirable not to be too large from the viewpoint of surface treatment, and because the surface treatment effect can be sustained for a long time. By adjusting the thickness of the swelling coating film at the time of coating to approximately these ranges, the thickness of the cured coating film can be adjusted to the above ranges.

[0141]

Materials such as metal, plastic, concrete, mortar, wood, and glass can be used under conditions of contact with rainwater, industrial wastewater, etc., and surface treatment using the resin composition of the present embodiment is desired.

5 [0141]

The surface treatment material of the present embodiment is the material such as metal, plastic, concrete, mortar, wood, and glass, of which each may be used in situations where it comes into contact with rainwater, industrial wastewater, etc., and is the material which is desired to carry out surface treatment by using the resin composition of the present
10 embodiment.

[0142]

It is preferred that the metals contain at least one selected from iron and aluminum. Iron and aluminum are components found in metals that are often used especially in situations where they come in contact with rainwater or industrial wastewater. Metals
15 containing iron may be substantially 100 mass% iron, or may also contain metals other than iron (for example, chromium), such as stainless steel.

There are no particular restrictions on the material of the wood.

[0143]

As the glass, there is no particular restriction as long as it may become an amorphous
20 solid which exhibits a glass transition phenomenon by increasing temperature. The glass may mainly contain silicate, or may mainly contain a component other than silicate, such as acrylic glass, chalcogen glass, metallic glass, organic glass, etc. The surface of the glass to be surface-treated may be smooth or uneven.

[0144]

In addition, examples of known additives for preventing sag include fumed silica such as Aerosil (registered trademark); and cellulose such as methylcellulose, hydroxypropylcellulose, and ethylcellulose.

[0145]

5 The typical form of these resin compositions is a pasty one, but, for example, when the emulsified resin composition of the present embodiment is used as a surface treatment material, the amount of the component (g) can be increased to increase fluidity when it is applied using spray painting or the like.

10 In addition, long-fiber-like compounds and additives of titanium oxide and carbon black may be added within a range that does not impair the effect of the present invention.

[0146]

15 The surface treatment material of the present embodiment and the anticorrosion method of concrete structures using the surface treatment material are suitable for anticorrosion lining of kitchen drainage-related water tanks in commercial buildings and hotels, building pit-related facilities, sewage and gray water, and sewerage system facilities.

[0147]

For example, the method described in Japanese Patent Laid-Open No. 2019-38972 can be used as an anticorrosion method of concrete structures using the surface treatment material of the present embodiment.

20 [0148]

<Method for Producing Cured-Coating-Film-Containing Material>

The method for producing the cured-coating-film-containing material of the present embodiment is a method of forming the cured coating film on the surface of a material selected from metal, plastic, concrete, mortar, wood, and glass. The method for producing

the cured-coating-film-containing material includes a step of forming the cured coating film on the surface of the material using the surface treatment method of the present embodiment.

[0149]

In the method for producing the cured-coating-film-containing material of the present embodiment, the surface treatment material to be used and the formation conditions are the same as those of the surface treatment method of the present embodiment.

EXAMPLES

[0150]

Next, the present invention will be described with reference to examples of the present invention, but the present invention is not limited to this. "Part" in the examples is "mass part" unless otherwise noted.

[0151]

<Production of Resin Containing Component (a)>

(Synthesis Example 1)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was loaded with 188.0 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), and 146.1 g of Haridimer (registered trademark) 270S (manufactured by Harima Kasei Co., Ltd.: concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 80 mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 19.5 mass%, others: 0.5 mass%, acid value: 192 mg KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and the temperature was raised to 120°C while blowing dry air at 4 liters per minute under agitation. After warming, the reaction was continued for 3 hours.

[0152]

Then, 0.25 g of hydroquinone was added as a polymerization inhibitor and 1.0 g of trimethylbenzylammonium chloride as a catalyst, and 43.05 g of methacrylic acid was added dropwise over 15 minutes. From 3 hours after the completion of dripping, the acid value
5 was measured every hour, and after confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 6.0 mg KOH/g (hereafter, it is referred to as "resin 1 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0153]

10 As a result of analyzing resin 1 containing component (a) under the following conditions, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin of and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 1 belonging to component (a)". Therefore, 0.25 g of hydroquinone as a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine,
15 and 1.0 g of trimethylbenzylammonium chloride as a catalyst are contained in "resin 1 belonging to component (a)". The content of each resin component in resin 1 containing component (a) is shown in Table 1.

[0154]

[Table 1]

Mass ratio		Synthesis example												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Component (a)	Resin belonging to component (a)	79.0%	79.0 %	75.0 %	80.0 %	79.0 %	79.0 %	79.0 %	79.0 %	79.0 %	79.0 %	100.0 %	75.0 %	
Component (b)	Resin belonging to component (b)													68.5 %
Component (c)	Diethylene glycol dimethacrylate													30.0 %
	Methacrylic acid	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%		1.0%	1.5%
	2-Hydroxy-3-methacryloyloxypropyl methacrylate			6.0%										
Other Components	Methacrylic acid adduct to bisphenol A-type epoxy resin	20.0%	20.0 %	18.0 %		20.0 %	20.0 %	20.0 %	20.0 %	20.0 %	20.0 %		18.0 %	
	Methacrylic acid adduct to bisphenol F-type epoxy resin				19.0 %								6.0%	
Resin No. belonging to component (a)		Resin 1	Resin 2	Resin 3	Resin 4	Resin 5	Resin 6	Resin 7	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12	
In resin belonging to component (a), the mass ratio of "hydrocarbon groups derived from dimer and trimer acids" with respect to "total amount of hydrocarbon groups derived from dimeric and trimeric acids, and their hydrates"		100%	62%	53%	100%	100%	0%	100%	49%	49%	100%	100%	100%	

[0155]

(Analysis conditions)

Device name: LC solution manufactured by Shimadzu Corporation

Column: Shodex column KF-804 x 3

5 Mobile phase: Tetrahydrofuran

Flow rate: 1.0 mL/min

Detector: RI detector made by Shimadzu Corporation: RID-10 A

Temperature: 40.0°C

Sample volume: Sample loop 100 microliters

10 Sample concentration: adjusted to 0.1 mass%.

[0156]

(Synthesis Example 2)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was loaded with 188.0 g of EPOMIK (registered trademark) R140P, a
 15 bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 97.5 g of Haridimer (registered trademark) 200 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 7% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 76%
 mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon
 20 atoms: 17% mass%, acid value: 192 mg KOH/g), 48.5 g of Pripol (registered trademark) 1009, a hydrogenated dimer acid (manufactured by Croda Japan Co., Ltd.: acid value: 196 mg KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and heated to 120°C while being stirred and while blowing 4 liters of dry air per minute. After warming, the reaction was continued for 3 hours.

