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(54) **HEAT-SEALABLE PAPER AND PACKAGING BAG**

(57) Heat-sealable paper including one or more heat-sealable layers on at least one surface of a paper substrate, wherein the heat-sealable layer contains a water-dispersible resin binder, a longitudinal and transverse geometric mean of a tear index of the heat-sealable paper is 10 mN·m²/g or more, a burst index of the

heat-sealable paper is 3.0 kPa·m²/g or more, and when two such heat-sealable layers are heat-sealed to each other at 150°C and 0.2 MPa for one second, a heat sealing peel strength is 2.0 N/15 mm or more and 10 N/15 mm or less.

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Description

Technical Field

[0001] The present invention relates to heat-sealable paper and a packaging bag using the heat-sealable paper.

Background Art

[0002] Packages using a heat sealing method have been widely used for packaging foods, medicines, medical devices, etc., other than packaging general industrial products.

[0003] In recent years, the problem of plastic waste is getting worse. Of the world's plastic production amount, the packaging sector accounts for a large portion of the plastic production amount, which is one of the causes of plastic waste. Plastics do not decompose semi-permanently, and their garbage turns into microplastics in the natural environment, which has a serious adverse effect on the ecosystem. As a countermeasure, it has been proposed to replace plastics with paper.

[0004] For example, JP 2022-024664 A discloses water-resistant, oil-resistant, heat-sealable paper that contains a coating layer containing a thermoplastic resin, a wax, and a pigment on at least one surface of a paper substrate, for the purpose of providing water-resistant, oil-resistant, heat-sealable paper that has water resistance, oil resistance, and the heat sealing suitability and can be stored for a long period of time.

Summary of Invention

[0005] The heat-sealable paper described in JP 2022-024664 has an excellent blocking resistance. However, tearing of a bag during transportation or ease of opening at the time of opening are not discussed.

[0006] An object of the present invention is to provide heat-sealable paper that can achieve a packaging bag that is difficult to tear and can be easily opened at the time of opening, and a packaging bag including the heat-sealable paper.

[0007] The object of the present invention can be achieved by the following configurations <1> to <17>.

<1> Heat-sealable paper comprising one or more heat-sealable layers on at least one surface of a paper substrate, wherein

the heat-sealable layer comprises a water-dispersible resin binder, a longitudinal and transverse geometric mean of a tear index of the heat-sealable paper is $10 \text{ mN} \cdot \text{m}^2/\text{g}$ or more, a burst index of the heat-sealable paper is $3.0 \text{ kPa} \cdot \text{m}^2/\text{g}$ or more, and when two such heat-sealable layers are heat-sealed to each other at 150°C and 0.2 MPa for one second, a heat sealing peel strength is $2.0 \text{ N}/15 \text{ mm}$ or more and $10 \text{ N}/15 \text{ mm}$ or less.

<2> The heat-sealable paper according to <1>, wherein the heat-sealable layer further comprises a lubricant.

<3> The heat-sealable paper according to <2>, wherein the lubricant comprises at least one selected from the group consisting of paraffin wax, carnauba wax, and polyolefin wax.

<4> The heat-sealable paper according to <2> or <3>, wherein a content of the lubricant in the heat-sealable layer is 1% by mass or more and 5% by mass or less.

<5> The heat-sealable paper according to any one of <1> to <4>, wherein a glass transition temperature of the water-dispersible resin binder is 0°C or more and 100°C or less.

<6> The heat-sealable paper according to any one of <1> to <5>, wherein the water-dispersible resin binder comprises at least one selected from the group consisting of a styrene-butadiene copolymer and an olefin-unsaturated carboxylic acid copolymer.

<7> The heat-sealable paper according to any one of <2> to <6>, wherein the water-dispersible resin binder comprises a styrene-butadiene copolymer, and the lubricant comprises paraffin wax.

<8> The heat-sealable paper according to any one of <2> to <6>, wherein the water-dispersible resin binder comprises an olefin-unsaturated carboxylic acid copolymer, and the lubricant comprises carnauba wax.

<9> The heat-sealable paper according to any one of <1> to <8>, wherein Canadian standard freeness of pulp constituting the paper substrate is 500 mL or more and 750 mL or less.

<10> The heat-sealable paper according to any one of <1> to <9>, wherein a main component of pulp constituting the paper substrate is needle unbleached kraft pulp.

<11> The heat-sealable paper according to any one of <1> to <10>, wherein a value (Clark stiffness/basis weight) obtained by dividing a longitudinal and transverse geometric mean of Clark stiffness of the heat-sealable paper by a basis weight (g/m^2) of the heat-sealable paper is $0.20 \text{ m}^2/\text{g}$ or more and $1.20 \text{ m}^2/\text{g}$ or less.

<12> The heat-sealable paper according to any one of <1> to <11>, wherein a piercing strength of the heat-sealable

paper is 10.0 N or more.

<13> The heat-sealable paper according to any one of <1> to <12>, wherein a basis weight of the paper substrate is 50 g/m² or more and 150 g/m² or less.

<14> The heat-sealable paper according to any one of <1> to <13>, wherein a basis weight of the heat-sealable layer is 3 g/m² or more and 30 g/m² or less.

<15> The heat-sealable paper according to any one of <1> to <14>, wherein a basis weight of the heat-sealable paper is 50 g/m² or more and 200 g/m² or less.

<16> The heat-sealable paper according to any one of <1> to <15>, wherein the paper substrate is extensible paper.

<17> A packaging bag using the heat-sealable paper according to any one of <1> to <16>.

Description of Embodiments

[0008] Hereinafter, the preferable embodiments of the present invention will be described. In this description, "X to Y" showing a range means a range of "X or more and Y or less". When numerical ranges are stated stepwise, the upper and lower limits of each numerical range can be combined arbitrarily. In this description, unless otherwise specified, operations and measurements of physical properties and the like are performed under the conditions of room temperature (20 to 25°C)/relative humidity of 40 to 50%RH. Further, the term "(meth)acrylic" collectively refers to acrylic and methacrylic.

<Heat-sealable paper>

[0009] Heat-sealable paper of the present embodiment (hereinafter, simply referred to as "heat-sealable paper") includes one or more heat-sealable layers on at least one surface of a paper substrate, wherein the heat-sealable layer comprises a water-dispersible resin binder, a longitudinal and transverse geometric mean of a tear index of the heat-sealable paper is 10 mN·m²/g or more, a burst index of the heat-sealable paper is 3.0 kPa·m²/g or more, and when two such heat-sealable layers are heat-sealed to each other at 150°C and 0.2 MPa for one second, a heat sealing peel strength is 2.0 N/15 mm or more and 10 N/15 mm or less. According to the heat-sealable paper of the present embodiment, it is possible to obtain a packaging bag that is difficult to tear and can be easily opened at the time of opening.

[0010] The water-dispersible resin binder is used to form a heat-sealable layer, which makes it possible to achieve the heat sealing property. In addition, it is thought that when heat-sealable paper has a longitudinal and transverse geometric mean of a tear index of 10 mN·m²/g or more, the heat-sealable paper can withstand shearing due to drop or deformation during transportation and is difficult to tear. Moreover, it is thought that when heat-sealable paper has a burst index of 3.0 kPa·m²/g or more, a packaging bag obtained from the heat-sealable paper is prevented from being torn due to drop or the like during transportation. In addition, it is thought that when heat-sealable paper has a heat sealing peel strength of 2.0 N/15 mm or more, a heat-sealed portion is prevented from being damaged due to drop or the like during transportation, and when the heat-sealable paper has a heat sealing peel strength of 10 N/15 mm or less, opening is easily performed. Note that, the effect of the present invention is not limited by the above mechanism. In the present specification, the longitudinal direction of the heat-sealable paper means a direction corresponding to a papermaking direction (MD direction) of a paper substrate, and the transverse direction of the heat-sealable paper means a direction corresponding to a width direction (CD direction) of the paper substrate.

[Paper substrate]

(Raw material pulp)

[0011] The pulp constituting the paper substrate is not particularly limited, and known pulps can be used. Specifically, examples thereof include unbleached pulps such as Leaf Unbleached Kraft Pulp (LUKP) and Needle Unbleached Kraft Pulp (NUKP); chemical pulps such as Leaf Bleached Kraft Pulp (LBKP) and Needle Bleached Kraft Pulp (NBKP); mechanical pulps such as Groundwood Pulp (GP), Pressurized Groundwood Pulp (PGW), Refiner Mechanical Pulp (RMP), ThermoMechanical Pulp (TMP), ChemiThermoMechanical Pulp (CTMP), ChemiMechanical Pulp (CMP), and ChemiGroundwood Pulp (CGP); waste paper pulps; non-wood fiber pulps such as kenaf, bagasse, bamboo, and cotton; and synthetic pulps. These pulps may be used individually by one type or in combination of two or more types. Among them, at least one selected from the group consisting of Leaf Unbleached Kraft Pulp (LUKP), Needle Unbleached Kraft Pulp (NUKP), Leaf Bleached Kraft Pulp (LBKP), and Needle Bleached Kraft Pulp (NBKP) is preferable, at least one selected from the group consisting of Leaf Unbleached Kraft Pulp (LUKP) and Needle Unbleached Kraft Pulp (NUKP) is more preferable, and Needle Unbleached Kraft Pulp (NUKP) is still more preferable.

