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(54) **TRANSPARENTIZING AGENT, METHOD FOR PRODUCING SAME, TRANSPARENT PAPER, AND METHOD FOR PRODUCING SAME**

(57) The present invention provides a transparentizing agent that uses bio-derived raw materials and that can produce a transparent paper that is excellent in transparency and stability over time. The present invention provides a transparentizing agent including a polyester resin component that is a reaction product of a raw

material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, wherein the polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less

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Description

TECHNICAL FIELD

[0001] The present invention relates to a transparentizing agent, a method for producing the same, a transparent paper, and a method for producing the same.

[0002] This application claims priority based on Japanese Patent Application No. 2023-176632, filed on October 12, 2023, the contents of which are incorporated herein by reference.

BACKGROUND ART

[0003] Common methods for producing a highly transparent paper include, for example, making paper using pulp fibers with a high degree of beating, or impregnating voids between the fibers of the made base paper with a resin or the like.

[0004] Methods of making paper using pulp fibers with a high degree of beating are used to make a glassine paper, a tracing paper, and the like. Paper made using pulp fibers with a high degree of beating is used as a packaging paper for windows of envelopes and the like. However, this type of paper is generally difficult to use for applications such as a packaging bag where strength is required, because the pulp fibers are crushed and cut by the high degree of beating.

[0005] On the other hand, a method of impregnating the voids between fibers of a base paper with a resin or the like is used in the production of an oil paper, a wax paper, and the like. For example, Patent Document 1 proposes obtaining a transparent paper by thermally melting and coating or impregnating a base paper with a transparentizing agent containing a resin and a paraffin wax. Patent Document 2 proposes obtaining a transparent paper by coating or impregnating paper with a composition containing a liquid diene polymer and irradiating it with ultraviolet light. Patent Document 3 proposes coating a rosin-based aqueous transparentizing agent to a portion of a base paper and heating it to obtain a windowed packaging bag. Patent Document 4 proposes printing and impregnating a transparentizing agent mainly containing a vegetable oil onto a specific surface of an opaque paper, and forming an oil layer protective film on both sides to make the opaque paper transparent.

PRIOR ART DOCUMENTS

PATENT LITERATURE

[0006]

Patent Document 1: Japanese Unexamined Patent Application, First Publication No. S61-132698

Patent Document 2: Japanese Unexamined Patent Application, First Publication No. S61-132699

Patent Document 3: Japanese Unexamined Patent Application, First Publication No. 2011-63286

Patent Document 4: Japanese Unexamined Patent Application, First Publication No. S62-15395

SUMMARY OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0007] In recent years, the replacement of a plastic film with paper has been considered as a sustainable and recyclable material. For example, the replacement of a packaging material with paper is also progressing. If the transparency of a plastic film could be imparted to paper, it is expected that its applications would be further expanded.

[0008] The technologies described in Patent Documents 1 to 4 impregnate the voids between cellulose fibers of paper with a transparentizing agent, thereby increasing the transparency of translucent regions impregnated with the transparentizing agent.

[0009] However, the paraffin wax used in Patent Document 1 is a mixture of solid hydrocarbons made from petroleum, and is not a bio-derived raw material.

[0010] The liquid diene-based polymer used in Patent Document 2 is also a petroleum-derived resin, and is not a bio-derived raw material.

[0011] The rosin-based aqueous transparentizing agent used in Patent Document 3 does not achieve sufficient transparency.

[0012] Patent Document 4 requires an oil layer protection layer to prevent the impregnated vegetable oil from seeping out. If an oil layer protection layer is not provided, the vegetable oil will seep out and dry over time, causing the paper to become cloudy.

[0013] The present invention aims to provide a transparentizing agent that uses bio-derived raw materials and that can

produce a transparent paper that is excellent in transparency and stability over time, and a method for producing the same; and a transparent paper that is excellent in transparency and stability over time and that uses a transparentizing agent that uses bio-derived raw materials, and a method for producing the same.

5 MEANS FOR SOLVING THE PROBLEM

[0014] The inventors investigated a transparentizing agent that uses a combination of rosins and aliphatic carboxylic acids. While rosins and aliphatic carboxylic acids each exhibit a refractive index close to that of cellulose pulp, using them together brings the refractive index closer to that of cellulose pulp than that of either of them. However, as in Patent Document 4, if left as is, the aliphatic carboxylic acid leaches out or dries, causing the paper to become cloudy. After further investigation, the inventors discovered that the above-mentioned problems can be solved by incorporating rosins and aliphatic carboxylic acids into polyester resins, leading to the completion of the present invention.

[0015] The present invention has the following aspects.

[1] A transparentizing agent containing a polyester resin component that is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, wherein the polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.

[2] The transparentizing agent according to [1], wherein the polyester resin component has an iodine value of 10 g/100 g or more and 140 g/100 g or less.

[3] A method for producing a transparentizing agent, containing reacting a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid to obtain a polyester resin component having an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.

[4] The method for producing a transparentizing agent according to [3], wherein the polyester resin component has an iodine value of 10 g/100 g or more and 140 g/100 g or less.

[5] The method for producing a transparentizing agent according to [3] or [4], wherein the (B) polycarboxylic acid contains an α,β -unsaturated dicarboxylic acid, and the polyester resin component is obtained by reacting the (A) rosin with the α,β -unsaturated dicarboxylic acid to obtain a first product, and then reacting the first product with the (C) polyol and the (D) aliphatic monocarboxylic acid.

[6] The method for producing a transparentizing agent according to [3] or [4], wherein the (B) polycarboxylic acid contains an α,β -unsaturated dicarboxylic acid, and the polyester resin component is obtained by reacting the (A) rosin with the α,β -unsaturated dicarboxylic acid to obtain a first product, modifying the (C) polyol with an oil or fat having the (D) aliphatic monocarboxylic acid as its constituent fatty acid to obtain a modified product, and then reacting the first product with the modified product.

[7] A transparent paper containing a transparentizing agent at least inside a paper base, wherein the transparentizing agent contains a polyester resin component that is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, and wherein an acid value of the polyester resin component is 100 mg KOH/g or less, a weight-average molecular weight of the polyester resin component is 1,000,000 or less, and a refractive index of the polyester resin component is 1.40 or more and 1.60 or less.

[8] The transparent paper according to [7], wherein an iodine value of the polyester resin component is 10 g/100 g or more and 140 g/100 g or less.

[9] The transparent paper according to [7] or [8], wherein the paper base contains softwood chemical pulps and hardwood chemical pulps.

[10] A method for producing a transparent paper by coating or impregnating a paper base with a liquid composition containing a transparentizing agent and a liquid medium, and then drying the paper base, wherein the transparentizing agent contains a polyester resin component that is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, and the polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.

[11] The method for producing a transparent paper according to [10], wherein an iodine value of the polyester resin component is 10 g/100 g or more and 140 g/100 g or less.

[12] The method for producing a transparent paper according to [10] or [11], wherein the paper base contains softwood chemical pulps and hardwood chemical pulps.

EFFECTS OF THE INVENTION

[0016] The present invention can provide a transparentizing agent that uses bio-derived raw materials and that can

produce a transparent paper that is excellent in transparency and stability over time, and a method for producing the same, as well as a transparent paper that uses a transparentizing agent that uses bio-derived raw materials and is excellent in transparency and stability over time, and a method for producing the same.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] In the present description, the use of "-" to indicate a numerical range means that the numerical values before and after it are included as lower and upper limits.

[0018] The lower and upper limits of the numerical ranges disclosed in the present description can be combined in any way to create new numerical ranges.

"Transparentizing Agent"

[0019] The transparentizing agent of the present invention contains a polyester resin component, which is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid. The polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less. The raw material component is described in detail below.

[0020] An acid value of the polyester resin component of 100 mg KOH/g or less results in excellent transparency properties. The acid value of the polyester resin component is preferably 70 mg KOH/g or less, more preferably 60 mg KOH/g or less, and even more preferably 50 mg KOH/g or less. From the standpoint of transparency suitability, the acid value of the polyester resin component is, for example, 0 mg KOH/g or more, preferably 5 mg KOH/g or more, more preferably 10 mg KOH/g or more, and even more preferably 20 mg KOH/g or more.

[0021] The acid value is measured in accordance with JIS K 5601-2-1 (1999).

[0022] Having a weight-average molecular weight (Mw) of 1,000,000 or less of the polyester resin component results in excellent transparency properties. The weight-average molecular weight of the polyester resin component is preferably 900,000 or less, and more preferably 800,000 or less. There is no particular lower limit for the weight-average molecular weight of the polyester resin component, and, for example, it is preferably 5,000 or more, and more preferably 10,000 or more.

[0023] The weight-average molecular weight of the polyester resin component is a value measured by gel permeation chromatography (GPC) in terms of standard polystyrene.

[0024] When the refractive index of the polyester resin component is 1.40 or more and 1.60 or less, the transparentizing agent has an excellent transparency effect on sheets whose main component is cellulose, such as paper. This is because the refractive index of cellulose fibers is generally in the range of 1.4 - 1.6. By setting the refractive index of the polyester resin component to a value close to that of the cellulose fibers, it is possible to reduce the refraction of light at the interface between the transparentizing agent and the pulp fibers in the paper base. The refractive index of the polyester resin component is preferably 1.45 or more and 1.58 or less, more preferably 1.47 or more and 1.57 or less, and even more preferably 1.48 or more and 1.56 or less.

[0025] The refractive index is measured in accordance with JIS K 7142 (2014).