25 [0157]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 15 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the acid value had decreased to less than 7 mg KOH/g, the resin mixture (hereafter, it is referred to as "resin 2 containing component (a)") containing component (a) with an acid value of 6.0 mg KOH/g, which is an essential component of the present embodiment, was obtained by cooling to 100°C.

[0158]

When the resin 2 containing component (a) was analyzed under the same conditions as in Synthetic Example 1, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 2 belonging to component (a)". Therefore, 0.25 g of hydroquinone as a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride as a catalyst are contained in "resin 2 belonging to component (a)". The content of each resin component in resin 2 containing component (a) is shown in Table 1.

[0159]

(Synthesis Example 3)

In a 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube, 112.8 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 73.05 g of Haridimer (registered trademark) 270S (manufactured by Harima Kasei Co., Ltd.: concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 80 mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 19.5 mass%, others: 0.5 mass%, acid value: 192 mg KOH/g), 71.57 g of Pripol

(registered trademark) 1009, a hydrogenated dimer acid (manufactured by Croda Japan Co., Ltd.: acid value: 196 mg KOH/g), 12.3 g of JER871, a dimer acid-based epoxy resin (manufactured by Mitsubishi Chemical Corporation: epoxy equivalent: 410 g/eq), 49.75 g of glycidyl methacrylate, 0.15 g of hydroquinone, and 1.0 g of N,N-dimethylbenzylamine
5 as a catalyst were loaded, and the temperature was raised to 120°C while blowing 4 liters of dry air per minute under stirring, and after warming, it was continued until the acid value fell below 5.0 mg KOH/g.

[0160]

Then, 0.15 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were
10 added, and 43.05 g of methacrylic acid was added dropwise over 30 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the acid value had decreased to less than 10 mg KOH/g, the resin (hereafter, it is referred to as "resin 3 containing component (a)") containing component (a) with an acid value of 7.5 mg KOH/g, which is an essential component of the present embodiment,
15 was obtained by cooling to 100°C.

[0161]

Analysis of resin 3 containing component (a) under the same conditions as in Synthetic Example 1 confirmed the presence of about 18% methacrylic acid adduct to bisphenol A-type epoxy resin, about 6% 2-hydroxy-3-methacryloyloxypropyl methacrylate,
20 and about 1% methacrylic acid. The remaining approximately 75% shall be denoted as "resin 3 belonging to component (a)". Therefore, 0.3 g of hydroquinone as a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride as a catalyst are contained in "resin 3 belonging to component (a)". The content of each resin component in resin 3 containing component (a) is shown in Table 1.

25 [0162]

(Synthesis Example 4)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was loaded with 171.0 g of EPICLON (registered trademark) 830-S, a bisphenol F-type epoxy resin (manufactured by DIC Corporation: epoxy equivalent: 171 g/eq), 146.1 g of Haridimer (registered trademark) 200 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 7% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 76% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 17% mass%, acid value: 192 mg KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and the temperature was raised to 120°C while blowing dry air at 4 liters per minute under agitation. After warming, the reaction was continued for 3 hours.

[0163]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 15 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 6.0 mg KOH/g (hereafter, it is referred to as "resin 4 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0164]

As a result of analyzing resin 4 containing component (a) under the following conditions, it was confirmed that about 19% of methacrylic acid adduct to bisphenol F-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 80% shall be described as "resin 4 belonging to component (a)". This means that 0.25 g of hydroquinone, which is a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine,

and 1.0 g of trimethylbenzylammonium chloride, which is a catalyst, are contained in "resin 4 belonging to component (a)". The content of each resin component in resin 4 containing component (a) is shown in Table 1.

[0165]

5 (Synthesis Example 5)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was charged with 188.0 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 146.1 g of Haridimer (registered trademark) 200 (manufactured by Harima Kasei
10 Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 7% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 76% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 17% mass%, acid value: 192 mg KOH/g) and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and the temperature was raised to 120°C under stirring while 4 liters of dry air
15 was blown per minute. After warming, the reaction was continued for 3 hours.

[0166]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 15 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after
20 confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 6.0 mg KOH/g (hereafter, it is referred to as "resin 5 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0167]

As a result of analyzing resin 5 containing component (a) under the following conditions, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 5 belonging to component (a)". This means that 0.25 g of hydroquinone, which is a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride, which are catalysts, are contained in "resin 5 belonging to component (a)". The content of each resin component in resin 5 containing component (a) is shown in Table 1.

[0168]

(Synthetic Example 6)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was loaded with 188.0 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 145.4 g of Pripol (registered trademark) 1009, a hydrogenated dimer acid (manufactured by Croda Japan Co., Ltd.: acid value: 196 mg KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and the temperature was raised to 125°C while blowing dry air at 4 liters per minute under agitation. After warming, the reaction was continued for 1 hour.

[0169]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 30 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 6.0 mg KOH/g (hereafter, it is referred to as "resin 6

containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0170]

When the resin 6 containing component (a) was analyzed under the same conditions
5 as in Synthetic Example 1, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 6 belonging to component (a)". Therefore, 0.25 g of hydroquinone as a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride as a catalyst are
10 contained in "resin 6 belonging to component (a)". The content of each resin component in resin 6 containing component (a) is shown in Table 1.

[0171]

(Synthesis Example 7)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and
15 an air induction tube was loaded with 169.2 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 41.0 g of JER871, a dimer acid-based epoxy resin (manufactured by Mitsubishi Chemical Corporation: epoxy equivalent: 410 g/eq), 146.1 g of Haridimer (registered
20 trademark) 250 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 3% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 79% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 18% mass%, acid value: 192 mg
KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and heated to 120°C while blowing dry air at 4 liters per minute under agitation. After warming, the reaction was
25 continued for 3 hours.