[0012] A main component of pulp constituting the paper substrate used in the heat-sealable paper of the present embodiment is preferably softwood pulp, and is more preferably Needle Unbleached Kraft Pulp (NUKP). The "main component of pulp constituting the paper substrate is softwood pulp" means that the content of softwood pulp in pulp

constituting the paper substrate is more than 50% by mass, and the content of the softwood pulp is preferably 80% by mass or more, more preferably 90% by mass or more, and still more preferably 100% by mass. Similarly, the "main component of pulp constituting the paper substrate is needle unbleached kraft pulp" means that the content of needle unbleached kraft pulp in pulp constituting the paper substrate is more than 50% by mass, and the content of the needle unbleached kraft pulp is preferably 80% by mass or more, more preferably 90% by mass or more, and still more preferably 100% by mass. The average fiber length of softwood pulp is long, and use of a paper substrate containing softwood pulp as raw material pulp is preferable because heat-sealable paper that has desirable tear index and burst index can be obtained. In addition, use of Needle Unbleached Kraft Pulp (NUKP) as pulp constituting a paper substrate is advantageous because the strength of the pulp fiber itself is higher than that of Needle Bleached Kraft Pulp (NBKP) or Leaf Unbleached Kraft Pulp (LUKP), and thus the obtained paper substrate has higher strength and elongation.

[0013] The softwood pulp is preferably pulp obtained from at least one or more selected from the group consisting of Douglas fir and pine tree, and is more preferably pulp obtained from Douglas fir, from the viewpoint of obtaining heat-sealable paper having desirable tear index and burst index.

[0014] The raw material pulp constituting the paper substrate preferably contains one or more selected from the group consisting of bleached kraft pulp and unbleached kraft pulp, and more preferably contains unbleached kraft pulp.

(Canadian standard freeness)

[0015] The beating degree of the raw material pulp constituting the paper substrate is not specifically limited. From the viewpoint of obtaining heat-sealable paper having desirable tear index and burst index, the Canadian standard freeness (CSF) is preferably 500 mL or more and more preferably 550 mL or more, and is preferably 750 mL or less and more preferably 700 mL or less. Moreover, the smoothness of the surface of paper becomes good and the printability can be maintained.

[0016] The CSF is measured according to JIS P 8121-2:2012 "Pulp-Freeness test method-Chapter 2: Canadian standard freeness method".

(Kappa number)

[0017] The pulp constituting the paper substrate preferably has a kappa number as measured in accordance with JIS P 8211:2011 of 30 or more, and preferably 60 or less, more preferably 55 or less, further preferably 50 or less, further preferably 46 or less, for obtaining heat-sealable paper having impact resistance and workability. The kappa number of the pulp constituting the paper substrate is measured in accordance with JIS P 8211:2011, using a paper substrate pulp disintegrated in accordance with JIS P 8220-1:2012 as a sample.

(Basis weight)

[0018] The basis weight of the paper substrate is not specifically limited, but is preferably 50 g/m² or more, more preferably 60 g/m² or more, and still more preferably 70 g/m² or more, and is preferably 150 g/m² or less, more preferably 120 g/m² or less, still more preferably 110 g/m² or less, and even still more preferably 100 g/m² or less, from the viewpoint of obtaining heat-sealable paper having desirable tear index and burst index. The basis weight of the paper substrate is measured in accordance with JIS P 8124:2011.

(Thickness)

[0019] The thickness of the paper substrate is preferably 60 μm or more, more preferably 80 μm or more, and still more preferably 100 μm or more, and is preferably 200 μm or less, more preferably 180 μm or less, and still more preferably 160 μm or less, from the viewpoint of obtaining heat-sealable paper having desirable tear index and burst index. The thickness of the paper substrate is measured in accordance with JIS P 8118:2014.

(Density)

[0020] The density of the paper substrate is preferably 0.3 g/cm³ or more and more preferably 0.5 g/cm³ or more, and is preferably 1.0 g/cm³ or less, more preferably 0.9 g/cm³ or less, and still more preferably 0.75 g/cm³ or less, from the viewpoint of obtaining heat-sealable paper having desirable tear index and burst index and from the viewpoint of formability. The density of the paper substrate is calculated from the basis weight and the thickness of the paper substrate obtained by the aforementioned measurement methods.

(Optional components)

[0021] The paper substrate may contain optional components including internal additives such as anionic, cationic, or amphoteric retention aids, drainage aids, dry paper strength additives, wet paper strength additives, sizing agents, fixing agents, and fillers, waterproofing agents, dyes, and fluorescent whitening agents, as required.

[0022] Examples of the dry paper strength additives include cationized starch, polyacrylamide, carboxymethylcellulose, and the like. The content of the dry paper strength additives is not specifically limited and is preferably 3.0 mass% or less per raw material pulp (absolute dry mass).

[0023] Examples of the wet paper strength additives include polyamide polyamine epichlorohydrin, urea formaldehyde resin, melamine formaldehyde resin, and the like. The content of the wet paper strength additive is not specifically limited, but is preferably 3.0% by mass or less per raw material pulp (absolute dry mass).

[0024] Examples of the sizing agents include internal sizing agents such as rosin sizing agents, synthetic sizing agents, petroleum resin sizing agents, and the like, and surface sizing agents such as styrene/acrylic acid copolymers, styrene/methacrylic acid copolymers, and the like. The content of the sizing agents is not specifically limited and is preferably 3.0 mass% or less per raw material pulp (absolute dry mass).

[0025] Examples of fixing agents include aluminum sulfate, polyethyleneimine, and the like. The content of the fixing agents is not specifically limited and is preferably 3.0 mass% or less per raw material pulp (absolute dry mass).

[0026] Examples of the fillers include inorganic fillers such as talc, kaolin, calcined kaolin, calcium carbonate, calcium sulfate, barium sulfate, titanium dioxide, zinc oxide, alumina, magnesium carbonate, magnesium oxide, silica, white carbon, bentonite, zeolite, sericite, and smectite, and organic fillers such as acrylic resins and vinylidene chloride resins.

[0027] As the paper substrate, Clupak paper (extensible paper) or the like which has been subjected to Clupak processing for shrinking paper strip may be used, for example. The extensible paper refers to paper that has an elongation in the longitudinal direction or in the transverse direction of 5% or more measured according to JIS P 8113:2006, and examples thereof include kraft paper type-5 Nos. 1 and 2 described in JIS P 3401:2000. The paper substrate is preferably Clupak paper (extensible paper) from the viewpoint of obtaining heat-sealable paper having desirable Clark stiffness and piercing strength.

[Heat-sealable layer]

[0028] The heat-sealable paper according to this embodiment comprises at least one heat-sealable layer on at least one surface of the paper substrate. The heat-sealable layer is a layer that is melted and adheres by heating, ultrasonic waves, or the like.

(Water-dispersible resin binder)

[0029] The heat-sealable layer contains a water-dispersible resin binder. The water-dispersible resin binder is a resin binder that is not water-soluble (specifically, the solubility in water at 25°C is 10 g/L or less) but is finely dispersed in water like an emulsion or a suspension. Aqueous application of the heat-sealable layer using a water-dispersible resin binder enables heat-sealable paper that is excellent in re-disintegration property and can be recycled as paper to be obtained. In the case where the water-dispersible resin binder also corresponds to the following lubricant, it is classified as a lubricant.

[0030] The water-dispersible resin binder is not specifically limited, as long as it exerts the effects of the present invention, but examples thereof include polyolefin resins (such as polyethylene and polypropylene), vinyl chloride resins, styrene resins, styrene-butadiene copolymers, styrene-unsaturated carboxylic acid copolymers (such as styrene-(meth)acrylic acid copolymer), acrylic resins, acrylonitrile-styrene copolymers, acrylonitrile-butadiene copolymers, ABS resins, AAS resins, AES resins, vinylidene chloride resins, polyurethane resins, poly-4-methyl pentene-1 resins, polybutene-1 resins, vinylidene fluoride resins, vinyl fluoride resins, fluorine resins, polycarbonate resins, polyamide resins, acetal resins, polyphenylene oxide resins, polyester resins (such as polyethylene terephthalate and polybutylene terephthalate), polyphenylene sulfide resins, polyimide resins, polysulfone resins, polyether sulfone resins, polyarylate resins, olefin-unsaturated carboxylic acid copolymers, and modified products thereof. These may be used individually by one type or may be used in combination of two types or more.

[0031] Among these, the heat-sealable layer preferably includes at least one selected from the group consisting of a styrene-butadiene copolymer and an olefin-unsaturated carboxylic acid copolymer.

[0032] Furthermore, the heat-sealable layer preferably includes an olefin-unsaturated carboxylic acid copolymer from the viewpoint of increasing heat sealing peel strength, and more preferably includes a styrene-butadiene copolymer from the viewpoint of availability, cost, and recyclability.

[0033] Examples of the olefin-unsaturated carboxylic acid copolymer include an ethylene-(meth)acrylic acid copolymer and an ethylene-(meth)acrylic acid alkyl ester copolymer. Among them, an ethylene-(meth)acrylic acid copolymer is preferably included, and an ethylene-acrylic acid copolymer is more preferably included.

[0034] Therefore, the water-dispersible resin binder contained in the heat-sealable layer preferably contains at least one selected from the group consisting of a styrene-butadiene copolymer and an ethylene-(meth)acrylic acid copolymer. Note that, the olefin-unsaturated carboxylic acid copolymer may be an ionomer.