[0026] From the viewpoint of drying properties, the iodine value of the polyester resin component is, for example, 5 g/100 g or more, preferably 10 g/100 g or more, more preferably 20 g/100 g or more, and even more preferably 40 g/100 g or more. From the viewpoint of suitability for transparency, the iodine value of the polyester resin component is, for example, 160 g/100 g or less, preferably 140 g/100 g or less, more preferably 120 g/100 g or less, and even more preferably 100 g/100 g or less.

[0027] The iodine value is measured in accordance with JIS K 0070 (1992).

[0028] From the viewpoint of film-forming ability and tack resistance, the softening point of the polyester resin component is, for example, 70°C or higher, preferably 75°C or higher, and more preferably 80°C or higher. From the viewpoint of film-forming ability and tack resistance, the softening point of the polyester resin component is, for example, 150°C or lower, preferably 130°C or lower, and more preferably 120°C or lower.

[0029] The softening point is measured by the Mettler method.

(Raw Materials for Polyester Resin Component)

[0030] The (A) rosin is plant-derived components. Therefore, the polyester resin components can contribute to carbon neutrality. More specifically, the (A) rosin is compounds derived from pine trees. Pine species are not particularly limited, but examples include Merkus pine, slash pine, and Masson pine. These can be used alone or in combination.

[0031] The (A) rosin is not particularly limited, and examples include known unmodified rosins and derivatives thereof. Examples of unmodified rosins include crude rosin and refined rosin. Examples of crude rosins include gum rosin, tall

rosin, and wood rosin. Examples of refined rosins include refined products of crude rosin. Examples of rosin derivatives include hydrogenated rosin, disproportionated rosin, and polymerized rosin. These can be used alone or in combination of two or more types. The origin of the rosin is not particularly limited, and examples include China, Vietnam, Indonesia, and Brazil. These can be used alone or in combination of two or more types.

[0032] From the standpoints of film-forming ability and water resistance, unmodified rosin is preferred as the (A) rosin, and gum rosin is more preferred.

[0033] The content ratio of the (A) rosin relative to the total amount of the raw material component is not particularly limited as long as the refractive index of the resulting polyester resin component satisfies 1.40 or more and 1.60 or less. From the viewpoints of suitability of transparency, film-forming ability, water resistance, and tack resistance, the content ratio of the (A) rosin relative to the total amount of the raw material component is, for example, 10% by mass or more, preferably 15% by mass or more, more preferably 20% by mass or more, and even more preferably 25% by mass or more. From the viewpoints of film-forming ability, water resistance, and tack resistance, the content ratio of the (A) rosin relative to the total amount of the raw material component is, for example, 80% by mass or less, preferably 70% by mass or less, more preferably 65% by mass or less, and even more preferably 60% by mass or less.

[0034] The (B) polycarboxylic acid refers to a compound having two or more carboxy groups and anhydrides thereof. The (B) polycarboxylic acid is a component that adjusts the molecular weight of the polyester resin component. Examples of the (B) polycarboxylic acid include oxalic acid, malonic acid, succinic acid, fumaric acid, maleic acid, itaconic acid, citraconic acid, glutaric acid, adipic acid, suberic acid, azelaic acid, sebacic acid, dodecanedioic acid, tetradecanedioic acid, hexadecanedioic acid, phthalic acid, isophthalic acid, terephthalic acid, tetrahydrophthalic acid, oxaloacetic acid, methylmalonic acid, dimethylmalonic acid, methylsuccinic acid, 2,2-dimethylsuccinic acid, methylglutaric acid, dimethylglutaric acid, diglycolic acid, 1,3-acetonedicarboxylic acid, ketoglutaric acid, cyclopropane-1,1-dicarboxylic acid, cyclobutane-1,1-dicarboxylic acid, cyclohexane-1,1-dicarboxylic acid, 2-oxoadipic acid, 4-oxoheptanedioic acid, 5-oxoazelaic acid, phenylenedioxydiacetic acid, indan-2,2-dicarboxylic acid, naphthalene-2,6-dicarboxylic acid, naphthalene-2,7-dicarboxylic acid, cyclohexanedicarboxylic acid, ethylenediaminetetraacetic acid, and anhydrides thereof. These can be used alone or in combination of two or more.

[0035] As the (B) polycarboxylic acid, dicarboxylic acids are preferred from the viewpoint of molecular weight adjustment.

[0036] The (B) polycarboxylic acid preferably contains an α,β -unsaturated dicarboxylic acid. Because the α,β -unsaturated dicarboxylic acid reacts with the (A) rosin, including the (B) polycarboxylic acid in an α,β -unsaturated dicarboxylic acid improves the stability of transparency.

[0037] Examples of the α,β -unsaturated dicarboxylic acid include fumaric acid, maleic acid, itaconic acid, citraconic acid, and anhydrides thereof. Examples of the anhydrides include maleic anhydride, itaconic anhydride, and citraconic anhydride. These can be used alone or in combination of two or more. The α,β -unsaturated dicarboxylic acid can also be used in combination with other dicarboxylic acids.

[0038] From the viewpoint of adjusting the molecular weight, the (B) polycarboxylic acid includes at least one selected from the group consisting of succinic acid, fumaric acid, maleic anhydride, and adipic acid, and more preferably includes fumaric acid.

[0039] The content of the (B) polycarboxylic acid relative to the total amount of the raw material component is, from the viewpoint of the molecular weight of the polyester resin component, for example, 3% by mass or more, preferably 5% by mass or more, more preferably 10% by mass or more, and even more preferably 12% by mass or more. Furthermore, the content of the (B) polycarboxylic acid relative to the total amount of the raw material component is, from the viewpoint of the molecular weight of the polyester resin, for example, 40% by mass or less, preferably 30% by mass or less, more preferably 25% by mass or less, and even more preferably 20% by mass or less.

[0040] The content of the (B) polycarboxylic acid relative to 100 moles of the (A) rosin is, from the viewpoint of the molecular weight of the polyester resin component, for example, 20 moles or more, preferably 30 moles or more, more preferably 35 moles or more, and even more preferably 40 moles or more. Furthermore, the content of the (B) polycarboxylic acid relative to 100 moles of the (A) rosin is, for example, 150 moles or less, preferably 120 moles or less, more preferably 110 moles or less, and even more preferably 100 moles or less. If the content of the (B) polycarboxylic acid is equal to or greater than the lower limit of the above range, the amount of unreacted (A) rosin will be relatively small, allowing the molecular weight of the polyester resin component to be increased. Also, if the content of the (B) polycarboxylic acid is equal to or less than the upper limit of the above range, the amount of unreacted (B) polycarboxylic acid will be relatively small, making it easier to adjust the molecular weight of the polyester resin component, and as a result, gelation will be less likely to occur.

[0041] Examples of the (C) polyols include dihydric alcohols, trihydric alcohols, and tetrahydric or higher alcohols.

[0042] Examples of dihydric alcohols include linear alkyl diols, branched alkyl diols, and ether diols. Examples of linear alkyl diols include ethylene glycol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, and 1,6-hexanediol. Examples of branched alkyl diols include propylene glycol, 1,3-butanediol, 1,2-butanediol, 3-methyl-1,5-pentanediol, and 2,6-dimethyl-1-octene-3,8-diol. Examples of ether diols include diethylene glycol, triethylene glycol, and dipropylene glycol.

Furthermore, examples of dihydric alcohols include 1,4-dihydroxy-2-butene, isosorbide, cyclohexanedimethanol, cyclohexanediol, tricyclodecanedimethylol, bisphenol A, hydrogenated bisphenol A, hydrogenated bisphenol F, hydrogenated bisphenol S, hydrogenated catechol, hydrogenated resorcinol, hydrogenated hydroquinone, and dicyclopentadiene diallyl alcohol copolymer.

[0043] Examples of trihydric alcohols include glycerin, trimethyloethane, trimethylolpropane, trimethylolhexane, and trimethylolactane.

[0044] Examples of tetrahydric or higher alcohols include tetrahydric - octahydric alcohols. Examples of tetrahydric - octahydric alcohols include pentaerythritol, diglycerin, ditrimethylolpropane, sorbitan, sorbitol, dipentaerythritol, inositol, and tripentaerythritol.

[0045] These can be used alone or in combination of two or more types.

[0046] From the viewpoint of adjusting the molecular weight of the polyester resin component, the (C) polyol preferably contains at least one selected from the group consisting of trihydric alcohols and tetrahydric or higher alcohols, more preferably contains a trihydric alcohol, still more preferably contains at least one selected from the group consisting of trimethylolpropane, glycerin, and pentaerythritol, and particularly preferably contains glycerin.

[0047] The (C) polyol has a carbon number of, for example, 2 or more, preferably 3 or more. The (C) polyol has a carbon number of, for example, 30 or less, preferably 20 or less, more preferably 10 or less, and still more preferably 8 or less.

[0048] The content of the (C) polyol relative to the total amount of the raw material component is, from the viewpoint of the molecular weight of the polyester resin component, for example, 5% by mass or more, preferably 8% by mass or more, more preferably 12% by mass or more, even more preferably 13% by mass or more, and particularly preferably 15% by mass or more. Also, the content of the (C) polyol relative to the total amount of the raw material component is, from the viewpoint of the molecular weight of the polyester resin, for example, 40% by mass or less, preferably 30% by mass or less, more preferably 25% by mass or less, and even more preferably 20% by mass or less.

[0049] Examples of the (D) aliphatic monocarboxylic acids include formic acid, acetic acid, trifluoroacetic acid, propionic acid, acrylic acid, methacrylic acid, pivalic acid, mercaptoacetic acid, and sorbic acid.