[0172]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 15 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after 5 confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 6.0 mg KOH/g (hereafter, it is referred to as "resin 7 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0173]

10 When the resin 7 containing component (a) was analyzed under the following conditions, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 7 belonging to component (a)". Therefore, 0.25 g of hydroquinone, which is a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 15 1.0 g of trimethylbenzylammonium chloride, which is a catalyst, are contained in "resin 7 belonging to component (a)". The content of each resin component in resin 7 containing component (a) is shown in Table 1.

[0174]

(Synthesis Example 8)

20 A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was loaded with 188.0 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 73.1 g of Haridimer (registered trademark) 250 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 3% by mass, 25 concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 79%

mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 18% mass%, acid value: 192 mg KOH/g), 73.1 g of Pripol (registered trademark) 1010VEG, a hydrogenated dimer acid (manufactured by Croda Japan Co., Ltd.: acid value: 192 mg KOH/g) and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and heated to 125°C
5 under stirring while blowing dry air at 4 liters per minute. After warming, the reaction was continued for 1 hour.

[0175]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 30 minutes. From 3 hours
10 after the completion of dripping, the acid value was measured every hour, and after confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 7.0 mg KOH/g (hereafter, it is referred to as "resin 8 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

15 [0176]

The resin 8 containing component (a) was analyzed under the same conditions as in Synthetic Example 1, and it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 8 belonging to component (a)".
20 Therefore, 0.25 g of hydroquinone as a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride as a catalyst are contained in "resin 8 belonging to component (a)." The content of each resin component in resin 8 containing component (a) is shown in Table 1.

[0177]

25 (Synthetic Example 9)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was loaded with 188.0 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 97.4 g of Haridimer (registered trademark) 250 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 3% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 79% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 18% mass%, acid value: 192 mg KOH/g), 48.7 g of Pripol (registered trademark) 1010VEG, a hydrogenated dimer acid (manufactured by Croda Japan Co., Ltd.: acid value: 192 mg KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and heated to 125°C under stirring while blowing dry air at 4 liters per minute. After warming, the reaction was continued for 1 hour.

[0178]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 30 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 7.0 mg KOH/g (hereafter, it is referred to as "resin 9 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0179]

When the resin 9 containing component (a) was analyzed under the same conditions as in Synthetic Example 1, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 9 belonging to component (a)".

Therefore, 0.25 g of hydroquinone as a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride as a catalyst are contained in "resin 9 belonging to component (a)." The content of each resin component in resin 9 containing component (a) is shown in Table 1.

[0180]

(Synthetic Example 10)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was charged with 188.0 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 139.4 g of Haridimer (registered trademark) 250 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 3% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 79% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 18% mass%, acid value: 192 mg KOH/g), 6.23 g of NAA-175, main component: stearic acid (manufactured by NOF Corporation: acid value: 207 mg KOH/g), and 1.0 g of N,N-dimethylbenzylamine as a catalyst, and heated to 125°C while blowing dry air at 4 liters per minute under agitation. After warming, the reaction was continued for 1 hour.

[0181]

Then, 0.25 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 30 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the value had decreased to less than 7 mg KOH/g, the resin containing component (a) with an acid value of 7.0 mg KOH/g (hereafter, it is referred to as "resin 10 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling the resin to 100°C.

[0182]

When the resin 10 containing component (a) was analyzed under the same conditions as in Synthetic Example 1, it was confirmed that about 20% of methacrylic acid adduct to bisphenol A-type epoxy resin and about 1% of methacrylic acid were present. The remaining approximately 79% shall be described as "resin 10 belonging to component (a)". This means that 0.25 g of hydroquinone, which is a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride, which is a catalyst, are contained in "resin 10 belonging to component (a)." The content of each resin component in resin 10 containing component (a) is shown in Table 1.

[0183]

(Synthetic Example 11)

In a 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube, 292.2 g of Haridimer (registered trademark) 200 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 7% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 76% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 17% mass%, acid value: 192 mg KOH/g), 16.4 g of JER871, a dimer acid-based epoxy resin (manufactured by Mitsubishi Chemical Corporation: epoxy equivalent: 410 g/eq), and 1.0 g of N,N-dimethylbenzylamine as a catalyst were charged, and the temperature was raised to 123°C under stirring while 4 liters of dry air was blown per minute. After warming, the reaction was continued for 3 hours.

[0184]

Then, 0.15 g of hydroquinone and 1.0 g of N,N-dimethylbenzylamine as a catalyst were added, and 133.62 g of glycidyl methacrylate was added dropwise over 15 minutes.

After the dropping, the reaction was continued by maintaining the temperature of the

solution during the reaction at 120 to 125°C. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the acid value had decreased to less than 10 mg KOH/g, the resin containing component (a) with an acid value of 7.5 mg KOH/g (hereafter, it is referred to as "resin 11 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling to 100°C.

[0185]

This means that 0.3 g of hydroquinone, which is a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride, which are catalysts, are contained in "resin 11 containing component (a)". The content of each resin component in resin 11 containing component (a) is shown in Table 1.

[0186]

(Synthetic Example 12)

In a 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube, 112.8 g of EPOMIK (registered trademark) R140P, a bisphenol A-type epoxy resin (manufactured by Mitsui Chemicals, Inc.: epoxy equivalent: 188 g/eq), 146.1 g of Haridimer (registered trademark) 250 (manufactured by Harima Kasei Co., Ltd.: concentration of unsaturated fatty acids having 18 carbon atoms: 3% by mass, concentration of dimer acid, a dimer of unsaturated fatty acids having 18 carbon atoms: 79% mass%, concentration of trimer acid, a trimer of unsaturated fatty acids having 18 carbon atoms: 18% mass%, acid value: 192 mg KOH/g), 12.3 g of JER871, a dimer acid-based epoxy resin (manufactured by Mitsubishi Chemical Corporation: epoxy equivalent: 410 g/eq), 49.04 g of glycidyl methacrylate, 0.15 g of hydroquinone, and 1.0 g of N,N-dimethylbenzylamine as a catalyst were loaded, and the temperature was raised to 120°C while blowing 4 liters of

dry air per minute under agitation, and after the temperature was raised, it was continued until the acid value fell below 5.0 mg KOH/g or less.