[0035] The styrene-butadiene copolymer may be any of synthetic product and commercially available product, and examples of the commercially available product include Nipol latex LX407G51, LX407S10, LX407S12, LX410, LX415M, LX416, LX430, LX433C, 2507H, available from Zeon Corporation, Nalstar SR-101, SR-102, SR-103, SR-115, and SR-153, available from NIPPON A&L INC., and styrene butadiene latex 0602 and 0597C, available from JSR Corporation.

[0036] The ethylene-(meth)acrylic acid copolymer to be used may be any of synthetic products and commercially available products, and examples of the commercially available products include MP498345N, MP4983R, MP4990R, and MFHS1279, available from Michelman Japan LLC, ZAIKTHENE (registered trademark) A and ZAIKTHENE (registered trademark) AC, available from Sumitomo Seika Chemicals Company, Limited, and CHEMPEARL S Series, available from Mitsui Chemicals, Inc.

[0037] The glass transition temperature of the water-dispersible resin binder is preferably 0°C or more, more preferably 10°C or more, and still more preferably 15°C or more. When the water-dispersible resin binder having a glass transition temperature that is equal to or higher than the above lower limit is used, the blocking resistance of the heat-sealable paper can be improved. From the viewpoint of the heat sealing property, the glass transition temperature of the water-dispersible resin binder is preferably 100°C or less, more preferably 80°C or less, still more preferably 60°C or less, and even still more preferably 50°C or less.

[0038] As the glass transition temperature of the water-dispersible resin binder, a value measured with a differential scanning calorimeter is used.

[0039] The content of the water-dispersible resin binder in the heat-sealable layer is preferably 30% by mass or more, more preferably 50% by mass or more, still more preferably 70% by mass or more, and even still more preferably 80% by mass or more, and is 100% by mass or less, preferably 99% by mass or less, and more preferably 98% by mass or less. When the content falls within the above range, the heat-sealable paper having a high heat sealing peel strength can be obtained.

[0040] That is, according to one embodiment of the present invention, the content of the styrene-butadiene copolymer and/or olefin-unsaturated carboxylic acid copolymer (preferably ethylene-(meth)acrylic acid copolymer) in the heat-sealable layer is preferably 30% by mass or more, more preferably 50% by mass or more, still more preferably 70% by mass or more, and even still more preferably 90% by mass or more, and is 100% by mass or less, preferably 99% by mass or less, and more preferably 98% by mass or less. Here, "content of A and/or B" refers to the content of A or B when only one of A and B is contained, or refers to the total content of A and B when both A and B are contained.

(Lubricant)

[0041] From the viewpoint of imparting the slip property and blocking resistance to the heat-sealable paper, the heat-sealable layer preferably includes a lubricant in addition to the above water-dispersible resin binder. The lubricant is a substance that can reduce the coefficient of friction on the surface of the heat-sealable layer by being mixed in the heat-sealable layer.

[0042] The lubricant is not specifically limited, and waxes, metal soaps, fatty acid esters, and the like can be used, for example. One of the lubricants may be used alone, or two or more of them may be used in combination. Examples of the waxes include natural waxes including animal or plant-derived waxes (such as beeswax and carnauba wax), mineral waxes (such as microcrystalline wax), and petroleum wax; and synthetic waxes including polyolefin wax, paraffin wax, polyester wax, and the like. Examples of the metal soaps include calcium stearate, sodium stearate, zinc stearate, aluminum stearate, magnesium stearate, fatty acid sodium soap, potassium oleate soap, castor oil potassium soap, composites thereof, and the like. Among the above lubricants, paraffin wax, carnauba wax, and polyolefin wax are preferable since the melting point is comparatively low, wax components are easily formed on the surface of the coating layer, and the effect of improving the blocking resistance is excellent. That is, the lubricant preferably contains at least one selected from the group consisting of paraffin wax, carnauba wax, and polyolefin wax. From the viewpoint of imparting the slip property and improving dampproofness, the lubricant preferably contains paraffin wax.

[0043] As carnauba wax, a synthesized product or a commercially available product may be used. Examples of the commercially available product include Selosol 524 available from Chukyo Yushi Co., Ltd. and Michem Lube 160RPH available from Michelman. The paraffin wax to be used may be any of synthetic products and commercially available products, and examples of the commercially available products include Hidorin L-700 and the like, available from Chukyo Yushi Co., Ltd. As polyethylene wax, a synthesized product or a commercially available product may be used. Examples of the commercially available product include Aquacer 531 available from BYK.

[0044] When the water-dispersible resin binder contains a styrene-butadiene copolymer, the lubricant preferably contains paraffin wax. When the water-dispersible resin binder contains an olefin-unsaturated carboxylic acid copolymer (preferably an ethylene-(meth)acrylic acid copolymer), the lubricant preferably contains carnauba wax.

[0045] When the heat-sealable layer contains a lubricant, the content of the lubricant is preferably 0.2 parts by mass or more, more preferably 0.5 parts by mass or more, and still more preferably 1 part by mass or more, and is preferably 30 parts by mass or less, more preferably 10 parts by mass or less, and still more preferably 5 parts by mass or less, relative to 100 parts by mass of the water-dispersible resin binder.

[0046] When the heat-sealable layer contains a lubricant, the content of the lubricant in the heat-sealable layer is preferably 0.1% by mass or more, more preferably 0.3% by mass or more, and still more preferably 1% by mass or more, and preferably 30% by mass or less, more preferably 10% by mass or less, and still more preferably 5% by mass or less.

[0047] In the present embodiment, the heat-sealable layer contains the water-dispersible resin binder, and preferably contains the lubricant in addition to the water-dispersible resin binder. In addition, the heat-sealable layer may contain the water-dispersible resin binder, and, if necessary, a pigment in addition to the lubricant.

(Pigment)

[0048] In the present embodiment, the heat-sealable layer may contain the above water-dispersible resin binder, and, if necessary, a pigment in addition to the lubricant. The problem of the heat-sealable layer-coated surface sticking to the back surface of the heat-sealable paper to cause peeling (blocking) is suppressed when producing the heat-sealable paper by containing a pigment, so that the heat-sealable paper having excellent blocking resistance is obtained.

[0049] The pigment is not specifically limited, and examples thereof include various pigments conventionally used for pigment coating layers. The pigment may be used alone by one type or may be used in combination of two or more types. As the pigment, the heat-sealable layer preferably contains a pigment having an aspect ratio of 20 or more from the viewpoint of heat sealing peel strength and blocking resistance. The aspect ratio of the pigment is more preferably 25 or more, further preferably 30 or more, particularly preferably 60 or more, and is preferably 10,000 or less, more preferably 1,000 or less, further preferably 300 or less, in view of the availability and smoothness of the heat-sealable layer surface. The aspect ratio of the pigment means major axis/minor axis and may be measured by the following method.

[0050] The pigment preferably contains a layered inorganic compound having an aspect ratio of 20 or more. The form of the layered inorganic compound is tabular. When the pigment is tabular, the protrusion of the pigment from the surface of the heat-sealable layer is suppressed, and a heat-sealable layer having excellent blocking resistance is obtained, while maintaining the heat sealing property.

[0051] The pigment preferably has a length (average particle size) of 0.1 μm or more and 100 μm or less. When the length is 0.1 μm or more, the pigment is easily arranged in parallel to the paper substrate. Further, when the length is 100 μm or less, there is little concern that a part of the pigment protrudes from the heat-sealable layer. The length of the pigment is more preferably 0.3 μm or more, further preferably 0.5 μm or more, particularly preferably 1.0 μm or more, and is more preferably 30 μm or less, further preferably 20 μm or less, particularly preferably 15 μm or less.

[0052] Here, the length of the pigment when contained in the heat-sealable layer is determined, as follows. An enlarged image of the cross section of the heat-sealable layer is captured with an electron microscope. At this time, the magnification is such that about 20 to 30 pigments are included in the screen. The length of each pigment in the screen is measured. Then, the average of the lengths obtained is calculated as the length of the pigment. The length of the pigment may be expressed in terms of particle size.

[0053] The pigment preferably has a thickness of 200 nm or less. The thickness of the pigment is more preferably 100 nm or less, further preferably 80 nm or less, even more preferably 50 nm or less, particularly preferably 30 nm or less. Further, it is preferably 5 nm or more, more preferably 10 nm or more. The smaller the average thickness of the pigment, the higher the heat sealing peel strength is obtained. Here, the thickness of the pigment when contained in the heat-sealable layer is determined, as follows. An enlarged image of the cross section of the heat-sealable layer is captured with an electron microscope. At this time, the magnification is such that about 20 to 30 pigments are included in the screen. The thickness of each pigment in the screen is measured. Then, the average of the thicknesses obtained is calculated as the thickness of the pigment.

[0054] Specific examples of the pigment include mica, bentonite, kaolin, pyrophyllite, talc, smectite, vermiculite, chlorite, septe chlorite, serpentine, stilpnomelane, montmorillonite, heavy calcium carbonate (ground calcium carbonate), light calcium carbonate (synthetic calcium carbonate), composite synthetic pigment of calcium carbonate and other hydrophilic organic compounds, satin white, lithopone, titanium dioxide, silica, barium sulfate, calcium sulfate, alumina, aluminum hydroxide, zinc oxide, magnesium carbonate, silicate, colloidal silica, plastic pigments of hollow or solid organic pigments, binder pigments, plastic beads, microcapsules, and the like, and the heat-sealable layer preferably contains at least one selected from the group consisting of the above.