[0050] Further examples of the (D) aliphatic monocarboxylic acids include fatty acids derived from fats and oils. More specific examples include linseed oil fatty acids, yuzu oil fatty acids, pistachio oil fatty acids, rice oil fatty acids, safflower oil fatty acids, apricot oil fatty acids, cottonseed oil fatty acids, sesame oil fatty acids, corn oil fatty acids, watermelon oil fatty acids, soybean oil fatty acids, poppy seed oil fatty acids, apple oil fatty acids, sunflower oil fatty acids, cactus oil fatty acids, tall oil fatty acids, walnut oil fatty acids, tung oil fatty acids, clove oil fatty acids, and castor oil fatty acids. These can be used alone or in combination of two or more.

[0051] The refractive index of the (D) aliphatic monocarboxylic acid is, for example, 1.35 - 1.65, or preferably 1.40 - 1.60.

[0052] From the viewpoint of suitability for transparency, the (D) aliphatic monocarboxylic acid preferably has a predetermined iodine value. From the viewpoint of suitability for transparency, the iodine value of the (D) aliphatic monocarboxylic acid is, for example, 0 mg/100 mg or more, preferably 70 mg/100 mg or more, and more preferably 100 mg/100 mg or more.

[0053] From the viewpoint of suitability for transparency, the (D) aliphatic monocarboxylic acid preferably contains an aliphatic monocarboxylic acid having an iodine value of 20 g/100 g or more as a main component. The term "main component" refers to a component having 80% by mass or more, preferably 90% by mass or more, and more preferably 95% by mass or more. That is, the content of the aliphatic monocarboxylic acid having an iodine value of 20 g/100 g or more relative to the total amount of the (D) aliphatic monocarboxylic acid is, for example, 80% by mass or more, preferably 90% by mass or more, and more preferably 95% by mass or more. Particularly preferably, the (D) aliphatic monocarboxylic acid is an aliphatic monocarboxylic acid having an iodine value of 20 g/100 g or more.

[0054] Examples of aliphatic monocarboxylic acids having an iodine value of 20 g/100 g or more include linseed oil fatty acids, yuzu oil fatty acids, pistachio oil fatty acids, rice oil fatty acids, safflower oil fatty acids, apricot oil fatty acids, cottonseed oil fatty acids, sesame oil fatty acids, corn oil fatty acids, watermelon oil fatty acids, soybean oil fatty acids, poppy seed oil fatty acids, apple oil fatty acids, sunflower oil fatty acids, cactus oil fatty acids, tall oil fatty acids, walnut oil fatty acids, tung oil fatty acids, clove oil fatty acids, and castor oil fatty acids.

[0055] The content ratio of the (D) aliphatic monocarboxylic acid (when used in combination, their total amount) relative to the total amount of the raw material component is not particularly limited, as long as the refractive index of the resulting polyester resin component satisfies 1.40 to 1.60. From the viewpoints of suitability for transparency, flexibility, water resistance, and the like, the content ratio of the (D) aliphatic monocarboxylic acid relative to the total amount of the raw material component is, for example, 5% by mass or more, preferably 10% by mass or more, more preferably 15% by mass or more, even more preferably 20% by mass or more, and particularly preferably 25% by mass or more. From the viewpoints of suitability for transparency, flexibility, water resistance, and the like, the content ratio of the (D) aliphatic monocarboxylic acid relative to the total amount of the raw material component is, for example, 60% by mass or less, preferably 55% by mass or less, more preferably 40% by mass or less, and even more preferably 35% by mass or less.

(Production of Polyester Resin Component)

[0056] The polyester resin component can be produced by reacting the raw material component described above.

[0057] The acid value and molecular weight of the polyester resin component can be adjusted within the above ranges, for example, by adjusting the blending amounts of the raw material component to the preferred ratios described above and by adjusting the reaction temperature and reaction time.

[0058] The refractive index of the polyester resin component can be adjusted within the above ranges, for example, by adjusting the content ratios of the (A) rosin and the (D) aliphatic monocarboxylic acids.

[0059] The iodine value of the polyester resin component can be adjusted within the above ranges, for example, by adjusting the iodine value and content ratio of the (D) aliphatic monocarboxylic acid.

[0060] When reacting the raw material components, they may be reacted all at once, or in multiple stages.

[0061] In a batch reaction, the above polyester resin components can be produced by a known dehydration condensation reaction between an acid and an alcohol. Suitable conditions for the dehydration condensation reaction are approximately 150 - 300°C, and a reaction time of approximately 2 - 20 hours.

[0062] When the (B) polycarboxylic acid contains an α,β -unsaturated dicarboxylic acid, a multi-stage reaction is preferred.

[0063] Specifically, the (A) rosin is first reacted with an α,β -unsaturated dicarboxylic acid to obtain a first product. Next, the first product is reacted with the (C) polyol and the (D) aliphatic monocarboxylic acid to obtain a second product containing a polyester resin component.

[0064] In the step of obtaining the first product, an unsaturated bond in the (A) rosin and an unsaturated bond in the α,β -unsaturated dicarboxylic acid are subjected to an addition reaction.

[0065] The reaction temperature in the step of obtaining the first product is, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component, for example, 150°C or higher, preferably 170°C or higher, and more preferably 180°C or higher. Furthermore, the reaction temperature in the step of obtaining the first product is, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component, for example, 230°C or lower, preferably 220°C or lower, and more preferably 200°C or lower.

[0066] The reaction time in the step of obtaining the first product is, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component, for example, 0.1 hours or longer, preferably 0.5 hours or longer. Furthermore, the reaction time in the step of obtaining the first product is, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component, for example, 5 hours or shorter, preferably 3 hours or shorter.

[0067] In addition, in the step of obtaining the first product, a known reaction catalyst can be added in an appropriate ratio, if necessary. In the step of obtaining the first product, the raw material component may be reacted in the absence of a solvent, or in the presence of a known solvent.

[0068] In the step of obtaining the second product, the carboxyl group of the first product or the (D) aliphatic monocarboxylic acid is subjected to an esterification reaction with the hydroxyl group of the (C) polyol. The first product, the (C) polyol, and the (D) aliphatic monocarboxylic acid may be reacted in one step or in multiple steps. The reaction temperature in the step of obtaining the second product is, from the viewpoint of adjusting the acid value and hydroxyl value of the polyester resin component, for example, 150°C or higher, preferably 160°C or higher, more preferably 170°C or higher, and even more preferably 180°C or higher. In addition, the reaction temperature in the step of obtaining the second product is, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component, for example, 230°C or lower, preferably 220°C or lower, more preferably 210°C or lower, and even more preferably 200°C or lower.

[0069] The reaction time in the step of obtaining the second product is, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component, for example, 1 hour or higher, and preferably 3 hours or higher. The reaction time in the step of obtaining the second product is, for example, 48 hours or less, preferably 24 hours or less, from the viewpoint of adjusting the acid value and molecular weight of the polyester resin component. In this reaction, if necessary, the condensation water produced by the esterification reaction can be distilled off using a known method.

[0070] In the step of obtaining the second product, if necessary, a known reaction catalyst can be added in an appropriate ratio. In the step of obtaining the second product, the raw material component may be reacted in the absence of a solvent, or in the presence of a known solvent.

[0071] If the (D) aliphatic monocarboxylic acid contains a fatty acid derived from a fat or oil, the (C) polyol can be modified with a fat or oil containing the (D) aliphatic monocarboxylic acid as its constituent fatty acid before obtaining the second product.

[0072] When the (C) polyol is modified with the fat or oil, a transesterification reaction occurs to obtain a modified product containing an ester of the (C) polyol and a fatty acid derived from the fat or oil (fatty acid ester). This fatty acid ester is then hydrolyzed to produce the (C) polyol and the fatty acid. Therefore, the modified product can be used in place of the (C) polyol and the (D) aliphatic monocarboxylic acid.

[0073] Specifically, as described above, the (A) rosin is reacted with an α,β -unsaturated dicarboxylic acid to obtain the

first product. Separately, the (C) polyol is modified with a fat or oil containing the (D) aliphatic monocarboxylic acid as its constituent fatty acid to obtain a modified product. Next, the first product is reacted with the modified product to obtain a second product containing a polyester resin component.

[0074] In the step of obtaining the second product, the first product and the modified product undergo an esterification reaction, thereby obtaining the second product.

[0075] Examples of the fats and oils having the (D) aliphatic monocarboxylic acid as their constituent fatty acid include linseed oil, yuzu oil, pistachio oil, rice bran oil, safflower oil, apricot oil, cottonseed oil, sesame oil, corn oil, watermelon oil, soybean oil, poppy seed oil, apple oil, sunflower oil, cactus oil, tall oil, walnut oil, tung oil, clove oil, and castor oil.

[0076] The blending ratio in the step of obtaining the modified product is set as appropriate, but, for example, the amount of hydroxyl groups in the (C) polyol relative to 1 mole of the fat or oil is, for example, 3 moles or more, preferably 10 moles or more, and, for example, 50 moles or less, and preferably 40 moles or less.

[0077] From the viewpoint of film-forming ability, the reaction temperature in the step of obtaining the modified product is, for example, 230°C or higher, preferably 240°C or higher, and more preferably 250°C or higher. From the viewpoint of film-forming ability, the reaction temperature in the step of obtaining the modified product is, for example, 300°C or lower, preferably 280°C or lower, and more preferably 270°C or lower. If the reaction temperature is excessively low, the reaction in the step of obtaining the modified product may not proceed, and the (D) aliphatic monocarboxylic acid may not be incorporated into the polyester resin. This may result in a decrease in film-forming ability. If the reaction temperature is excessively high, a decomposition reaction may occur, causing an increase in low-molecular-weight components. This may result in a decrease in film-forming ability.