[0187]

Then, 0.15 g of hydroquinone and 1.0 g of trimethylbenzylammonium chloride were added, and 43.05 g of methacrylic acid was added dropwise over 30 minutes. From 3 hours after the completion of dripping, the acid value was measured every hour, and after confirming that the acid value had decreased to less than 10 mg KOH/g, the resin containing component (a) with an acid value of 7.5 mg KOH/g (hereafter, it is referred to as "resin 12 containing component (a)"), which is an essential component of the present embodiment, was obtained by cooling to 100°C.

[0188]

Analysis of the resin 12 containing component (a) under the same conditions as in Synthetic Example 1 confirmed the presence of about 18% of methacrylic acid adduct to bisphenol A-type epoxy resin, about 6% of 2-hydroxy-3-methacryloyloxypropyl methacrylate, and about 1% of methacrylic acid. The remaining approximately 75% shall be denoted as "resin 12 belonging to component (a)". This means that 0.3 g of hydroquinone, which is a polymerization inhibitor, 1.0 g of N,N-dimethylbenzylamine, and 1.0 g of trimethylbenzylammonium chloride, which is a catalyst, are contained in "resin 12 belonging to component (a)". The content of each resin component in resin 12 containing component (a) is shown in Table 1.

[0189]

<Production of Resin Liquid Containing Component (b)>

(Synthetic Example 13)

A 2-liter four-neck flask equipped with an agitator, a condenser, a thermometer, and an air induction tube was fitted with 183.0 g of novolak-type epoxy resin "EPICRON

(registered trademark) N-740" (epoxy equivalent = 183 g/eq, manufactured by DIC Corporation), 81.79 g of methacrylic acid, 56.74 g of Diethylene glycol dimethacrylate (product name: Light Ester (registered trademark) 2EG), 0.265 g of hydroquinone, and 0.53 g of N,N-dimethylbenzylamine were loaded and allowed to react at 117 +/- 3°C under stirring while blowing 4 liters of dry air per minute until the acid value was below 12.0 mg KOH/g. As a result, a mixture of novolak-type epoxy methacrylate and diethylene glycol dimethacrylate (acid value: 10 mg KOH/g, denoted as "resin 1 containing component (b)") was obtained. It was also confirmed that 1.5 mass% of methacrylic acid remained in the solution.

[0190]

Note that the above mixture minus the total amount of diethylene glycol dimethacrylate and the total amount of methacrylic acid is denoted as "resin 1 belonging to component (b)".

[0191]

Then, 56.74 g of diethylene glycol dimethacrylate was added and dissolved by stirring well. Thus, a mixture containing novolak-type epoxy methacrylate: diethylene glycol dimethacrylate was obtained.

[0192]

This means that 0.265 g of hydroquinone, which is a polymerization inhibitor, and 0.53 g of N,N-dimethylbenzylamine as a catalyst are contained in "resin 1 belonging to component (b)".

The content of each resin component in resin 1 containing component (b) is shown in Table 1.

[0193]

<Preparation of Resin Composition>

(Example 1-1)

An appropriate amount of the resin mixture produced in Synthetic Example 1 (resin 1 containing component (a)) was used so that 38.71 parts by mass of "resin 1 belonging to component (a)" as component (a) was used. An appropriate amount of the resin mixture
5 produced in Synthetic Example 13 (resin 1 containing component (b)) was used so that 20.64 parts by mass of "resin 1 belonging to component (b)" as component (b) was used.

An appropriate amount of diethylene glycol dimethacrylate was used together with diethylene glycol dimethacrylate contained in the resin mixture (b) so that 30 parts by mass of diethylene glycol dimethacrylate (product name: Light Ester (registered trademark) 2EG)
10 as component (c) was used.

The above component (a)-containing resin 1, the above component (b)-containing resin 1, and the added diethylene glycol dimethacrylate were mixed.

The mixture contained 9.80 parts by mass of methacrylic acid adduct to bisphenol A-type epoxy resin (as component (b')) contained in the component (a)-containing resin 1;
15 and a total of 0.85 parts by mass of methacrylic acid contained in the component (a)-containing resin 1 and the component (b)-containing resin 1. The resin component containing components (a) to (c) and component (b') totaled 100 parts by mass.

To the above mixture, 1.5 parts by mass of a 50 mass% octylate-cobalt mineral spirit solution (cobalt concentration: 8 mass%) as component (d) and 1.0 parts by mass of Curing
20 agent 328EM (t-butyl peroxybenzoate, cumene hydroperoxide, methyl ethyl ketone peroxide diluted with a solvent, manufactured by Kayaku Nouryon Co., Ltd.) as component (h) were mixed and stirred and used as a resin composition for the preparation of specimens for a simple cold-hot-cycle test, 80°C warm water test, acid resistance test, and base resistance test described later.

[0194]

(Example 1-2 to Example 1-15, Comparative Example 1-1, and Comparative Example 1-2)

Mixtures of Example 1-2 to Example 1-15, Comparative Example 1-1, and Comparative Example 1-2 were prepared in the same manner as in Example 1-1 with the
5 formulations described in Table 2.

[0195]

<Ease of Forming Cured Coating Film>

The resin composition adjusted by the formula described in Table 2 was applied on the glass with a PET film so that the wet film thickness was 1 mm. After application, a
10 cured coating film was obtained by leaving it in an environment with a temperature of 23°C and a relative humidity of 50% for 24 hours. A polyester film stretched on the glass is to prevent the paint film from sticking to the glass.

[0196]

The condition of the coating film was evaluated according to the following
15 evaluation criteria when the coating solution was left for 24 hours in an environment of 23°C and 50% relative humidity after application. The evaluation method is as follows.

A: A cured paint film was formed and a person did not feel stickiness when touching it with fingers.

B: The paint film was cured, but a person felt stickiness when touching it with fingers.