[0055] Specific examples of mica include synthetic mica (such as swelling synthetic mica), white mica (muscovite), silk mica (sericite), phlogopite (phlogopite), black mica (biotite), fluorine phlogopite (artificial mica), red mica, soda mica, vanadium mica, illite, tin mica, paragonite, and brittle mica. Further, specific examples of bentonite include montmorillonite.

[0056] Specific examples of kaolin include various kaolins such as kaolin, calcined kaolin, structured kaolin, and

delaminated kaolin.

[0057] Among them, in particular, the heat-sealable layer preferably contains a pigment having an aspect ratio of 20 or more, more preferably contains one or more selected from mica, bentonite, kaolin, and talc, and still more preferably contains kaolin from the viewpoint of heat sealing peel strength, blocking resistance, and economy.

[0058] When the heat-sealable layer contains a pigment, the content of the pigment is preferably 1 part by mass or more, more preferably 3 parts by mass or more, still more preferably 5 parts by mass or more, and even still more preferably 8 parts by mass or more relative to 100 parts by mass of the water-dispersible resin binder from the viewpoint of blocking resistance, whereas the content of the pigment is preferably 200 parts by mass or less, more preferably 100 parts by mass or less, and still more preferably 30 parts by mass or less relative to 100 parts by mass of the water-dispersible resin binder, from the viewpoint of the heat sealing property.

[0059] When the heat-sealable layer contains a pigment, the content of the pigment in the heat-sealable layer is preferably 1% by mass or more, more preferably 3% by mass or more, still more preferably 5% by mass or more, and even still more preferably 8% by mass or more from the viewpoint of blocking resistance and recyclability, whereas the content of the pigment in the heat-sealable layer is preferably 70% by mass or less, more preferably 30% by mass or less, and still more preferably 20% by mass or less from the viewpoint of the heat sealing property.

(Other components)

[0060] The heat-sealable layer may contain other components in addition to the water-dispersible resin binder, and the lubricant and/or the pigment if necessary. Examples of the other components include silane coupling agents; defoaming agents; viscosity modifiers; leveling agents such as surfactants and alcohols; colorants such as coloring dyes.

[0061] The coating amount (basis weight) of the heat-sealable layer is not specifically limited. However, the coating amount (basis weight) is preferably 3 g/m² or more, more preferably 5 g/m² or more, and still more preferably 8 g/m² or more from the viewpoint of obtaining a sufficient heat sealing property and from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and is preferably 30 g/m² or less, more preferably 20 g/m² or less, and still more preferably 15 g/m² or less from the viewpoint of economy and recyclability.

<Physical properties of heat-sealable paper>

(Tear index)

[0062] The longitudinal and transverse geometric mean of the tear index of the heat-sealable paper is 10 mN·m²/g or more, and preferably 12 mN·m²/g or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and the upper limit thereof is not specifically limited, but is preferably 30 mN·m²/g or less, more preferably 25 mN·m²/g or less, and still more preferably 20 mN·m²/g or less.

[0063] The tear index of the heat-sealable paper is a value obtained by dividing the tear strength measured according to JIS P 8116:2000 by the basis weight.

[0064] A method for adjusting the longitudinal and transverse geometric mean of the tear index of the heat-sealable paper to the above range is not specifically limited, but the longitudinal and transverse geometric mean of the tear index can be adjusted by selecting the kind of pulp constituting the paper substrate or beating conditions (the beating degree, the pulp concentration at the time of beating, or the like). The tear index can be increased by using, for example, softwood pulp, preferably needle unbleached kraft pulp. In addition, the tear index can be adjusted by setting an appropriate beating degree, and a high beating degree (a low CSF) tends to decrease the tear index. Moreover, beating at a high concentration results in a branched or microfibrillar pulp, which makes it possible to increase the tearing resistance. Moreover, use of extensible paper subjected to Clupak processing as the paper substrate can also absorb energy at the time of tearing when the extensible paper is elongated, which makes it possible to obtain a high tear index.

[0065] The tear index of the heat-sealable paper in a longitudinal direction is preferably 8 mN·m²/g or more, and more preferably 10 mN·m²/g or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and the upper limit thereof, which is not specifically limited, is preferably 30 mN·m²/g or less, more preferably 24 mN·m²/g or less, and still more preferably 18 mN·m²/g or less.

[0066] The tear index of the heat-sealable paper in a transverse direction is preferably 10 mN·m²/g or more, more preferably 12 mN·m²/g or more, and still more preferably 14 mN·m²/g or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and the upper limit thereof, which is not specifically limited, is preferably 32 mN·m²/g or less, more preferably 28 mN·m²/g or less, and still more preferably 24 mN·m²/g or less.

(Burst index)

[0067] The burst index of the heat-sealable paper is 3.0 kPa·m²/g or more, and preferably 3.5 kPa·m²/g or more, from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and the upper limit thereof, which is not specifically limited, is preferably 10.0 kPa·m²/g or less, more preferably 8.5 kPa·m²/g or less, and still more preferably 7.0 kPa·m²/g or less.

[0068] The burst index of the heat-sealable paper is a value obtained by dividing the bursting strength measured according to JIS P 8112:2008 by the basis weight.

[0069] A method for adjusting the burst index of the heat-sealable paper to the above range is not specifically limited, but the burst index of the heat-sealable paper can be adjusted by selecting the kind of pulp constituting the paper substrate or the beating conditions, and the burst index can be increased by using, for example, softwood pulp, preferably needle unbleached kraft pulp. In addition, the burst index can be adjusted by setting an appropriate beating degree, and a high beating degree (a low CSF) tends to decrease the burst index. Moreover, beating at a high concentration results in a branched or microfibrillar pulp, which makes it possible to increase the bursting strength.

[0070] Moreover, use of extensible paper subjected to Clupak processing as the paper substrate can also obtain a high burst index. In addition, addition of an internal paper strengthening agent or the like to the paper substrate can also increase the burst index.

(Heat sealing peel strength)

[0071] In the heat-sealable paper of the present embodiment, from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, the heat sealing peel strength is 2.0 N/15 mm or more, preferably 3.0 N/15 mm or more, more preferably 4.0 N/15 mm or more, and still more preferably 4.5 N/15 mm or more, and is preferably 10.0 N/15 mm or less, more preferably 9.0 N/15 mm or less, still more preferably 8.0 N/15 mm or less, even still more preferably 6.5 N/15 mm or less, and further still more preferably 7.0 N/15 mm or less. Moreover, the heat sealing peel strength is preferably 4.8 N/15 mm or more from the viewpoint of automatic packaging formability. The peel strength of the heat-sealable layer is a peel strength when two heat-sealable layers are heat-sealed under the conditions of 150°C, 0.2 MPa, and 1 second, specifically, is a value measured by the method according to Examples, which is described below.

[0072] The peel strength can be adjusted by selecting the glass transition temperature, the kind, and the coating amount of the water-dispersible resin binder. For example, the resins melt and heat-sealable layers adhere well to each other under predetermined heat sealing conditions by setting the glass transition temperature of the water-dispersible resin binder to 100°C or less, so that a desired peel strength can be ensured.

(Surface smoothness)

[0073] The Oken smoothness of a surface of the heat-sealable layer of the heat-sealable paper of the present embodiment is preferably 30 seconds or more, more preferably 40 seconds or more, and still more preferably 50 seconds or more, from the viewpoint of improving the heat sealing peel strength, and the upper limit thereof, which is not specifically limited, is preferably 500 seconds or less, more preferably 300 seconds or less, and still more preferably 100 seconds or less.

[0074] The heat-sealable layer may be provided on W side (wire side) of the paper substrate or may be provided on F side (felt side), which is not specifically limited. Here, the W side (wire side) is a side that is in contact with a wire when the paper strip is formed, and its opposite side is the F side (felt side).

[0075] Further, the Oken smoothness of the surface opposite to the heat-sealable layer (the other surface of the paper substrate, for example, in the case where the heat-sealable layer is provided only on one surface of the paper substrate, and the paper substrate is exposed on the other surface) is preferably 3 seconds or more, and more preferably 5 seconds or more from the viewpoint of improving the printability, and the upper limit thereof, which is not specifically limited, is preferably 1,000 seconds or less, more preferably 300 seconds or less, and still more preferably 100 seconds or less.

[0076] The Oken smoothness is measured in accordance with JIS P8155:2010.

[0077] The Oken smoothness of each of the surface of the heat-sealable layer and the opposite surface of the heat-sealable paper can be adjusted to the aforementioned range by super calendering or the like, which is described below.

(Basis weight)

[0078] From the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, the basis weight of the heat-sealable paper of the present embodiment is preferably 50 g/m² or more, more preferably 70 g/m² or more, still more preferably 80 g/m² or more, and even still more preferably 85 g/m² or more, and is preferably 200 g/m² or less, more preferably 150 g/m² or less, still more preferably 120 g/m² or less, and even still more

preferably 100 g/m² or less.

[0079] The basis weight of the heat-sealable paper is measured according to JIS P 8124:2011.

(Thickness)

[0080] From the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, the thickness of the heat-sealable paper of the present embodiment is preferably 60 μm or more, more preferably 80 μm or more, still more preferably 90 μm or more, and even still more preferably 100 μm or more, and is preferably 300 μm or less, more preferably 200 μm or less, and still more preferably 150 μm or less.

[0081] The thickness of the heat-sealable paper is measured according to JIS P 8118:2014.