[0078] From the viewpoint of film-forming ability, the reaction time in the step of obtaining the modified product is, for example, 0.5 hours or higher, and preferably 1 hour or higher. From the viewpoint of film-forming ability, the reaction time in the step of obtaining the modified product is, for example, 20 hours or less, and preferably 10 hours or less.

[0079] If necessary, a known reaction catalyst can be added in an appropriate ratio in the step of obtaining the modified product. In the step of obtaining the modified product, the raw material component may be reacted in the absence of a solvent, or in the presence of a known solvent.

[0080] The second product obtained in this manner is a resin composition containing the polyester resin modified with the (A) rosin and the (D) aliphatic monocarboxylic acid (hereinafter also referred to as a rosin-modified polyester resin). The second product can be used as the polyester resin component of a transparentizing agent.

[0081] In addition to the rosin-modified polyester resin, the second product may also contain unreacted raw material components. Examples of unreacted raw material components include unreacted (A) rosin, unreacted (B) polydicarboxylic acid, unreacted (C) polyol, and unreacted (D) aliphatic monocarboxylic acid. The unreacted raw material components are removed from the second product as necessary.

[0082] The content of the rosin-modified polyester resin relative to the total amount of the polyester resin components is, for example, 25% by mass or more, preferably 30% by mass or more, and, for example, 100% by mass or less, and preferably 90% by mass or less, relative to the total amount of the polyester resin components.

(Other Components)

[0083] If necessary, the transparentizing agent may further contain components other than the polyester resin component described above.

[0084] For example, the transparentizing agent can contain a liquid medium.

[0085] Examples of liquid media include organic solvents, water, and mixtures thereof. A liquid medium that can dissolve or disperse the polyester resin component is preferred.

[0086] An organic solvent is preferred as a liquid medium, as it has excellent penetration into the paper base, does not cause lumps that occur when water is used, and has excellent drying properties.

[0087] Examples of organic solvents include alcohols, ethers, esters, and non-polar solvents.

[0088] Examples of alcohols include alcohols having 1 - 6 carbon atoms, such as methanol, ethanol, n-propanol, isopropanol, n-butanol, n-pentanol, and n-hexanol.

[0089] Examples of ethers include glycol ethers, such as ethylene glycol monomethyl ether, diethylene glycol monomethyl ether, triethylene glycol monomethyl ether, tetraethylene glycol monomethyl ether, ethylene glycol monoethyl ether, diethylene glycol monoethyl ether, triethylene glycol monoethyl ether, tetraethylene glycol monoethyl ether, ethylene glycol monopropyl ether, diethylene glycol monopropyl ether, triethylene glycol monopropyl ether, tetraethylene glycol monopropyl ether, ethylene glycol monoisopropyl ether, diethylene glycol monoisopropyl ether, triethylene glycol monoisopropyl ether, tetraethylene glycol monoisopropyl ether, ethylene glycol monobutyl ether, diethylene glycol monobutyl ether, triethylene glycol monobutyl ether, tetraethylene glycol monobutyl ether, ethylene glycol monoisobutyl ether, diethylene glycol monoisobutyl ether, triethylene glycol monoisobutyl ether, tetraethylene glycol monoisobutyl ether, ethylene glycol monotertiary butyl ether, diethylene glycol monotertiary butyl ether, triethylene glycol monotertiary butyl ether, tetraethylene glycol monotertiary butyl ether, propylene glycol monomethyl ether, dipropylene glycol mono-

methyl ether, tripropylene glycol monomethyl ether, propylene glycol monoethyl ether, dipropylene glycol monoethyl ether, tripropylene glycol monoethyl ether, tetrapropylene glycol monoethyl ether, propylene glycol monopropyl ether, dipropylene glycol monopropyl ether, tripropylene glycol monopropyl ether, propylene glycol monoisopropyl ether, dipropylene glycol monoisopropyl ether, tripropylene glycol monoisopropyl ether, dipropylene glycol monobutyl ether, tripropylene glycol monobutyl ether, propylene glycol monoisobutyl ether, dipropylene glycol monoisobutyl ether, tripropylene glycol monoisobutyl ether, propylene glycol monotertiary butyl ether, dipropylene glycol monotertiary butyl ether, and tripropylene glycol monotertiary butyl ether.

[0090] Examples of esters include diethylene glycol monoethyl ether acetate and diethylene glycol monobutyl ether acetate.

[0091] Examples of non-polar solvents include paraffinic hydrocarbons such as pentane, hexane, heptane, octane, nonane, decane, and dodecane; isoparaffinic hydrocarbons such as isohexane, isooctane, and isododecane; alkyl-naphthenic hydrocarbons such as liquid paraffin; aromatic hydrocarbons such as benzene, toluene, xylene, alkylbenzene, and solvent naphtha; silicone oil, and the like.

[0092] The content of the liquid medium is appropriately set depending on the purpose and application. For example, the content of the liquid medium is, for example, 5% by mass or more, and preferably 10% by mass or more, relative to the total amount of the liquid medium and the polyester resin component. Furthermore, the content of the liquid medium is, for example, 80% by mass or less, and preferably 70% by mass or less, relative to the total amount of the liquid medium and the polyester resin component. Furthermore, the content of the polyester resin component is, for example, 20% by mass or more, and preferably 30% by mass or more, relative to the total amount of the liquid medium and the polyester resin component. Furthermore, the content of the polyester resin component is, for example, 95% by mass or less, and preferably 90% by mass or less, relative to the total amount of the liquid medium and the polyester resin component. When the ratio of the liquid medium to the polyester resin component is within the above range, a sudden increase in viscosity can be suppressed, and the productivity, coatability, and drying properties of the transparentizing agent can be improved.

[0093] The transparentizing agent can contain other resins. These other resins are resins other than the polyester resin component mentioned above.

[0094] Examples of other resins include acrylic resin, styrene-modified acrylic resin, silicone acrylic resin, modified silicone acrylic resin, rosin phenolic resin, rosin ester resin, terpene phenolic resin, coumarone-indene resin, petroleum resin, epoxy resin, modified epoxy resin, polyester resin, vinyl acetate resin, ethylene-vinyl acetate resin, urethane resin, urea resin, melamine resin, and cellulose resin. These can be used alone or in combination of two or more types.

[0095] The transparentizing agent can contain wax. By containing wax, blocking can be suppressed when used on a paper base.

[0096] Examples of waxes include fatty acid amide wax, carnauba wax, rice wax, polyolefin wax, paraffin wax, Fischer-Tropsch wax, beeswax, microcrystalline wax, oxidized polyethylene wax, and amide wax. These can be used alone or in combination of two or more.

[0097] Examples of preferred waxes include fatty acid amide wax, carnauba wax, polyolefin wax, paraffin wax, and microcrystalline wax, and more preferably carnauba wax, polyolefin wax, and paraffin wax.

[0098] More specifically, examples of fatty acid amide waxes include pelargonic acid amide, capric acid amide, undecylic acid amide, lauric acid amide, tridecylic acid amide, myristic acid amide, pentadecylic acid amide, palmitic acid amide, heptadecylic acid amide, stearic acid amide, nonadecanoic acid amide, arachidic acid amide, behenic acid amide, lignoceric acid amide, oleic acid amide, cetoleic acid amide, linoleic acid amide, linolenic acid amide, and mixtures thereof. Examples of fatty acid amide waxes also include animal and vegetable oil fatty acid amides. These may be used alone or in combination of two or more.

[0099] More specific examples of carnauba waxes include MICROKLEAR 418 (Micro Powders, Inc.) and Refined Carnauba Wax No. 1 Powder (Nippon Wax Co., Ltd.). These can be used alone or in combination of two or more types.

[0100] More specific examples of olefin waxes include polyethylene wax, polypropylene wax, MPP-635VF (Micro Powders, Inc.), and MP-620VF XF (Micro Powders, Inc.). These can be used alone or in combination of two or more types.

[0101] More specific examples of paraffin waxes include MP-28C, MP-22XF, and MP-28C (all Micro Powders, Inc.). These can be used alone or in combination of two or more types.

[0102] The melting point of the wax is, for example, 60°C or higher and, for example, 130°C or lower from the viewpoint of heat resistance.

[0103] The content of the wax in the transparentizing agent is appropriately set depending on the purpose and application. For example, the content of the wax is, for example, 0 parts by mass or more, preferably 1 part by mass or more, and more preferably 3 parts by mass or more, with respect to 100 parts by mass of the polyester resin component. Furthermore, the content of the wax is, for example, 50 parts by mass or less, and preferably 30 parts by mass or less, with respect to 100 parts by mass of the polyester resin component.

[0104] The transparentizing agent can contain additives in an appropriate ratio. Examples of additives include fillers, thickeners, foaming agents, antioxidants, light stabilizers, heat stabilizers, flame retardants, color adjusters, and drying accelerators such as cobalt octylate and cobalt naphthenate. These can be used alone or in combination of two or more.

[0105] The transparentizing agent can be produced by producing the polyester resin component as described above and, if necessary, mixing other components.

[0106] The transparentizing agent of the present invention uses bio-derived raw materials ((A) rosin, (D) aliphatic monocarboxylic acids, and the like), yet produces a transparent paper with excellent transparency and stability over time.