20 C: Uncured.

[0197]

<Simple Cold-Hot-Cycle Test>

A surface of an SUS plate was sandpapered, on which a moisture-curable urethane primer (grade name: UM -50 P Mitsui Chemicals, Inc.) was applied, and after 4 to 5 hours,
25 the resin composition described in Table 2 was applied to obtain a thickness of about 3.5

mm after curing, and cured for 24 hours in an environment of 23°C and 50% relative humidity. Then, the resin composition was further applied to obtain a thickness of 3.5 mm after curing, and then, cured in an environment of 23°C and 50% relative humidity for 3 days.

5 [0198]

The samples were placed in a cold-hot-cycle testing machine and subjected to a cycle test at "80°C, 30 min." ↔ "-10°C, 30 min." for one cycle. Tests were performed every 12 cycles, up to a maximum of 48 cycles, to determine whether cracks were present in the cured layer. The evaluation method is as follows.

10 A: No small cracks after 48 cycles

B: No cracks after 12 cycles and small cracks after 48 cycles

C: Cracks after 12 cycles

[0199]

<70°C Warm Water Test>

15 The resin composition described in Table 2 was coated to a PET film supported by a glass plate, with the same thickness as in the simple cold-hot-cycle, at a temperature of 23°C and a relative humidity of 50%, and was coated two times at a speed of one-coating per day. After being cured, the PET film was peeled off to obtain a free-standing film. After leaving the film for 1 week, the specimens were prepared by cutting the film into 15
20 mm in width x 100 mm in length x 7 mm in thickness with a box cutter. The specimens were soaked in water and allowed to dry after 2 weeks in an oven at 70°C and evaluated by checking for delamination and bleaching between layers. The evaluation method is as follows.

[0200]

25 A: No delamination between layers and no bleaching of the surface were observed.

B: No bleaching but less than four situations of small delamination between layers were observed.

C: At least one situation of bleaching and four or more situations of small delamination between layers were observed.

5 [0201]

The swelling rate after 2 weeks (unit: mass%) was evaluated; and after measuring the swelling rate after 2 weeks, the rate of mass change after drying for 6 hours in an oven at 80°C (unit: mass%) was evaluated.

[0202]

10 (Calculation Formula)

Swelling rate (mass%) = (mass of specimen after immersion - mass of specimen before immersion)/mass of specimen before immersion x 100

[0203]

15 Rate of mass change (mass%) = (mass after drying in an oven at 80°C for 6 hours - mass of specimen before immersion)/mass of specimen before immersion x 100

[0204]

<Acid Resistance Test and Base Resistance Test>

20 The resin composition described in Table 2 was coated to a PET film supported by a glass plate, with the same thickness as in the simple cold-hot-cycle, at a temperature of 23°C and a relative humidity of 50%, and was coated two times at a speed of one-coating per day. After being cured, the PET film was peeled off to obtain a free-standing film. After the film was left for 1 week, a specimen of 15 mm in width x 100 mm in length x 7 mm in thickness obtained by cutting the cured coating film was immersed in 10 volume% acetic acid at 40°C for 2 months and saturated calcium hydroxide at 40°C for 2 months, and
25 then removed, and the specimen was washed with ion-exchanged water, and the weight

change was measured to determine the swelling rate (unit: mass%) from the following formula, which was used as an index of water resistance, acid resistance, and base resistance. Smaller numbers indicate higher water resistance, acid resistance, and base resistance.

[0205]

5 (Calculation Formula)

Swelling rate (mass%) = (mass of specimen after immersion - mass of specimen before immersion)/mass of specimen before immersion x 100

[0206]

The test results are shown in Table 2.

10 [0207]

[Table 2]

		Examples															Comparative Examples	
		1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13	1-14	1-15		
Component (b)	Resin 1 belonging to component (b)	20.55	20.64	34.39	20.64	20.64	20.64	20.64	20.64	20.64	20.64	48.15	30.95	24.08	26.14	34.39		68.79
	Resin 1 belonging to component (a)	38.71																
Component (a)	Resin 2 belonging to component (a)		38.71															
	Resin 3 belonging to component (a)			33.75														
	Resin 4 belonging to component (a)				39.20													
	Resin 5 belonging to component (a)					38.71												
	Resin 6 belonging to component (a)						38.71										59.25	
	Resin 7 belonging to component (a)							38.71										
	Resin 8 belonging to component (a)								38.71									
	Resin 9 belonging to component (a)									38.71								
	Resin 10 belonging to component (a)										38.71							
	Resin 11 belonging to component (a)											37.00						
	Resin 12 belonging to component (a)												36.38	41.63	39.38	33.75		

Component (c)	Methacrylic acid	0.94	0.85	1.06	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.98	0.99	1.06	0.75	1.21
	2-Hydroxy-3-methacryloyloxypropyl methacrylate			2.70														3.33	3.15	2.7		
	Dicyclopentenylloxyethyl methacrylate (FA-512 MT)																			4.00		
	Ethylene glycol dimethacrylate (FA-121 MR)																					15.00
	Diethylene glycol dimethacrylate (Light Ester 2EG)	30.00	30.00	20.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	14.00	20.00	20.00	20.90	16.00	25.00	
	Tetraethylene glycol dimethacrylate (Light Ester 4EG)																					15.00
	Methacrylic acid adduct to bisphenol A-type epoxy resin	9.80	9.80	8.10	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	0.00	8.73	9.99	9.45	8.10	15.00	0.00
Other Component	Methacrylic acid adduct to bisphenol F-type epoxy resin																					
Component (d)	50 wt% Octylic acid cobalt mineral spirit solution (Co concentration 8 wt%)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Component (h)	Curing agent 328EM manufactured by Kayaku Nouryon Co., Ltd.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Evaluation Results	Surface dryness during curing	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A
	Simple cold-hot-cycle test results (80°C, 30 min ↔ -10°C < 30 min)	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	C
	70°C warm water test results (2 weeks): Existence of delamination and bleaching	A	A	A	A	A	A	A	A	B	B	B	B	A	A	B	B	B	B	B	C	A
	70°C warm water test results (2 weeks): Swelling rate after 2 weeks (mass%)	3.0	3.4	2.7	3.6	3.6	3.6	2.6	1.5	2.0	2.2	3.4	2.4	2.5	2.1	2.4	3.0	4.0				