(Density)

[0082] From the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, the density of the heat-sealable paper is preferably 0.50 g/cm³ or more, more preferably 0.60 g/cm³ or more, and still more preferably 0.65 g/cm³ or more, and is preferably 1.0 g/cm³ or less, more preferably 0.90 g/cm³ or less, and still more preferably 0.80 g/cm³ or less. The density of the heat-sealable paper is calculated from the basis weight and the thickness of the heat-sealable paper that are obtained from the above measurement methods.

(Clark stiffness)

[0083] The longitudinal and transverse geometric mean of the Clark stiffness of the heat-sealable paper is preferably 20 or more, more preferably 30 or more, still more preferably 35 or more, and even still more preferably 40 or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and the longitudinal and transverse geometric mean of the Clark stiffness of the heat-sealable paper is preferably 150 or less, more preferably 100 or less, still more preferably 85 or less, even still more preferably 70 or less, or may be 60 or less, or may be 50 or less from the viewpoint of automatic packaging formability.

[0084] The longitudinal and transverse geometric mean of the Clark stiffness of the heat-sealable paper is obtained by determining a geometric mean of Clark stiffnesses in the longitudinal direction and in the transverse direction measured by the method of Example according to JIS P 8143:2009.

[0085] A method for adjusting the longitudinal and transverse geometric mean of the Clark stiffness of the heat-sealable paper is not specifically limited but the longitudinal and transverse geometric mean of the Clark stiffness of the heat-sealable paper can be adjusted by conditions such as the kind or the beating degree of pulp constituting the paper substrate, the basis weight, calendering, and Clupak processing. For example, when softwood pulp and hardwood pulp are used as the pulp constituting the paper substrate, an increase in the content of the hardwood pulp tends to decrease the Clark stiffness. In addition, when the pulp constituting the paper substrate having an increased beating degree and a low CSF is used, the Clark stiffness tends to decrease. Moreover, a decrease in the basis weight tends to decrease the Clark stiffness, and the paper substrate subjected to Clupak processing or calendering tends to decrease the Clark stiffness.

[0086] The Clark stiffness of the heat-sealable paper in the longitudinal direction is preferably 20 or more, more preferably 30 or more, and still more preferably 40 or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and is preferably 250 or less, more preferably 200 or less, still more preferably 150 or less, even still more preferably 100 or less, further still more preferably 85 or less, much more preferably 80 or less, particularly preferably 75 or less, may be 70 or less, may be 65 or less, and may be 55 or less from the viewpoint of automatic packaging formability.

[0087] The Clark stiffness of the heat-sealable paper in the transverse direction is preferably 20 or more, more preferably 30 or more, and still more preferably 35 or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and is preferably 250 or less, more preferably 200 or less, still more preferably 150 or less, even still more preferably 100 or less, further still more preferably 85 or less, much more preferably 80 or less, particularly preferably 70 or less, may be 60 or less, and may be 50 or less from the viewpoint of automatic packaging formability.

(Clark stiffness/basis weight)

[0088] A value (Clark stiffness/basis weight) (unit: m²/g) obtained by dividing the longitudinal and transverse geometric mean of the Clark stiffness of the heat-sealable paper by the basis weight (g/m²) of the heat-sealable paper is preferably 0.20 m²/g or more, more preferably 0.30 m²/g or more, and still more preferably 0.40 m²/g or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening and from the viewpoint of formability (e.g., appearance of a bag), and is preferably 1.20 m²/g or less, more preferably 1.00 m²/g or less, even still

more preferably 0.90 m²/g or less, much more preferably 0.80 m²/g or less, particularly preferably 0.65 m²/g or less, may be 0.60 m²/g or less, and may be 0.55 m²/g or less from the viewpoint of automatic packaging formability.

[0089] In addition, when "the longitudinal and transverse geometric mean of Clark stiffness/basis weight (unit: m²/g)" is 1.00 m²/g or less, the heat-sealable paper has an appropriate softness and the heat-sealable paper can follow deformation when formed with a bag making machine. Therefore, it is thought that wrinkles or bad appearance is prevented, and excellent automatic packaging formability is achieved. Moreover, when "the longitudinal and transverse geometric mean of Clark stiffness/basis weight (unit: m²/g)" is 0.20 m²/g or more, it is thought that firmness or robustness of the packaging bag is improved, and the packaging bag is prevented from being torn.

[0090] In the specification, the phrase "excellent automatic packaging formability" means that a bag can be continuously produced with an automatic packaging machine, and that the appearance of the obtained bag is good. Here, the phrase "a bag can be continuously produced" means that when a packaging bag is formed with an automatic packaging machine, phenomena such as wrinkles, meandering, fracture of a packaging material, and sticking to a packaging machine do not occur, or that even such phenomena occur, it does not affect continuous production of bags. Furthermore, the phrase "the appearance of a bag is good" means that bad appearance such as wrinkles on a bag, seal defect (misalignment of a sealed portion), or deformation is not found, or that even such bad appearance is found, it falls within an acceptable range.

[0091] A value (Clark stiffness/basis weight) (unit: m²/g) obtained by dividing the Clark stiffness of the heat-sealable paper in the longitudinal direction with the basis weight (g/m²) of the heat-sealable paper is preferably 0.20 m²/g or more, more preferably 0.30 m²/g or more, and still more preferably 0.40 m²/g or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and is preferably 2.40 m²/g or less, more preferably 2.00 m²/g or less, still more preferably 1.50 m²/g or less, even still more preferably 1.00 m²/g or less, further still more preferably 0.90 m²/g or less, yet even still more preferably 0.80 m²/g or less, much more preferably 0.70 m²/g or less, may be 0.60 m²/g or less, or may be 0.55 m²/g or less from the viewpoint of automatic packaging formability.

[0092] A value (Clark stiffness/basis weight) (unit: m²/g) obtained by dividing the Clark stiffness of the heat-sealable paper in the transverse direction with the basis weight (g/m²) of the heat-sealable paper is preferably 0.20 m²/g or more, more preferably 0.30 m²/g or more, and still more preferably 0.40 m²/g or more from the viewpoint of obtaining a packaging bag that is difficult to tear and can be easily opened at the time of opening, and is preferably 1.20 m²/g or less, more preferably 1.00 m²/g or less, still more preferably 0.90 m²/g or less, particularly preferably 0.80 m²/g or less, and may be 0.60 m²/g or less from the viewpoint of automatic packaging formability.

(Piercing strength)

[0093] The piercing strength of the heat-sealable paper is preferably 10.0 N or more, more preferably 11.0 N or more, still more preferably 12.0 N or more, and even still more preferably 12.5 N or more from the viewpoint of obtaining a packaging bag that is difficult to tear, and the upper limit thereof, which is not specifically limited, is preferably 30.0 N or less, more preferably 25.0 N or less, still more preferably 20.0 N or less, even still more preferably 18.0 N or less, and much more preferably 17.0 N or less from the viewpoint of obtaining heat-sealable paper having a desirable Clark stiffness and from the viewpoint of easy production.

[0094] The piercing strength of the heat-sealable paper is measured according to JIS Z 1717:2019.

[0095] A method for adjusting the piercing strength of the heat-sealable paper to the above range is not specifically limited but the piercing strength of the heat-sealable paper can be adjusted by selecting conditions such as the kind or beating degree of pulp constituting the paper substrate, basis weight, and Clupak processing. For example, when at least one selected from softwood pulp and hardwood pulp as the pulp constituting the paper substrate is used, an increase in the content of softwood pulp tends to increase piercing strength. In addition, when the pulp constituting the paper substrate having an increased beating degree and a low CSF is used, the piercing strength tends to decrease. Moreover, an increase in the basis weight tends to increase piercing strength. Moreover, the paper substrate subjected to Clupak processing increases elongation of paper and can absorb an impact due to piercing, which tends to increase piercing strength.

[Production method of heat-sealable paper]

[0096] The production method of the heat-sealable paper of the embodiment is not specifically limited. Examples thereof include a production method comprising an application step of applying at least one heat-sealable layer on at least one surface of a paper substrate obtained by a method that comprises a cooking step of cooking a raw material pulp, a beating step of beating a dispersion containing 20 mass% or more and 45 mass% or less of the raw material pulp subjected to cooking, and a papermaking step of making paper from the raw material pulp subjected to beating. Each step of the production method will be described below.

(Cooking step)

[0097] The cooking step is step of cooking a raw material pulp. The kappa number of the raw material pulp is preferably 30 or more and 60 or less by the cooking step. Although not specifically limited, raw material chips used as a material of the raw material pulp are preferably treated with a chemical solution containing sodium hydroxide. As the method for treatment with a chemical solution containing sodium hydroxide, a known treatment method using a known chemical solution can be used.

[0098] By setting the kappa number of the raw material pulp 30 or more and 60 or less, it is possible to obtain heat-sealable paper that can form a packaging bag, which is difficult to tear and can be easily opened at the time of opening. From this point of view, the kappa number of raw material pulp is preferably 50 or less, more preferably 45 or less.

[0099] The raw material chips used as a material of the raw material pulp preferably contains softwood pulp as a main component. The "raw material chips containing softwood pulp as a main component" has a content of the softwood of over 50 mass%, preferably a content of the softwood of 80 mass% or more, more preferably 90 mass% or more, further preferably 100 mass%, in the raw material chips.

[0100] The raw material pulp may not be bleached or may be bleached. The raw material pulp is preferably one or more selected from the group consisting of bleached kraft pulp and unbleached kraft pulp, more preferably unbleached kraft pulp.