The polyester resin component in the transparentizing agent has a refractive index close to that of **pulp** (cellulose), the main component of the paper base. Therefore, the polyester resin component fills the voids inside the paper base, reducing light refraction inside the paper base and resulting in excellent transparency. Furthermore, the transparentizing agent of the present invention is highly recyclable, as transparency can be ensured by single-sided coating.

[0107] The transparentizing agent of the present invention can be applied not only to paper bases, but also to substrates made of materials with a refractive index similar to that of cellulose, such as woven fabrics, nonwoven fabrics, films, synthetic papers, and the like.

"Transparent Paper"

[0108] The transparent paper of the present invention contains a transparentizing agent at least inside a paper base. The transparentizing agent includes a polyester resin component, which is a reaction product of the raw material component including the (A) rosin, the (B) polycarboxylic acid, the (C) polyol, and the (D) aliphatic monocarboxylic acid. The polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.

(Transparentizing agent)

[0109] The transparentizing agents listed above can be used the transparentizing agents.

(Paper base)

[0110] The paper base includes pulp.

[0111] Pulp that constitutes the paper base includes chemical pulp, mechanical pulp, recycled paper pulp, non-wood pulp, and the like. These pulps may be used alone or in combination of two or more types. Of these, chemical pulp is preferred.

[0112] Chemical pulp includes softwood chemical pulp and hardwood chemical pulp, and it is preferable that the paper base contain both softwood chemical pulp and hardwood chemical pulp.

[0113] Hardwood chemical pulp has a shorter and thinner fiber structure than softwood chemical pulp. Using hardwood chemical pulp results in excellent paper base formation due to its short and thin fiber structure. If the paper base has poor formation, even if it is impregnated with a transparentizing agent, the non-uniformity caused by the formation can cause uneven penetration of the transparentizing agent, resulting in a loss of transparency. To obtain excellent transparent paper, it is preferable that the paper base have excellent formation. However, hardwood chemical pulp, with its thin and short fiber structure, has good formation, but the gaps and voids are small, making it prone to areas where the transparentizing agent has difficulty penetrating. Furthermore, the increased number of interfaces tends to result in refracted and attenuated transmitted light, reducing transparency. Furthermore, because it is easily coated with a transparentizing agent, its defibration properties when recycled as waste paper tend to be inferior to those of softwood chemical pulp. Therefore, by using both hardwood and softwood chemical pulp as the paper base, it is possible to achieve both the transparency of transparent paper and its recyclability.

[0114] Examples of softwood chemical pulp include unbleached softwood kraft pulp (NUKP), bleached softwood kraft pulp (NBKP), semi-bleached softwood kraft pulp (NSBKP), softwood sulfite pulp (NSP), and the like. Among these, bleached softwood kraft pulp (NBKP) and softwood sulfite pulp (NSP) are preferred from the viewpoint of achieving both transparency and strength in transparent paper.

[0115] The Canadian Standard Freeness (CSF) of the softwood chemical pulp is preferably 400 - 700 mL, more preferably 420 - 650 mL, and even more preferably 450 - 600 mL. When the CSF of the softwood chemical pulp is at or above the lower limit of the above range, the voids in the paper base can be maintained, resulting in excellent impregnation of the transparentizing material. When the CSF of the softwood chemical pulp is at or below the upper limit of the above range, the formation of the paper base can be improved, making it easier to obtain a transparent paper with transparent regions that are excellent in transparency and visibility.

[0116] Examples of the hardwood chemical pulp include unbleached hardwood kraft pulp (LUKP), bleached hardwood kraft pulp (LBKP), semi-bleached hardwood kraft pulp (LSBKP), hardwood sulfite pulp (LSP), and the like. Among these, bleached hardwood kraft pulp (LBKP) and hardwood sulfite pulp (LSP) are preferred from the viewpoint of achieving both transparency and strength in transparent paper.

[0117] The Canadian Standard Freeness (CSF) of the hardwood chemical pulp is preferably 350 - 650 mL, more

preferably 370 - 630 mL, and even more preferably 400 - 600 mL. When the CSF of the hardwood chemical pulp is at or above the lower limit of the above range, the strength of the paper base can be increased. When the CSF of the hardwood chemical pulp is at or below the upper limit of the above range, the formation of the paper base can be improved, and a transparent paper with a transparent region that is excellent in transparency and visibility can be easily obtained.

[0118] The mass ratio of the softwood chemical pulp to the hardwood chemical pulp (softwood chemical pulp : hardwood chemical pulp) is preferably 80:20 - 20:80, more preferably 75:25 - 25:75, and even more preferably 70:30 - 30:70.

[0119] When the paper base contains the softwood chemical pulp and the hardwood chemical pulp, the paper base may contain, in addition to these chemical pulps, other pulps such as mechanical pulp, recycled paper pulp, non-wood pulp, and the like.

[0120] Examples of the mechanical pulp include stone ground pulp (SGP), pressed stone ground pulp (PGW), refiner ground pulp (RGP), thermoground pulp (TGP), chemiground pulp (CGP), groundwood pulp (GP), thermomechanical pulp (TMP), and the like.

[0121] Examples of the recycled paper pulp include disintegrated recycled paper pulp, disintegrated and deinked recycled paper pulp, and disintegrated, deinked, and bleached recycled paper pulp. Examples of the waste paper that can be used as a raw material for waste paper pulp include brown paper, kraft envelope paper, magazine paper, newspaper paper, flyer paper, office paper, corrugated cardboard, white paper, Kent paper, imitation paper, and land certificate recycled paper.

[0122] Examples of the non-wood pulp include various pulps such as pulp produced chemically or mechanically from non-wood fibers such as kenaf, cotton, hemp, and reed.

[0123] One type of these pulps may be used alone, or two or more types may be used in combination.

[0124] When the recycled paper pulp is used as the pulp, the recycled paper pulp content is preferably 10% by mass or less, and more preferably 5% by mass or less, with respect to the total mass of the pulp constituting the paper base. When the recycled paper pulp content is equal to or less than the upper limit, the transparent paper can be suitably used as a packaging material for food and beverages. The lower limit of the recycled paper pulp content is 0% by mass.

[0125] The opacity of the paper base is, for example, 45 - 95%.

[0126] The opacity is measured in accordance with JIS P 8149 (2000).

[0127] The basis weight of the paper base is preferably 35 - 150 g/m², more preferably 40 - 100 g/m², and even more preferably 43 - 80 g/m². When the basis weight is at or above the lower limit of the above range, the paper strength is obtained and the transparent paper is suitable for applications such as a packaging paper and a printing paper. When the basis weight is at or below the upper limit of the above range, the transparency of the transparent paper can be increased.

[0128] The basis weight is measured in accordance with JIS P 8124.

[0129] The air permeability of the paper base is preferably 10 - 40 seconds, more preferably 12 - 35 seconds, and even more preferably 15 - 33 seconds. When the air permeability is at or above the lower limit of the above range, the paper strength is sufficient, resulting in a transparent paper suitable for applications such as a packaging paper and a printing paper. When the air permeability is at or below the upper limit of the above range, the penetration of the transparentizing agent is excellent, and the transparency of the transparent paper can be increased.

[0130] The air permeability is the Oken air permeability measured in accordance with J. TAPPI-5-2:2000.

[0131] The density of the paper base is preferably 0.5 - 0.90 g/cm³, and more preferably 0.6 - 0.8 g/cm³. When the density is at or above the lower limit of the above range, the paper has sufficient strength and becomes a transparent paper suitable for applications such as a packaging paper and a printing paper. When the density is at or below the upper limit of the above range, the permeability of the transparent material is excellent, and the transparency of the transparent paper can be increased.

[0132] The density is measured in accordance with JIS P 8118.

[0133] The porosity of the paper base is preferably 30 - 80%, more preferably 40 - 70%, and even more preferably 50 - 70%. When the porosity of the paper base is at or above the lower limit of the above range, the transparency of the transparent region is easily increased. When the porosity of the paper base is at or below the upper limit of the above range, the physical strength of the paper base is less likely to decrease.

[0134] The porosity of the paper base is the density measured in accordance with JIS P 8118 divided by the true density of cellulose, 1.50.

[0135] The Parker Print Surf smoothness of at least one surface of the paper base is preferably 7 μm or less, and more preferably 5 μm or less. There is no particular lower limit. The smaller the value, the smoother the surface. Parker Print Surf smoothness can be evaluated for fine details, and the smaller this value, the more the light scattering on the paper surface can be reduced, thereby improving visibility through the transparent parts.

[0136] The Parker Print Surf smoothness is determined in accordance with ISO 8791-4:1992 (soft backing/clamping pressure 500 kPa).

[0137] In addition to pulp, the paper base may contain known papermaking aids such as paper strength agents, sizing agents, fillers, and colorants.

[0138] The inclusion of fillers such as talc or calcium carbonate improves the smoothness and whiteness of the paper

base, but also increases the paper's hiding power, making it difficult to impart transparency. For this reason, it is preferable to keep the filler content in the paper base within a range that does not impair transparency or visibility, and it is even more preferable for the paper base to contain no fillers.

[0139] The method for producing the paper base is not particularly limited, and examples thereof include a method including a step of beating pulp, which is the raw material for the paper base, a step of papermaking a pulp slurry containing the beaten pulp, and a step of drying the wet sheet obtained by papermaking.

[0140] In the beating step, it is preferable to beat the raw pulp so that the pulp has the above-mentioned Canadian Standard Freeness. There are no particular restrictions on the beating machine. Examples thereof include well-known beating machines such as double-disc refiners.

[0141] There are no particular restrictions on the paper machine used for papermaking. Examples thereof include Fourdrinier paper machines, short wire paper machines, and cylinder paper machines.