[0208]

(Example 2-1)

49 parts by mass of the resin produced in Synthetic Example 1, 30 parts by mass of the mixture produced in Synthetic Example 8, 21 parts by mass of diethylene glycol dimethacrylate (product name: Light Ester (registered trademark) 2EG), 1.5 parts by mass of a 50 mass% cobalt octylic acid mineral spirit solution (cobalt concentration: 8 mass%) as component (d), 3.7 parts by mass of KEMIBESTO (registered trademark) FD990 (manufactured by Mitsui Chemicals Fine Co., Ltd.) as component (e), and 1.0 parts by mass of Curing agent 328EM (t-butyl peroxybenzoate, cumene hydroperoxide, methyl ethyl ketone peroxide diluted with a solvent, manufactured by Kayaku Nouryon Co., Ltd.) as component (h) were mixed and stirred and used as a resin composition for the preparation of specimens for the simple cold-hot-cycle test, 80°C warm water test, acid resistance test, and base resistance test described below.

[0209]

(Example 2-2 to Example 2-15, Comparative Example 2-1, and Comparative Example 2-2)

Mixtures of Example 2-2 to Example 2-15, Comparative Example 2-1, and Comparative Example 2-2 were prepared in the same manner as in Example 2-1 with the formulations described in Table 3.

[0210]

A simple cold-hot-cycle test, 70°C warm water test, acid resistance test, and base resistance test were performed in the same manner as described above for the mixtures of Example 2-2 to Example 2-15, Comparative Example 2-1, and Comparative Example 2-2 with the formulations described in Table 3 which were prepared in the same manner as in Example 2-1. The results are shown in Table 3.

[0211]

Other Component	Diethylene glycol dimethacrylate (Light Ester2EG)	30.00	30.00	20.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	14.00	20.00	20.00	20.90	16.00	25.00	
	Tetraethylene glycol dimethacrylate (Light Ester 4EG)																	15.00
	Methacrylic acid adduct to bisphenol A-type epoxy resin	9.80	9.80	8.10	9.80	9.80	9.80	9.80	9.80	9.80	9.80	0.00	8.73	9.99	9.45	8.10	15.00	0.00
Component (d)	Methacrylic acid adduct to bisphenol F-type epoxy resin																	
	50 wt% octylic acid cobalt mineral spirit solution (Co concentration 8 wt%)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Component (e)	KEMIBESTO (registered trademark) FD990 (manufactured by Mitsui Chemicals Fine Co., Ltd.)	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Component (h)	Curing agent 328EM manufactured by Kayaku Nouryon Co., Ltd.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Evaluation Results	Surface dryness during curing	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A
	70°C warm water test results (2 weeks): Existence of delamination and bleaching	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C
	70°C warm water test results (2 weeks): Swelling rate after 2 weeks (mass%)	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	C	A
	70°C warm water test results (2 weeks): Percentage mass change after drying of 70°C warm water test sample (mass%)	2.9	3.3	2.6	3.5	3.5	3.5	3.5	3.5	2.5	1.4	1.9	2.1	2.3	2.0	2.3	2.9	3.5
	Acid resistance test (mass%)	-0.3	0.8	-0.4	-0.5	-0.5	-0.5	-0.5	0.3	-0.9	-0.3	-0.2	0.8	-0.3	0.3	0.3	-1.8	-0.1

	Base resistance test (mass%)	1.1	1.1	0.9	1.2	1.2	1.4	1.2	1.2	1.1	1.2	1.3	1.2	1.3	1.3	0.8	2.9	0.9
	Base resistance test (mass%)	3.0	3.4	2.5	3.4	3.4	3.5	2.4	1.4	1.9	2.2	3.2	2.4	2.5	2.1	2.2	3.8	3.7

[0212]

<Preparation of Emulsified Resin Composition>

(Example 3-1)

An emulsified resin composition was prepared by adding 49 parts by mass of the resin produced in Synthetic Example 1, 30 parts by mass of the mixture produced in Synthetic Example 8, 21 parts by mass of diethylene glycol dimethacrylate (product name: Light Ester (registered trademark) 2EG), 1.5 parts by mass of a 50 mass% cobalt octylic acid mineral spirit solution (cobalt concentration: 8 mass%) as component (d), 1.0 g of Anionic reactive surfactant "ADEKA REASOAP (registered trademark) SR-10" (manufactured by ADEKA Co., Ltd.), and 10.0 g of Nonionic reactive surfactant "ADEKA REASOAP (registered trademark) ER-30" (manufactured by ADEKA Co., Ltd.) as component (f), and stirring well while dropping 15.0 g of pure water as component (g) into the resulting mixture at 100 ml/h. In this resin composition, no separation of surfactants from the resin component was observed, and the emulsified state was stable.

[0213]

(Example 3-2 to Example 3-15, Comparative Example 3-1, and Comparative Example 3-2)

Emulsified resin compositions containing the formulations, described in Table 4, of Example 3-2 to Example 3-15, Comparative Example 3-1, and Comparative Example 3-2 were prepared in the same manner as in Example 3-1. In all these resin compositions, no separation of surfactants from the resin components was observed, and the emulsified state was stable.

[0214]

Using an emulsified composition obtained by mixing and stirring a mixture which was prepared by adding 1.0 parts by mass of Curing agent 328EM (t-butyl peroxybenzoate,

cumene hydroperoxide, methyl ethyl ketone peroxide diluted with a solvent, manufactured by Kayaku Nouryon Co., Ltd.) as a component (h) into each of the emulsified resin compositions prepared in Examples 3-1 to 3-15, Comparative Example 3-1, and Comparative Example 3-2, a simple cold-hot-cycle test and a 70°C warm water test, an acid
5 resistance test, and a base resistance test were performed by the above method.

The results are shown in Table 4.