(Beating step)

[0101] The beating step is a step of beating a dispersion preferably containing 20 mass% or more and 45 mass% or less of the raw material pulp subjected to cooking. The beating method is not specifically limited and preferably includes: dispersing, in water, the raw material pulp subjected to cooking, producing a dispersion having the above raw material pulp concentration, and subjecting the dispersion to beating. The beating method is not specifically limited and can be performed, for example, using a beater such as a double disk refiner, a single disk refiner, and a conical refiner.

[0102] Beating the dispersion containing 20 mass% or more and 45 mass% or less of the raw material pulp subjected to cooking allows a paper substrate with impact resistance and workability and heat-sealable paper using the paper substrate to be obtained, as well as allowing excellent productivity.

(Papermaking step)

[0103] The papermaking step is a step of making paper from the raw material pulp subjected to beating. The papermaking method is not specifically limited, and examples thereof include the acidic papermaking method in which papermaking is performed at a pH of around 4.5, the neutral papermaking method in which papermaking is performed at a pH of about 6 to about 9, and the like. In the papermaking step, agents for papermaking step such as pH adjusters, defoamers, pitch control agents, and slime control agents can be appropriately added, as required. The paper making machine is also not specifically limited, and examples thereof include Fourdrinier, cylindrical, and inclined continuous paper machines or multilayer paper machines that combine these.

[0104] The paper substrate used for the heat-sealable paper of the embodiment can be obtained by a method including the cooking step, the beating step, and the papermaking step. After the papermaking step, a Clupak step of shrinking the paper strip using Clupak equipment may be provided, as required. A known Clupak equipment can be used. The production method of the paper substrate used for the heat-sealable paper of the embodiment is not limited to the aforementioned method.

[0105] Further, the production method of the heat-sealable paper in the embodiment may include a surface treatment step of treating the surface of the paper substrate with an agent. Examples of the agent used for the surface treatment step include sizing agents, waterproofing agents, water retention agents, thickeners, lubricants, and the like. A known device can be used for the surface treatment step.

[0106] The production method of the heat-sealable paper of the embodiment comprises an application step of applying the heat-sealable layer on at least one surface of the paper substrate obtained as described above. The heat-sealable layer coating liquid (heat-sealable layer coating material) may be applied twice or more.

[0107] In the case of forming multiple heat-sealable layers on the paper substrate, the aforementioned method of sequentially forming the heat-sealable layers is preferable, but there is no limitation to this, and a simultaneous multilayer coating method may be employed. The simultaneous multilayer coating method is a method of discharging multiple types of coating liquids separately from slit-shaped nozzles to form a liquid laminate and applying the laminate to the paper substrate to form multiple heat-sealable layers simultaneously.

[0108] The application equipment for applying the heat-sealable layer coating liquid to the paper substrate is not specifically limited, and known equipment may be used. Examples of the application equipment include blade coaters, bar coaters, air knife coaters, slit die coaters, gravure coaters, micro gravure coaters, roll coaters, size presses, gate roll

coaters, Sym-sizers, and the like.

[0109] The drying equipment for drying the heat-sealable layer is not specifically limited, and known equipment can be used. Examples of the drying equipment include hot air dryers, infrared dryers, gas burners, hot plates, and the like. Further, the drying temperature may be appropriately set in consideration of the drying time.

[0110] The solvent for the heat-sealable layer coating liquid is not specifically limited, and water or an organic solvent such as ethanol, isopropyl alcohol, methyl ethyl ketone, and toluene can be used. Among these, water is preferable as a dispersion medium for the heat-sealable layer coating liquid, since there is no problem of volatile organic solvents. That is, the heat-sealable layer coating liquid is preferably an aqueous composition for heat-sealable layers.

[0111] The solid content (solid content concentration) of the heat-sealable layer coating liquid is not specifically limited and may be appropriately selected from the viewpoint of the coating property and ease of drying but is preferably 10% by mass or more, more preferably 20% by mass or more, and still more preferably 30% by mass or more, and is preferably 80% by mass or less, more preferably 60% by mass or less, still more preferably 50% by mass or less, and even still more preferably 40% by mass or less.

[0112] The preferable range of the coating amount (after drying) of the heat-sealable layer is as described above. The heat-sealable layer may be one layer or may be two or more layers. When the number of the heat-sealable layer is two or more, the aforementioned coating amount is the total coating amount.

[0113] After the heat-sealable layer is applied and dried, super calendering is preferably performed. Here, the super calendering is provided independently from the papermaking and is generally to pass the paper to be processed between metal rolls or between a metal roll and an elastic roll, heat it, apply a pressure thereto, and the like. Super calendering may be performed in one stage or in multiple stages, and there is no specific limitation.

[0114] Preferably, super calendering improves the smoothness of the surface of the heat-sealable layer, which results in improvement of the heat sealing peel strength (decrease in the minimum substrate destruction temperature) and a decrease in the Clark stiffness.

[0115] Further, it is preferable since the smoothness of the surface opposite to the heat-sealable layer (the other surface of the paper substrate, for example, in the case where the heat-sealable layer is provided only on one surface of the paper substrate, and the paper substrate is exposed on the other surface) is improved, as a result of which the printability is improved.

[0116] Further, since the density of the heat-sealable paper tends to increase by super calendering, and the surface smoothness is improved, as described above, super calendering is preferable because delivering the heat-sealable paper in the packing machine during bag making becomes good, thereby improving processability.

[0117] The linear pressure in super calendering is preferably 10 kg/cm or more, more preferably 30 kg/cm or more, further preferably 50 kg/cm or more, and is preferably 1000 kg/cm or less, more preferably 500 kg/cm or less, further preferably 200 kg/cm or less. However, the linear pressure may be appropriately changed according to the desired smoothness and density.

[0118] Further, in the case where heating is performed in super calendering, the heating temperature is not specifically limited but is preferably 20°C or more, more preferably 30°C or more, further preferably 35°C or more, and is preferably 80°C or less, more preferably 70°C or less, further preferably 60°C or less, for preventing deterioration of the paper substrate and the heat-sealable layer due to heat and sticking of the heat-sealable layer while enhancing the effect of treatment.

<Applications>

[0119] The heat-sealable paper according to the present embodiment can be favorably used as a packaging bag for foods, household goods, books, commodities (soaps, cleaning agents, and diapers), and the like. Accordingly, the present invention also provides a packaging bag using the heat-sealable paper.

Examples

[0120] Hereinafter, examples will be mentioned in order to specifically describe this invention, but this invention is not limited to these examples. Unless otherwise specified, the following operations were performed under the conditions of 23°C and a relative humidity of 50%RH. In the following examples and comparative examples, "parts" and "%" respectively refer to "parts by mass" and "mass%", unless otherwise specified.

[Example 1]

<Preparation of heat-sealable layer coating material>

[0121] 98 parts of an aqueous dispersion of a styrene/butadiene copolymer (Nipol latex LX407S12, available from Zeon

Corporation, solid content 46%, glass transition temperature: 18°C (catalog value)) (in terms of solid content) and 2 parts of a paraffin wax emulsion (Hidorin L-700, available from Chukyo Yushi Co., Ltd., solid content 30%) (in terms of solid content) were mixed, and water was added thereto to a solid content concentration of 33%, followed by stirring, to prepare a heat-sealable layer coating material (concentration 33%). The styrene/butadiene copolymer had a solubility in water at 25°C of 10 g/L or less.

<Production of heat-sealable paper>

[0122] The obtained heat-sealable layer coating material was used to form a heat-sealable layer with an air knife coater on the W side of extensible paper having a basis weight of 82.9 g/m², a thickness of 123 μm, and a density of 0.67 g/cm³ (available from Oji Materia Co., Ltd., needle unbleached kraft pulp: 100% by mass, Canadian standard freeness: 677 mL, Clupak processing was done, smoothness F side: 4 seconds, W side: 7 seconds) so that the coating amount of the heat-sealable layer after drying was 10 g/m², then, the heat-sealable layer coating material was dried with a dryer at 130 to 160°C, finally, a chilled roll was in contact with the coated surface and a cotton roll was in contact with the non-coated surface so as to achieve a linear load of 90 kg/cm, followed by heating the rolls to 40°C and one-stage super calendering, to thereby obtain heat-sealable paper (smoothness F side: 8 seconds, W side: 64 seconds). Super calendering increased the smoothness and improved printability compared to paper before coating.

[Example 2]

[0123] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to extensible paper having a basis weight of 78.3 g/m², a thickness of 126 μm, and a density of 0.62 g/cm³ (available from Oji Materia Co., Ltd., needle unbleached kraft pulp: 100% by mass, Canadian standard freeness: 563 mL, smoothness F side: 12 seconds, W side: 29 seconds) and the coating amount of a heat-sealable layer after drying was set to 12 g/m², thereby to obtain heat-sealable paper (smoothness F side: 15 seconds, W side: 61 seconds).

[Example 3]

[0124] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to heavy-duty packaging paper having a basis weight of 79.2 g/m², a thickness of 132 μm, and a density of 0.60 g/cm³ (available from Oji Materia Co., Ltd., needle unbleached kraft pulp: 100% by mass, Canadian standard freeness: 578 mL, smoothness F side: 3 seconds, W side: 2 seconds, Clupak processing was not performed) and the coating amount of a heat-sealable layer after drying was set to 10 g/m², thereby to obtain heat-sealable paper (smoothness F side: 25 seconds, W side: 65 seconds).