[0142] There are also no particular restrictions on the drying step. For example, a dryer attached to the paper machine can be used.

[0143] The paper base may be smoothed. Smoothing can reduce light scattering on the paper surface, improving visibility through the transparent portions.

[0144] Examples of the smoothing processes include, for example, tension pressing, machine calendering, gloss calendering, soft nip calendering, and super calendering. However, these devices increase the density of the paper base, so care must be taken to reduce the linear pressure and prevent the density from becoming too high. On the other hand, the transfer method, in which the paper base is attached to a smooth surface while still wet and then dried to transfer the smooth surface, is preferred as it does not increase the density of the paper base. For example, techniques such as Yankee cylinders, cast drums, and film transfer can be used. Of these, Yankee dryers using Yankee cylinders are preferred as they are attached to papermaking machines and offer excellent productivity.

[0145] The paper base can also be commercially available paper, such as kraft paper, one-side gloss kraft paper, fine paper, electrophotographic paper, inkjet recording paper, thermal recording paper, laser thermal paper, thermal transfer recording paper, art paper, coated paper, cast-coated paper, white paperboard, colored paperboard, cardboard liner, glassine paper, rice paper, India paper, Japanese paper, and the like. Among these, fine paper, electrophotographic paper, kraft paper, and one-side gloss kraft paper with low pigment content are preferred because they provide excellent visibility of the transparent region due to the transparentizing agent.

(Transparent Paper)

[0146] By incorporating the transparentizing agent at least inside the paper base, transparency is increased compared to when no transparentizing agent is incorporated.

[0147] The area of the paper base made transparent by the transparentizing agent (transparent area) can be the entire surface or a portion of the paper base in a planar view.

[0148] The opacity of the transparent area is preferably 30% or less, more preferably 20% or less, and even more preferably 16% or less. The lower the opacity, the better the transparency.

[0149] As a method for incorporating the transparentizing agent into at least the inside of the paper base, it is possible to incorporate the transparentizing agent when making paper, but if productivity is important, it is preferable to coat or impregnate the paper base with the transparentizing agent, as shown in the method for producing described below.

[0150] In the transparent paper, it is not necessary for all of the transparentizing agent to be present inside the paper base.

[0151] If part of the transparentizing agent covers the surface of the paper base, diffuse reflection of light by the paper base surface can be suppressed, further increasing transparency. Furthermore, since the coating film of the transparentizing agent on the surface of the paper base has heat-sealing properties, it can also be used as a sealant layer.

[0152] The content of the transparentizing agent varies depending on the type of paper base used (void volume, and the like), but is preferably 10 - 80 g/m², more preferably 20 - 70 g/m², and even more preferably 30 - 60 g/m², in terms of the mass of the polyester resin component converted to solids per unit area of the transparent region. When the content of the transparentizing agent is at or above the lower limit of the above range, the transparency of the transparent region is easily increased. When the content of the transparentizing agent is at or below the upper limit of the above range, recyclability can be improved.

[0153] As described above, the transparent paper of the present invention has excellent transparency because the voids inside the paper base are filled with the transparentizing agent containing the polyester resin component with a refractive index close to that of pulp, the main component of the paper base, thereby reducing the refraction of light inside the paper base. It also has excellent stability over time and recyclability.

[0154] The transparent paper of the present invention can be used as a packaging paper with a transparent region for applications such as boxes, bags, envelopes, clear files, and the like. Furthermore, because it can achieve unprecedented transparency and visibility, it can be used not only for a packaging paper but also for a variety of applications such as a

printing paper, a book paper, a copying paper, an information paper, a label paper, and a household paper, where images (letters, symbols, pictures, objects, and the like) on the opposite side of the paper can be seen through the paper base.

"Method for Producing Transparent Paper"

[0155] The method for producing a transparent paper of the present invention involves coating or impregnating a paper base with a liquid composition containing a transparentizing agent and a liquid medium, followed by drying to produce a transparent paper. The transparentizing agent contains a polyester resin component, which is a reaction product of the raw material component including the (A) rosin, the (B) polycarboxylic acid, the (C) polyol, and the (D) aliphatic monocarboxylic acid. The polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 to 1.60.

(Liquid Composition)

[0156] The transparentizing agents described above can be used as the transparentizing agent.

[0157] Any liquid medium can be used as long as it is capable of dissolving or dispersing the transparentizing agent.

[0158] The same liquid medium as used for the transparentizing agent can be used, with organic solvents being preferred. The use of an organic solvent has the advantages of allowing the transparentizing agent to quickly penetrate into the paper base, preventing lumps in the paper base, and allowing for rapid drying. One type of liquid medium may be used alone, or two or more types may be used in combination.

[0159] The content of the liquid medium can be appropriately set taking into consideration the ease of coating or impregnating the paper base, and is, for example, 30 - 50% by mass relative to the total mass of the liquid composition.

[0160] The viscosity of the liquid composition is preferably 50 - 5000 mPa·s, more preferably 50 - 4000 mPa·s, and even more preferably 50 - 3000 mPa·s. When the viscosity is at or below the upper limit of the above range, the liquid composition easily penetrates into the paper base, making it easier to increase the transparency of the transparent region. When the viscosity is at or above the lower limit of the above range, when part of the paper base is made into a transparent region, the boundary between the transparent region and other regions becomes clear.

[0161] The viscosity is measured using a Brookfield viscometer at 30°C and 60 rpm.

(Paper base)

[0162] The paper bases listed above can be used.

[0163] The coating or impregnation of the liquid composition can be carried out by a known method, for example, a coating method, an impregnation method, or a printing method such as flexographic printing, inkjet printing, gravure printing, offset printing, gravure offset printing, silk screen printing, a spray coater, a roll coater, a gravure coater, a bar coater, a blade coater, a curtain coater, a flow coater, a comma coater, brush coating, or a dipping method.

[0164] The liquid composition may be coated to or impregnated over the entire surface of the paper base, or may be coated partially. Furthermore, when coating or impregnating the liquid composition, a section may be formed in the cross section of the paper base where the transparentizing agent does not reach part of the surface opposite the impregnated surface.

[0165] The liquid composition may be coated to or impregnated onto only one surface of the paper base, or may be coated to or impregnated onto both one surface and the other surface of the paper base.

[0166] The liquid composition may be coated to or impregnated in one step, or in multiple steps. When coated in multiple steps, the constituent components and composition of the transparentizing material used in each step may be the same or different.

[0167] The amount of the liquid composition to be coated or impregnated varies depending on the type of paper base used (void volume, and the like), but the mass of the polyester resin component in the transparentizing agent per unit area of the region to be coated or impregnated with the liquid composition (transparentized region), calculated as solid content, is preferably 10 - 80 g/m², more preferably 20 - 70 g/m², and even more preferably 30 - 60 g/m². When the amount of coating or impregnation is at or above the lower limit of the above range, the transparency of the transparentized region is likely to be increased. When the amount of coating or impregnation is at or below the upper limit of the above range, recyclability can be improved.

[0168] By drying the paper base coated or impregnated with the liquid composition, the liquid medium is removed, and transparent paper containing the transparentizing agent at least inside the paper base is obtained.

[0169] Drying after coating or impregnation can be carried out using known methods. Drying conditions may include natural drying at room temperature, or heated drying. Heated drying is preferred. The drying temperature in heated drying is, for example, 40°C or higher, and preferably 50°C or higher. The drying temperature is, for example, 150°C or lower, and preferably 130°C or lower. The drying time is, for example, 1 second or longer, and preferably 5 seconds or longer. The

drying time is, for example, 600 seconds or shorter, and preferably 500 seconds or shorter.

[0170] After drying, humidity control may be performed to adjust the moisture content. Humidity control conditions are, for example, a temperature of 23°C and a relative humidity of 50%.

EXAMPLES

[0171] Next, the present invention will be described based on examples and comparative examples, but the present invention is not limited to the following examples. "Parts" and "%" are by mass unless otherwise specified.

[0172] Note that specific numerical values such as blending ratios (content ratios), physical properties, parameters, and the like used in the following description can be substituted with the upper limit (a numerical value defined as "equal to or less than") or lower limit (a numerical value defined as "equal to or greater than") of the corresponding blending ratios (content ratios), physical properties, parameters, and the like described in the above "Description of Embodiments".

<Measurement Method>

(1) Acid Value

[0173] The acid value of the polyester resin component was measured in accordance with JIS K 5601-2-1 (1999).

(2) Iodine Value

[0174] The iodine value of the polyester resin component was measured in accordance with JIS K 0070 (1992).

(3) Molecular Weight

[0175] The polyester resin component was dissolved in tetrahydrofuran to obtain a 1.0 g/L sample. The sample was then measured using a gel permeation chromatograph (GPC) equipped with a refractive index detector (RID). The weight-average molecular weight (Mw) of the sample was calculated from the resulting chromatogram (chart). The measurement equipment and conditions are as follows:

Apparatus:	Shodex GPC-101 (Showa Denko K.K.)
Detector:	RI detector
Column used:	Shodex Column GPC KF-802, 803, 804, 806 (Shoko Science Co., Ltd.)
Eluent:	THF
Column speed:	1.0 mL/min.
Measurement temperature:	40°C
Molecular weight marker:	Standard polystyrene (Agilent EasiCal Polystyrene Standards PS-1)

(4) Refractive Index

[0176] The refractive index was measured using a multi-wavelength Abbe refractometer DR-M4 (manufactured by Atago Co., Ltd.) in accordance with JIS K 7142 (2014).