[0215]

[illegible]

	70°C warm water test results (2 weeks):	-0.3	0.9	-0.4	-0.5	-0.5	-0.5	0.3	-1.1	-0.3	-0.2	0.9	0.3	-0.3	0.3	0.3	-2.1	-0.1
	Acid resistance test (mass%)	1.1	1.2	1.0	1.3	1.2	1.6	1.2	1.2	1.1	1.2	1.5	1.2	1.4	1.3	1.0	3.1	0.8
	Base resistance test (mass%)	3.1	3.5	2.6	3.5	3.5	3.5	2.5	2.5	2.0	2.3	3.3	2.5	2.6	2.6	2.2	3.6	3.4

[0216]

(Example 4-1)

An emulsified resin composition was prepared by adding 49 parts by mass of the resin produced in Synthetic Example 1, 30 parts by mass of the mixture produced in Synthetic Example 8, 21 parts by mass of diethylene glycol dimethacrylate (product name: Light Ester (registered trademark) 2EG), 1.5 parts by mass of a 50 mass% cobalt octylic acid mineral spirit solution (cobalt concentration: 8 mass%) as component (d), 1.0 g of Anionic reactive surfactant "ADEKA REASOAP (registered trademark) SR-10" (manufactured by ADEKA Co., Ltd.), and 10 g of Nonionic reactive surfactant "ADEKA REASOAP (registered trademark) ER-30" (manufactured by ADEKA Co., Ltd.) as component (f), and stirring well while dropping 20 g of pure water as component (g) into the resulting mixture at 100 ml/h. Then, 3.7 parts by mass of KEMIBESTO (registered trademark) FD990 (manufactured by Mitsui Chemicals Fine Co., Ltd.) as component (e) was added and mixed and stirred to prepare an emulsified resin composition.

In this resin composition, no separation of surfactants from the resin component was observed, and the emulsified state was stable.

[0217]

(Example 4-2 to Example 4-15, Comparative Example 4-1, and Comparative Example 4-2)

Emulsified resin compositions containing the formulations of Example 4-2 to Example 4-15, Comparative Example 4-1, and Comparative Example 4-2 were prepared in the same manner as in Example 4-1 with the formulations described in Table 5, respectively. In all these resin compositions, no separation of surfactants from the resin components was observed, and the emulsified state was stable.

[0218]

Using an emulsified composition obtained by mixing and stirring a mixture which was prepared by adding 1.0 parts by mass of Curing agent 328EM (t-butyl peroxybenzoate, cumene hydroperoxide, methyl ethyl ketone peroxide diluted with a solvent, manufactured by Kayaku Nouryon Co., Ltd.) as a component (h) into each of the emulsified resin
5 compositions prepared in Examples 4-1 to 4-15, Comparative Example 4-1, and Comparative Example 4-2, a simple cold-hot-cycle test and a 70°C warm water test, an acid resistance test, and a base resistance test were performed by the above method.

The test results are shown in Table 5.

[0219]

[Table 5]

		Examples															Comparative Examples	
		4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	4-12	4-13	4-14	4-15		
Component (b)	Resin 1 belonging to component (b)	20.64	20.64	34.39	20.64	20.64	20.64	20.64	20.64	20.64	20.64	48.15	30.95	24.08	26.14	34.39		68.79
	Resin 1 belonging to component (a)	38.71																
	Resin 2 belonging to component (a)		38.71															
	Resin 3 belonging to component (a)			33.75														
	Resin 4 belonging to component (a)				39.20													
	Resin 5 belonging to component (a)					38.71												
	Resin 6 belonging to component (a)						38.71										59.3	
	Resin 7 belonging to component (a)							38.71										
	Resin 8 belonging to component (a)								38.71									
	Resin 9 belonging to component (a)									38.71								
	Resin 10 belonging to component (a)										38.71							
	Resin 11 belonging to component (a)											37.00						
Resin 12 belonging to component (a)												36.38	41.63	39.38	33.75			
Component (c)	Methacrylic acid	0.85	0.85	1.06	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	1.03	0.98	0.99	1.06	0.75	1.21
	2-Hydroxy-3-methacryloyloxypropyl methacrylate			2.70								2.91	3.33	3.15	2.7			
	Dicyclopentenylloxyethyl methacrylate (FA-512 MT)															4.00		
	Ethylene glycol dimethacrylate (FA-121 MR)																	15.00
	Diethylene glycol dimethacrylate (Light Ester 2EG)	30.00	30.00	20.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	14.00	20.00	20.00	20.90	16.00	25.00	

[illegible]

	70°C warm water test results (2 weeks): Swelling rate after 2 weeks (mass%)	3.0	3.3	2.7	3.5	3.5	3.5	3.5	3.5	2.6	1.5	2.0	2.2	3.4	3.4	2.5	2.2	2.5	3.0	3,5
	70°C warm water test results (2 weeks): Acid resistance test (mass%)	-0.3	0.8	-0.4	-0.5	-0.5	-0.5	0.3	-0.9	-0.3	-0.2	0.8	0.3	-0.3	0.3	0.3	0.3	0.3	-1.8	-0.1
	Base resistance test (mass%)	1.2	1.2	1.0	1.3	1.3	1.6	1.3	1.3	1.2	1.2	1.6	1.4	1.3	1.3	1.4	1.4	1.1	3.1	0.8
	Base resistance test (mass%)	3.2	3.4	2.6	3.5	3.4	3.5	2.4	1.5	1.9	2.4	3.2	2.4	2.4	2.5	2.3	2.1	4.0	3.5	

[0220]

From the results of Tables 2 to 5, it can be seen that when the resin composition of the present embodiment or the emulsified resin composition is used, the cured coating film is easy to form at room temperature, and the cured coating film has excellent warm water
5 resistance, acid resistance, and base resistance.

[Industrial Availability]

[0221]

The resin compositions and emulsified resin compositions of the present invention are available in the fields of coatings agents, paints, inks, adhesives, anticorrosion materials,
10 fiber processing materials, etc.

The resin compositions and emulsified resin compositions of the present invention are particularly available in the fields of lining materials for surface coating of concrete in sewerage treatment facilities; lining materials for repair of inner surfaces of manholes; lining materials for repair of concrete facilities in food factories, pharmaceutical factories,
15 and electronic materials related factories; paints; putty; adhesives; or the like.