[Example 4]

[0125] Ninety eight parts of an aqueous dispersion of a commercially available ethylene-acrylic acid copolymer (glass transition temperature: 45°C) (in terms of solid content) and 2 parts of an aqueous dispersion of a commercially available carnauba wax (Michem Lube 160RPH, available from Michelman, solid content concentration: 25% by mass) (in terms of solid content) were mixed, and water was added thereto with stirring so that the solid content concentration was 35%, to thereby prepare a heat-sealable layer coating material (concentration: 35%). A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 2 except that the obtained heat-sealable layer coating material was used, to thereby obtain heat-sealable paper (smoothness F side: 8 seconds, W side: 82 seconds). The ethylene-acrylic acid copolymer had a solubility to water of 10 g/L or less at 25°C.

[Example 5]

[0126] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that 2 parts of a polyethylene wax emulsion (Aquacer 531, available from BYK, solid content concentration: 45% by mass) (in terms of solid content) was added instead of 2 parts of the paraffin wax emulsion (in terms of solid content), to prepare a heat-sealable layer coating material, to thereby obtain heat-sealable paper

(smoothness F side: 8 seconds, W side: 42 seconds)

[Example 6]

[0127] Heat-sealable paper (smoothness F side: 12 seconds, W side: 40 seconds) was obtained in the same manner as in Example 2 except that super calendering was not performed.

[Example 7]

[0128] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the paraffin wax emulsion was not added, to thereby obtain heat-sealable paper (smoothness F side: 8 seconds, W side: 60 seconds).

[Example 8]

[0129] Heat-sealable paper (smoothness F side: 8 seconds, W side: 12 seconds) was obtained in the same manner as in Example 1 except that 10 parts of an aqueous dispersion of kaolin (average particle size: 8 μm , aspect ratio: 80 to 100) having a solid content concentration of 50% (in terms of solid content), 88 parts of an aqueous dispersion of a styrene/butadiene copolymer (available from Zeon Corporation, Nipol latex LX407S12, solid content concentration: 46%, glass transition temperature: 18°C (catalog value)) (in terms of solid content), and 2 parts of a paraffin wax emulsion (available from Chukyo Yushi Co., Ltd., Hidorin L-700, solid content concentration: 30%) (in terms of solid content) were used to prepare a heat-sealable layer coating material.

[Example 9]

[0130] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that 2 parts of a carnauba wax emulsion (Michem Lube 160RPH, available from Michelman, solid content concentration: 25% by mass) (in terms of solid content) was added instead of 2 parts of the paraffin wax emulsion (in terms of solid content), to prepare a heat-sealable layer coating material, to thereby obtain heat-sealable paper (smoothness F side: 8 seconds, W side: 64 seconds).

[Example 10]

[0131] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 2 except that 2 parts of a polyethylene wax emulsion (Aquacer 531, available from BYK, solid content concentration: 45% by mass) (in terms of solid content) was added instead of 2 parts of the paraffin wax emulsion (in terms of solid content) to prepare a heat-sealable layer coating material, to thereby obtain heat-sealable paper (smoothness F side: 15 seconds, W side: 42 seconds).

[Example 11]

[0132] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to extensible paper having a basis weight of 100.0 g/m², a thickness of 149 μm , and a density of 0.67 g/cm³ (available from Oji Materia Co., Ltd., needle unbleached kraft pulp: 100% by mass, Canadian standard freeness: 677 mL, Clupak processing was performed, smoothness F side: 7 seconds, W side: 18 seconds), to thereby obtain heat-sealable paper (smoothness F side: 8 seconds, W side: 57 seconds).

[Example 12]

[0133] Heat-sealable paper (smoothness F side: 15 seconds, W side: 24 seconds) was obtained in the same manner as in Example 2 except that 10 parts of an aqueous dispersion of kaolin (average particle size: 8 μm , aspect ratio: 80 to 100) having a solid content concentration of 50% (in terms of solid content), 88 parts of an aqueous dispersion of a styrene/butadiene copolymer (available from Zeon Corporation, Nipol latex LX407S12, solid content concentration: 46%, glass transition temperature: 18°C (catalog value)) (in terms of solid content), and 2 parts of a paraffin wax emulsion (available from Chukyo Yushi Co., Ltd., Hidorin L-700, solid content concentration: 30%) (in terms of solid content) were used to prepare a heat-sealable layer coating material.

[Example 13]

[0134] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 2

except that 2 parts of a carnauba wax emulsion (Michem Lube 160RPH, available from Michelman, solid content concentration: 25% by mass) (in terms of solid content) was added instead of 2 parts of the paraffin wax emulsion (in terms of solid content), to prepare a heat-sealable layer coating material, to thereby obtain heat-sealable paper (smoothness F side: 15 seconds, W side: 62 seconds).

[Comparative Example 1]

[0135] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to unbleached light-duty packaging paper having a basis weight of 80.5 g/m², a thickness of 114 μm, and a density of 0.71 g/cm³ (available from Oji Materia Co., Ltd., needle unbleached kraft pulp / leaf bleached kraft pulp = 80/20 (mass ratio), Canadian standard freeness: 478 mL, smoothness F side: 17 seconds, W side: 16 seconds), to thereby obtain heat-sealable paper (smoothness F side: 89 seconds, W side: 219 seconds).

[Comparative Example 2]

[0136] Unbleached light-duty packaging paper having a basis weight of 70.0 g/m², a thickness of 100 μm, and a density of 0.70 g/cm³ (available from Oji Materia Co., Ltd., needle unbleached kraft pulp/leaf bleached kraft pulp = 80/20 (mass ratio), Canadian standard freeness: 478 mL, smoothness F side: 16 seconds, W side: 14 seconds) was subjected to melt extrusion lamination so that the thickness of polyethylene was 20 μm, to thereby form polyethylene laminated paper having a basis weight of 89.2 g/m² (smoothness F side: 16 seconds, W side: 140 seconds).

[Comparative Example 3]

[0137] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 3 except that an aqueous dispersion of an ethylene/vinyl acetate copolymer (available from Sumika Chemtex Company, Limited, SUMIKAFLEX 470HQ, solid content: 55%, glass transition temperature: 0°C (catalog value)) was used instead of the aqueous dispersion of the styrene/butadiene copolymer as the heat-sealable layer coating material, and the paraffin wax emulsion was not used, to thereby obtain heat-sealable paper (smoothness F side: 25 seconds, W side: 56 seconds).

[Comparative Example 4]

[0138] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to one-side glazed kraft paper having a basis weight of 78.2 g/m², a thickness of 100 μm, and a density of 0.78 g/cm³ (available from Oji Materia Co., Ltd., needle bleached kraft pulp/leaf bleached kraft pulp = 35/65 (mass ratio), Canadian standard freeness: 578 mL, smoothness F side: 120 seconds, W side: 18 seconds), to thereby obtain heat-sealable paper (smoothness F side: 300 seconds, W side: 291 seconds).

[Comparative Example 5]

[0139] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to one-side bleached kraft paper having a basis weight of 50.7 g/m², a thickness of 61 μm, and a density of 0.83 g/cm³ (available from Oji F-Tex Co., Ltd., leaf bleached kraft pulp: 100% by mass, Canadian standard freeness: 420 mL, smoothness F side: 430 seconds, W side: 16 seconds, Clupak processing was not performed), to thereby obtain heat-sealable paper (smoothness F side: 963 seconds, W side: 219 seconds).

[Comparative Example 6]

[0140] A heat-sealable layer was formed and super calendering was performed in the same manner as in Example 1 except that the extensible paper was changed to thick glassine paper having a basis weight of 30.6 g/m², a thickness of 30 μm, and a density of 1.01 g/cm³ (available from Oji F-Tex Co., Ltd., needle bleached kraft pulp: 100% by mass, smoothness F side: 1,300 seconds, W side: 1,350 seconds), to thereby obtain heat-sealable paper (smoothness F side: 1,700 seconds, W side: 1,500 seconds).

[Measurement method]

[0141] The obtained heat-sealable paper was used to perform the following measurements.

<Smoothness>

[0142] The Oken smoothness was measured according to JIS P8155:2010 to determine a value of the smoothness. The smoothness of the paper substrate was measured in the same manner as described above.

<Clark stiffness>

[0143] Each of the Clark stiffnesses of paper in the longitudinal direction and the transverse direction was measured according to JIS P 8143:2009, and both of them were used to determine a geometric mean, and the geometric mean was defined as a value of Clark stiffness geometric mean.

<Tear index of heat-sealable paper>

[0144] The tearing resistance of the heat-sealable paper was measured according to JIS P 8116:2000. Each of the tearing resistances in the longitudinal direction and the transverse direction was measured, and the obtained value was divided by a basis weight, and the thus-obtained value was defined as a tear index. From the obtained tear indexes in the longitudinal direction and the transverse direction, a longitudinal and transverse geometric mean was determined.

<Burst index of heat-sealable paper>

[0145] The bursting strength of the heat-sealable paper was measured according to JIS P 8112:2008. The obtained value was divided by a basis weight, and thus-obtained value was defined as a burst index.

<Piercing strength>

[0146] The test was performed according to JIS Z1717:2019.