<Production Example 1>

[0177] 27.8 parts of gum rosin were placed in a four-neck flask equipped with a stirrer, a reflux condenser with a water separator, and a thermometer, and heated to 210°C while nitrogen gas was blown in. Next, 9.8 parts of fumaric acid were added and stirred at 210°C for approximately 90 minutes. This yielded a first product.

[0178] 73.4 parts of linseed oil and 15.5 parts of glycerin were added to another four-neck flask equipped with a reflux condenser with a water separator and a thermometer, and stirred at 250°C for approximately 90 minutes. Next, the first product was mixed into the mixture, and after mixing, it was cooled to 190°C. A dehydration condensation reaction was then carried out at 190°C for 8 hours, yielding a second product, a polyester resin component (Resin 1). This Resin 1 had an acid value of 10 mg KOH/g, an iodine value of 109 g/100 g, a weight-average molecular weight of 82,000, and a refractive index of 1.49.

[0179] Furthermore, the refractive index of linseed oil fatty acid was 1.49.

<Production Examples 2, 3, 5, 8, and 10>

[0180] Polyester resin components (Resins 2, 3, 5, 8, and 10) were obtained in the same manner as in Production Example 1, except that the ratios of the raw material component were changed to those shown in Table 1. The physical properties of each resin are shown in Table 1.

<Production Example 4>

[0181] 46.9 parts of gum rosin were placed in a four-neck flask equipped with a stirrer, a reflux condenser with a water separator, and a thermometer, and heated to 210°C while nitrogen gas was blown in. Next, 16.5 parts of fumaric acid were added and stirred at 210°C for approximately 90 minutes. This yielded a first product.

[0182] 56.8 parts of linseed oil and 25 parts of pentaerythritol were added to another four-neck flask equipped with a reflux condenser with a water separator and a thermometer, and stirred at 250°C for approximately 90 minutes. Next, the first product was mixed into the mixture, and after mixing, the mixture was cooled to 190°C. A dehydration condensation reaction was then carried out at 190°C for 7 hours, yielding a second product, a polyester resin component (Resin 4). This Resin 4 had an acid value of 8 mg KOH/g, an iodine value of 74 g/100 g, a weight-average molecular weight of 618,000, and a refractive index of 1.50.

<Production Example 6>

[0183] A polyester resin component (Resin 6) was obtained using the same method as Production Example 1, except for replacing linseed oil with tung oil. This Resin 6 had an acid value of 8 mg KOH/g, an iodine value of 98 g/100 g, a weight-average molecular weight of 98,000, and a refractive index of 1.56.

[0184] The refractive index of tung oil fatty acid was 1.52.

<Production Example 7>

[0185] 18.5 parts of gum rosin were placed in a four-neck flask equipped with a stirrer, a reflux condenser with a water separator, and a thermometer, and heated to 210°C while nitrogen gas was blown in. 6.5 parts of fumaric acid was then added and stirred at 210°C for approximately 90 minutes. After the reaction, the mixture was cooled to 190°C, and 25.0 parts of glycerin and 77.9 parts of oleic acid were added. A dehydration condensation reaction was carried out at 190°C for 10 hours to obtain a polyester resin component (Resin 7). This Resin 7 had an acid value of 10 mg KOH/g, an iodine value of 55 g/100 g, a weight-average molecular weight of 122,000, and a refractive index of 1.40.

[0186] The refractive index of oleic acid was 1.37.

<Production Example 9>

[0187] 27.8 parts of gum rosin were placed in a four-neck flask equipped with a stirrer, a reflux condenser with a water separator, and a thermometer, and heated to 210°C while nitrogen gas was blown in. Next, 9.8 parts of fumaric acid were added and stirred at 210°C for approximately 90 minutes. This yielded a first product.

[0188] 73.4 parts of coconut oil and 15.5 parts of glycerin were added to another four-neck flask equipped with a reflux condenser with a water separator and a thermometer, and stirred at 250°C for approximately 90 minutes. Next, the first product was mixed into the mixture, and after mixing, the mixture was cooled to 190°C. A dehydration condensation reaction was then carried out at 190°C for 8 hours, yielding a second product, a polyester resin component (Resin 9). This Resin 9 had an acid value of 8 mg KOH/g, an iodine value of 9 g/100 g, a weight-average molecular weight of 86,000, and a refractive index of 1.47.

[0189] The refractive index of coconut oil fatty acid was 1.45.

<Production Example 11>

[0190] A polyester resin component (Resin 11) was obtained in the same manner as in Production Example 1, except that the dehydration condensation reaction time to obtain the second product was extended to 12 hours. This Resin 11 had an acid value of 2 mg KOH/g, an iodine value of 109 g/100 g, a weight-average molecular weight of 11,000,000, and a refractive index of 1.49.

<Production Example 12>

[0191] 35.2 parts of gum rosin were placed in a four-neck flask equipped with a stirrer, a reflux condenser with a water

separator, and a thermometer, and heated to 210°C while nitrogen gas was blown in. Next, 12.4 parts of fumaric acid were added and stirred at 210°C for approximately 90 minutes. This yielded a first product.

[0192] 64.3 parts of clove oil and 19.1 parts of glycerin were added to another four-neck flask equipped with a reflux condenser with a water separator and a thermometer, and stirred at 250°C for approximately 90 minutes. Next, the first product was mixed into the mixture, and after mixing, it was cooled to 190°C. A dehydration condensation reaction was then carried out at 190°C for 8 hours, yielding a second product, a polyester resin component (Resin 12). This Resin 12 had an acid value of 9 mg KOH/g, an iodine value of 45 g/100 g, a weight-average molecular weight of 72,000, and a refractive index of 1.61.

[0193] The refractive index of clove oil fatty acid was 1.56.

<Production Example 13>

[0194] 13.7 parts of gum rosin were placed in a four-neck flask equipped with a stirrer, a reflux condenser with a water separator, and a thermometer, and heated to 210°C while nitrogen gas was blown in. Next, 4.7 parts of fumaric acid were added and stirred at 210°C for approximately 90 minutes. After the reaction, the mixture was cooled to 190°C, and 18.2 parts of glycerin and 75.6 parts of oleic acid were added. A dehydration condensation reaction was carried out at 190°C for 10 hours to obtain a polyester resin component (Resin 13). This Resin 13 had an acid value of 10 mg KOH/g, an iodine value of 61 g/100 g, a weight-average molecular weight of 102,000, and a refractive index of 1.38.

[0195] The refractive index of oleic acid was 1.37.

Examples 1 - 9 and Comparative Examples 1 - 4

(Preparation of Liquid Composition)

[0196] 50 parts of the polyester resin components shown in Table 2 and 50 parts of isopropyl alcohol were placed in an Erlenmeyer flask equipped with a reflux condenser and stirred at 50°C for approximately 1 hour. This yielded a liquid composition.

(Preparation and Evaluation of Transparent Paper)

[0197] A single-side gloss kraft paper with a basis weight of 50 g/m² was prepared as a paper base. The pulp used to compose this single-side gloss kraft paper was 40% bleached hardwood kraft pulp and 60% bleached softwood kraft pulp. The opacity of this single-side gloss kraft paper was 68.5%, its density was 0.72 g/cm³, and its thickness was 70 μm.

[0198] A liquid composition adjusted to 25°C was coated to the non-glossy side of the paper base using a wire-wound bar coater No. 36 to obtain a coated paper. The coated amount of the liquid composition was 30 g/m², calculated as resin solids. The resulting coated paper was then dried at 120°C for 2 minutes. After drying, it was conditioned for 12 hours in a constant temperature and humidity environment (23°C, 50% relative humidity). This resulted in a transparent paper.

<Comparative Example 5>

[0199] A gum rosin solution was obtained by mixing 50 parts of gum rosin and 50 parts of isopropyl alcohol. A linseed oil solution was obtained by mixing 50 parts of linseed oil and 50 parts of isopropyl alcohol. Next, 90 parts of the rosin solution and 10 parts of the linseed oil solution were mixed. This resulted in a liquid composition of Comparative Example 7.

<Comparative Example 6>

[0200] A rosin solution was obtained by mixing 50 parts of gum rosin and 50 parts of isopropyl alcohol. A linseed oil solution was obtained by mixing 50 parts of linseed oil and 50 parts of isopropyl alcohol. Next, 44 parts of the rosin solution and 56 parts of the linseed oil solution were mixed. This yielded a liquid composition of Comparative Example 8.

<Comparative Example 7>

[0201] A rosin solution was obtained by mixing 50 parts of gum rosin and 50 parts of isopropyl alcohol. A linseed oil solution was obtained by mixing 50 parts of linseed oil and 50 parts of isopropyl alcohol. Next, 20 parts of the rosin solution and 80 parts of the linseed oil solution were mixed. This resulted in a liquid composition of Comparative Example 9.

<Evaluation>

[0202] The following evaluations were performed on the resulting transparent paper. The results are shown in Table 2.

5 (Transparency)

[0203] The opacity of transparent paper immediately after conditioning was measured according to JIS P 8149 (2000). An opacity of 16% or less was evaluated as ◎, more than 16% - 20% or less as ◦, exceeding 20% - 30% or less as △, and exceeding 30% as ×.

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(Total Light Transmittance)

[0204] The total light transmittance of the transparent paper was measured immediately after conditioning (total light transmittance immediately after conditioning). The transparent paper was then left to stand for 7 days at 22°C and 50% relative humidity, and the total light transmittance was measured again (total light transmittance after 7 days). Total light transmittance was measured using a haze meter NDH5000 (manufactured by Nippon Denshoku Industries Co., Ltd.) in accordance with JIS K 7361-1 (1997).