[Document Name] Claims

[Claim 1]

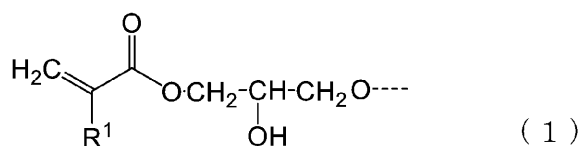
A resin composition comprising a component (a), a component (b), and a component (c), wherein:

5 the component (a) is at least one of the compounds comprising,

an organic residue derived from one or more compounds selected from the group consisting of dimeric acid, a dimer of unsaturated fatty acids having 18 carbon atoms, trimeric acid, a trimer of unsaturated fatty acids having 18 carbon atoms, and their hydrates in the molecule, and

10 a terminal structure of formula (1);

[Chemical Formula 1]



(in the formula, R^1 represents H or CH_3 ; dashed lines represent bonding sites),

15 the component (b) is at least one of the compounds, without the organic residue derived from the dimeric acid, the trimeric acid, and their hydrates, which comprises

a structure derived from a novolak phenolic resin and a terminal structure of the formula (1) in the molecule; and

20 the component (c) comprises at least one polymerizable unsaturated group in the molecule, and is at least one type of reactive diluent having a viscosity of 500 mPa·s or less at 25°C.

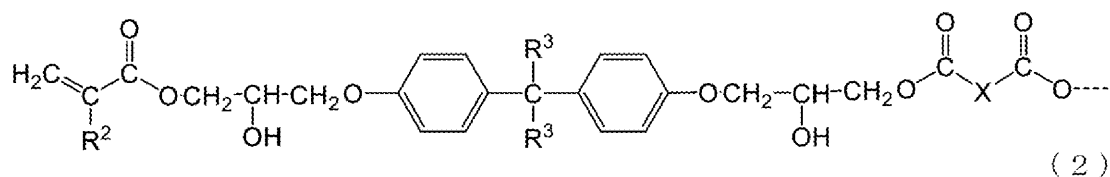
[Claim 2]

The resin composition according to claim 1, wherein the component (a) comprises a compound having a structure derived from at least one selected from the group consisting of bisphenol A and bisphenol F.

[Claim 3]

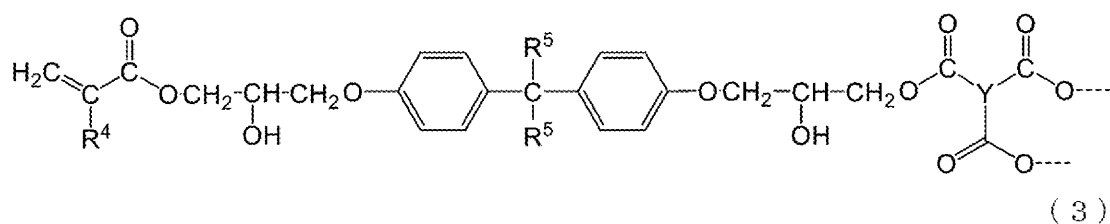
- 5 The resin composition according to claim 1 or claim 2, wherein the component (a) comprises one or more compounds having at least one structure selected from the group consisting of formula (2) and formula (3),

[Chemical Formula 2]



- 10 (in the formula, R^2 and R^3 independently represent H or CH_3 , respectively, and X represents the dimer acid or a hydrocarbon group from which a carboxy group is removed from the hydrate of the dimer acid; dashed lines represent bonding sites),

[Chemical Formula 3]



- 15 (in the formula, R^4 and R^5 independently represent H or CH_3 , respectively, and Y represents the hydrocarbon group from which the carboxy group is removed from the trimeric acid or the hydrate of the trimeric acid; dashed lines represent bonding sites).

[Claim 4]

The resin composition according to claim 1 or claim 2, wherein the component (c) comprises 50 mass% or more of a reactive diluent having two polymerizable unsaturated groups in the molecule.

[Claim 5]

5 The resin composition according to claim 1 or claim 2, wherein the component (c) comprises 50 mass% or more of a reactive diluent having a viscosity of 100 mPa·s or less at 25°C.

[Claim 6]

10 The resin composition according to claim 1 or claim 2, wherein with respect to a total amount of all polymerizable components, including the component (a), the component (b), and the component (c),

a content of the component (a) is 20 to 60 mass%,

a content of the component (b) is 15 to 60 mass%, and

a content of the component (c) is 10 to 50 mass%.

15 [Claim 7]

The resin composition according to claim 1 or claim 2, further comprising a polymerization accelerator as a component (d).

[Claim 8]

20 The resin composition according to claim 1 or claim 2, further comprising at least one selected from the group consisting of a short-fiber-like organic compound and a short-fiber-like inorganic compound, as a component (e).

[Claim 9]

The resin composition according to claim 1 or claim 2, further comprising a surfactant as a component (f).

25 [Claim 10]

The resin composition according to claim 9, wherein water, as a component (g), is further added to the resin composition and the resin composition is emulsified.

[Claim 11]

The resin composition according to claim 1 or claim 2, further comprising a
5 methacrylic acid adduct to a bisphenol A-type epoxy resin, as a component (b').

[Claim 12]

The resin composition according to claim 1 or claim 2, further comprising a polymerization initiator as a component (h).

[Claim 13]

10 The resin composition according to claim 12, wherein the component (h) comprises at least one organic peroxide.

[Claim 14]

A polymer of the resin composition according to claim 12.

[Claim 15]

15 A surface treatment material comprising the resin composition according to claim 12,

wherein the surface treatment material is applied to at least one surface selected from the group consisting of metal, plastic, concrete, mortar, wood, and glass.

[Claim 16]

20 A surface treatment method of a material selected from the group consisting of metal, plastic, concrete, mortar, wood, and glass, the method comprising:

a first step of preparing a coating solution by adding a polymerization initiator as a component (h) to the resin composition according to claim 1 or claim 2; and

a second step of applying the coating solution prepared in the first step to a surface of the material and then curing the coating solution at 0 to 50°C to form a cured coating film on the surface of the material.

[Claim 17]

- 5 A method for producing a cured-coating-film-containing material, including a step of forming the cured coating film on the surface of the material using the surface treatment method according to claim 16.