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[0205] However, in Comparative Example 4, the viscosity of the liquid composition exceeded 10,000 mPa·s, making it difficult to coat or impregnate the paper base. Therefore, transparent paper was not produced or evaluated.

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[Table 1]

Raw material component (parts)		Polyester resin component													
		Production Example 1 Resin 1	Production Example 2 Resin 2	Production Example 3 Resin 3	Production Example 4 Resin 4	Production Example 5 Resin 5	Production Example 6 Resin 6	Production Example 7 Resin 7							
Properties	(A)	Gum rosin	27.8	16.9	28.0	46.9	49.5	27.8	18.5						
	(B)	Fumaric acid	9.8	6.0	9.8	16.5	17.4	9.8	6.5 5						
	(C)	Glycerin	15.5	11.3	15.6	-	9.2	15.5	25.0						
		Pentaerythritol	-	-	-	25.0	-	-	-						
		(D)	Linseed oil	73.4	82.1	73.9	56.8	43.6	-	-					
	Tung oil		-	-	-	-	-	73.5	-						
	Tung seed oil		-	-	-	-	-	-	-						
	Palm oil		-	-	-	-	-	-	-						
		Oleic acid	-	-	-	-	-	-	77.9						
		Reaction water	26.5	16.3	27.3	45.2	19.7	26.6	27.9						
	Yield	100	100	100	100	100	100	100							
Properties		Acid value [mg KOH/g]	10	8	4	8	10	8	10						
		Iodine value [g/100 mg]	109	133	109	74	68	98	55						
		Weight-average molecular weight	82000	98000	332000	618000	235000	98000	122000						
		Refractive index	1.49	1.49	1.49	1.50	1.51	1.56	1.40						

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			Production Example 8	Production Example 9	Production Example 10	Production Example 11	Production Example 12	Production Example 13
5	Raw material component (parts)	Polyester resin component	Resin 8	Resin 9	Resin 10	Resin 11	Resin 12	Resin 13
	(A)	Gum rosin	11.0	27.8	56.0	27.8	35.2	13.7
10	(B)	Fumaric acid	3.9	9.8	19.5	15.5	12.4	18.2
	(C)	Glycerin	9.1	15.5	5.2	15.5	19.1	18.2
		Pentaerythritol	-	-	-	-	-	-
15	(D)	Linseed oil	86.7	-	24.7	73.4	-	-
		Tung oil	-	-	-	-	-	-
		Tung seed oil	-	-	-	-	64.3	-
		Palm oil	-	73.4	-	-	-	-
		Oleic acid	-	-	-	-	-	75.6
20		Reaction water	10.7	26.5	5.3	26.5	31	12.2
		Yield	100	100	100	100	100	100
25	Properties	Acid value [mg KOH/g]	8	8	181	2	9	10
		Iodine value [g/100 mg]	147	9	44	109	45	61
		Weight-average molecular weight	57000	86000	74000	110000	72000	102000
30		Refractive index	1.49	1.47	1.52	1.49	1.61	1.38

[Table 2]

	Transparentizing agent					Transparency	Total light transmittance	
	Polyester resin component	Acid value [mg KOH/g]	Iodine value [g/100 mg]	Weight-average molecular weight	Refractive index	Immediately after	Immediately after [%]	7 days later
35								
40	Example 1	Resin 1	10	109	82000	1.49	⊙	65
	Example 2	Resin 2	8	133	98000	1.49	⊙	64
45	Example 3	Resin 3	4	109	332000	1.49	⊙	62
	Example 4	Resin 4	8	74	618000	1.50	⊙	58
50	Example 5	Resin 5	70	68	235000	1.51	⊙	61
	Example 6	Resin 6	8	98	98000	1.56	○	60
55	Example 7	Resin 7	10	55	122000	1.40	○	58
	Example 8	Resin 8	8	147	57000	1.49	△	57

(continued)

	Transparentizing agent					Transparency	Total light transmittance	
	Polyester resin component	Acid value [mg KOH/g]	Iodine value [g/100 mg]	Weight-average molecular weight	Refractive index	Immediately after	Immediately after [%]	7 days later
Example 9	Resin 9	8	9	86000	1.47	△	45	45
Comp. Ex. 1	Resin 10	181	44	74000	1.52	×	39	38
Comp. Ex. 2	Resin 11	2	109	1100000	1.49	thickening	thickening	thickening
Comp. Ex. 3	Resin 12	9	45	72000	1.61	×	49	49
Comp. Ex. 4	Resin 13	10	61	102000	1.38	×	47	48
Comp. Ex. 5	Gum rosin / linseed oil = 90 / 10					⊙	65	50
Comp. Ex. 6	Gum rosin / linseed oil = 44 / 56					⊙	63	44
Comp. Ex. 7	Gum rosin / linseed oil = 20 / 80					⊙	60	41

[0206] As the results above show, the transparent papers of Examples 1 to 9 were transparent papers with excellent stability over time, with a small difference between the total light transmittance immediately after and after seven days. Of these, the transparent papers of Examples 1 to 7 had total light transmittances of 58% or higher both immediately after and after seven days, demonstrating excellent transparency. Furthermore, the transparent papers of Examples 1 to 5 had the same total light transmittance immediately after and after seven days, demonstrating particularly excellent stability of transparency over time.

[0207] On the other hand, Comparative Example 1, which had an acid value exceeding 100 mg KOH/g, exhibited poor transparency. Comparative Example 2, which had a weight-average molecular weight exceeding 1,000,000, exhibited increased viscosity, leading to the discontinuation of transparent paper production. The transparent papers of Comparative Examples 3 and 4, which used polyester resin components with refractive indices not satisfying the refractive index range of 1.40 to 1.60, exhibited poor transparency. Comparative Examples 5 to 7, in which a mixture of rosin and linseed oil was used instead of the polyester resin component, had poor stability over time, such as a lower total light transmittance after 7 days than the total light transmittance immediately after use and whitening over time.

Claims

1. A transparentizing agent comprising a polyester resin component that is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, wherein the polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.
2. The transparentizing agent according to Claim 1, wherein the polyester resin component has an iodine value of 10 g/100 g or more and 140 g/100 g or less.
3. A method for producing a transparentizing agent, comprising reacting a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid to obtain a polyester resin component having an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.

4. The method for producing a transparentizing agent according to Claim 3, wherein the polyester resin component has an iodine value of 10 g/100 g or more and 140 g/100 g or less.
5. The method for producing a transparentizing agent according to Claim 3 or 4, wherein the (B) polycarboxylic acid contains an α,β -unsaturated dicarboxylic acid, and the polyester resin component is obtained by reacting the (A) rosin with the α,β -unsaturated dicarboxylic acid to obtain a first product, and then reacting the first product with the (C) polyol and the (D) aliphatic monocarboxylic acid.
6. The method for producing a transparentizing agent according to Claim 3 or 4, wherein the (B) polycarboxylic acid contains an α,β -unsaturated dicarboxylic acid, and the polyester resin component is obtained by reacting the (A) rosin with the α,β -unsaturated dicarboxylic acid to obtain a first product, modifying the (C) polyol with an oil or fat having the (D) aliphatic monocarboxylic acid as its constituent fatty acid to obtain a modified product, and then reacting the first product with the modified product.
7. A transparent paper containing a transparentizing agent at least inside a paper base, wherein the transparentizing agent contains a polyester resin component that is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, and wherein an acid value of the polyester resin component is 100 mg KOH/g or less, a weight-average molecular weight of the polyester resin component is 1,000,000 or less, and a refractive index of the polyester resin component is 1.40 or more and 1.60 or less.
8. The transparent paper according to Claim 7, wherein an iodine value of the polyester resin component is 10 g/100 g or more and 140 g/100 g or less.
9. The transparent paper according to Claim 7 or 8, wherein the paper base contains softwood chemical pulps and hardwood chemical pulps.
10. A method for producing a transparent paper by coating or impregnating a paper base with a liquid composition containing a transparentizing agent and a liquid medium, and then drying the paper base, wherein the transparentizing agent contains a polyester resin component that is a reaction product of a raw material component including (A) rosin, (B) polycarboxylic acid, (C) polyol, and (D) aliphatic monocarboxylic acid, and the polyester resin component has an acid value of 100 mg KOH/g or less, a weight-average molecular weight of 1,000,000 or less, and a refractive index of 1.40 or more and 1.60 or less.
11. The method for producing a transparent paper according to Claim 10, wherein an iodine value of the polyester resin component is 10 g/100 g or more and 140 g/100 g or less.
12. The method for producing a transparent paper according to Claim 10 or 11, wherein the paper base contains softwood chemical pulps and hardwood chemical pulps.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/036312

A. CLASSIFICATION OF SUBJECT MATTER

D21H 21/26(2006.01)i

FI: D21H21/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D21H21/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2024
 Registered utility model specifications of Japan 1996-2024
 Published registered utility model applications of Japan 1994-2024

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2023-14977 A (OJI HOLDINGS CORPORATION) 31 January 2023 (2023-01-31) paragraphs [0001]-[0072], fig. 1-5	1-12
A	JP 8-109597 A (BAN, Seiji) 30 April 1996 (1996-04-30) paragraphs [0001]-[0016]	1-12
P, A	JP 2023-146430 A (OJI HOLDINGS CORPORATION) 12 October 2023 (2023-10-12) paragraphs [0001]-[0111], fig. 1-9	1-12

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP	2023-14977	A	31 January 2023	(Family: none)	
JP	8-109597	A	30 April 1996	(Family: none)	
JP	2023-146430	A	12 October 2023	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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