<Measurement of heat sealing peel strength>

[0147] One set of two heat-sealable papers was stacked so that heat-sealable layers face each other and heat-sealed using a heat seal tester (TP-701-B, available from TESTER SANGYO CO, LTD.) under the conditions of 150°C, 0.2 MPa, and one second. The heat-sealed test specimens were left standing in a room at a temperature of 23°C ± 1°C and a humidity of 50% ± 2% for 4 hours or more. Subsequently, the test specimen heat-sealed was cut into a width of 15 mm and T-peeled using a tensile tester at a tensile speed of 300 mm/min, and the maximum load recorded was taken as a heat sealing peel strength.

<Drop test using sand>

[0148] Two sheets of heat-sealable paper with 400 square millimeters were placed with the surfaces of the heat-sealable paper facing each other, and heat sealing was performed at three sides, approximately 2 kg of sand was filled thereinto, and the remaining one side was heat-sealed, to thereby produce a packaging bag filled with the contents. A drop test was then conducted on this according to JIS Z 0202:2017. Five bags were made in the same manner as described above for the drop test. The number of torn bags, the number of broken bags, and the number of opened heat-sealed portions in all the bags were totaled, followed by determination based on the following criteria (only A is acceptable).

A: In the drop test, torn paper, a broken bag, and opening of the heat-sealed portions were not found at all.

B: In the drop test, the total number of torn paper or the number of opened heat-sealed portions was 1 or more but 4 or less.

C: In the drop test, the total number of torn paper or the number of opened heat-sealed portions was 5 or more.

<Drop test using gravel>

[0149] Two sheets of heat-sealable paper with 400 square millimeters were placed with the surfaces of the heat-sealable paper facing each other, and heat sealing was performed at three sides, approximately 2 kg of gravel (sharper than sand) was filled thereinto, and the remaining one side was heat-sealed, to thereby produce a packaging bag filled with the contents. A drop test was then conducted on this according to JIS Z 0202:2017. Five bags were made in the same manner as described above for the drop test. The number of torn bags, the number of broken bags, and the number of opened heat-sealed portions in all the bags were totaled, followed by determination based on the following criteria (only A

is acceptable).

A: In the drop test, torn paper and a broken bag were not found at all.

B: In the drop test, the total number of torn paper or the number of broken bags was 1 or more but 4 or less.

C: In the drop test, the total number of torn paper or the number of broken bags was 5 or more.

<Ease of opening test>

[0150] The heat-sealed portion of a packaging bag similar to that used in the drop test was pulled in both directions perpendicular to the heat-sealed surface without tearing (by pulling both sheets of heat-sealed paper in opposite directions so as to peel the heat-sealed layers from each other), and the ease of opening at the time of opening was evaluated as follows.

A: A packaging bag could be easily opened.

B: A packaging bag was very tight and is difficult to open.

<Blocking resistance>

[0151] Ten sheets of the heat-sealable paper were laminated so that the coated surface and the non-coated surface were in contact with each other, and were pressed at a pressure of 20 kgf/cm² for 15 hours while the sheets were heated to 40°C in the longitudinal direction with a hot press machine. After the pressure was released, the paper was taken out. Then, the result obtained when the sheets were peeled with hand was evaluated.

A: Neither breakage nor paper peeling was found.

B: Either breakage or paper peeling was found.

[0152] <Automatic packaging formability test>

[0153] Heat-sealable paper was continuously made into bags using a high-speed transverse pillow packing machine (αWrapper FW3410, available from FUJI MACHINERY CO., LTD.). At this time, no contents were put into the bag, but an empty bag was used for molding, and the appearance and the runnability were checked to determine the followings. Here, "continuous bag making was impossible" means a state in which wrinkles were generated, a state in which a bag could not formed due to meandering, or a paper break occurred. The phrase "bad appearance" means the presence of wrinkles, misalignment of the sealed portion, or deformation of the bag (A and B are acceptable).

A: Continuous bag making was possible, and the appearance of the bag was good.

B: Continuous bag making was possible, but the appearance of the bag was slightly defective.

C: Continuous bag making was impossible.

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Table 2

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6
Kind	-	Unbleached light-duty packaging paper	Unbleached light-duty packaging paper	Heavy-duty packaging paper	One-side glazed kraft paper	One-side glazed kraft paper	Thick glassine paper
Freeness after beating	mL	478	478	578	578	420	-
Basis weight	g/m ²	80.5	70.0	79.2	78.2	50.7	30.6
Thickness	μm	114	100	132	100	61	30
Density	g/cm ³	0.71	0.70	0.60	0.78	0.83	1.01
F side smoothness	Second	17	16	3	120	430	1300
W side smoothness	Second	16	14	2	18	16	1350
Heat-sealable layer	Kind of main agent	SBR	PE-laminated	Ethylenevinyl acetate	SBR	SBR	SBR
	Tg (°C)	18	-	0	18	18	18
	Lubricant	Paraffin wax	None	None	Paraffin wax	Paraffin wax	Paraffin wax
	Pigment	None	None	None	None	None	None
Basis weight	g/m ²	90.5	89.2	89.3	88.9	60.2	40
Thickness	μm	115	123	130	95	62	40
Density	g/cm ³	0.79	0.73	0.69	0.94	0.97	1.00
F side smoothness	Second	89	16	25	300	963	1700
W side smoothness	Second	219	140	56	291	219	1500
Clark stiffness	Longitudinal	158.0	130.0	168.2	40.2	40.2	10.3
	Transverse	57.6	57.3	50.6	18.3	18.3	4.4
	Longitudinal and transverse geometric mean	95.4	86.3	92.3	27.1	27.1	6.7

(continued)

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6
Heat-sealable paper	Clark stiffness/Basis weight	1.75	1.46	1.88	0.45	0.67	0.26
	Transverse (m ² /g)	0.64	0.64	0.57	0.21	0.30	0.11
	Longitudinal and transverse geometric mean (m ² /g)	1.05	0.97	1.03	0.30	0.45	0.17
	Longitudinal (mN·m ² /g)	12.4	10.8	11.5	7.1	6.6	4.1
	Transverse (mN·m ² /g)	16.0	14.9	14.5	7.5	7.2	4.5
	Longitudinal and transverse geometric mean (mN·m ² /g)	14.1	12.7	12.9	7.3	6.9	4.3
	Burst index kPa·m ² /g	2.6	3.5	3.9	3.7	4.2	3.6
	Piercing strength	8.9	9.5	10.5	5.9	4.7	1.8
	Heat sealing peel strength	5.0	20.0	12.0	5.0	4.8	3.3
	Drop test (sand)	C	B	A	C	C	C
	Drop test (gravel)	C	C	B	C	C	C
	Ease of opening	A	B	B	A	A	A
	Blocking resistance	A	A	A	A	A	A
	Automatic packaging formability	C	B	C	A	A	A

[0154] From Table 1, the packaging bags obtained from the heat-sealable paper of Examples 1 to 13 were excellent in drop impact resistance and were prevented from being torn. In addition, these packaging bags were easily opened at the time of opening.

[0155] In contrast, from Table 2, the packaging bag obtained from the heat-sealable paper of Comparative Example 1 having a burst index of less than $3.0 \text{ kPa} \cdot \text{m}^2/\text{g}$ was deteriorated in drop impact resistance and was torn. The packaging bag obtained from the heat-sealable paper of Comparative Example 2, which was obtained by providing a PE layer on unbleached light-duty packaging paper through lamination and had a heat sealing peel strength of more than $10 \text{ N}/15 \text{ mm}$, was deteriorated in drop impact resistance and ease of opening. Moreover, the packaging bag obtained from the heat-sealable paper of Comparative Example 3 having a heat sealing peel strength of more than $10 \text{ N}/15 \text{ mm}$ was deteriorated in ease of opening. The packaging bags obtained from the heat-sealable paper of Comparative Examples 4 to 6 each having a longitudinal and transverse geometric mean of a tear index of less than $10 \text{ mN} \cdot \text{m}^2/\text{g}$ were deteriorated in drop impact resistance and were torn.

[0156] The heat-sealable paper of Examples 1 to 6 and 8 to 13, which contained a lubricant, were excellent in blocking resistance. In addition, comparison between Example 2 and Example 6 found that super calendering decreases Clark stiffness and improves heat sealing peel strength.

[0157] It can be said from the above results that the heat-sealable paper of the present embodiment makes it possible to obtain a packaging bag that is difficult to tear and can be easily opened at the time of opening.

Claims

1. Heat-sealable paper comprising one or more heat-sealable layers on at least one surface of a paper substrate, wherein
 - the heat-sealable layer comprises a water-dispersible resin binder, a longitudinal and transverse geometric mean of a tear index of the heat-sealable paper is $10 \text{ mN} \cdot \text{m}^2/\text{g}$ or more, a burst index of the heat-sealable paper is $3.0 \text{ kPa} \cdot \text{m}^2/\text{g}$ or more, and when two such heat-sealable layers are heat-sealed to each other at 150°C and 0.2 MPa for one second, a heat sealing peel strength is $2.0 \text{ N}/15 \text{ mm}$ or more and $10 \text{ N}/15 \text{ mm}$ or less.
2. The heat-sealable paper according to claim 1, wherein the heat-sealable layer further comprises a lubricant.
3. The heat-sealable paper according to claim 2, wherein the lubricant comprises at least one selected from the group consisting of paraffin wax, carnauba wax, and polyolefin wax.
4. The heat-sealable paper according to claim 2 or 3, wherein a content of the lubricant in the heat-sealable layer is 1% by mass or more and 5% by mass or less.
5. The heat-sealable paper according to any one of claims 1 to 4, wherein a glass transition temperature of the water-dispersible resin binder is 0°C or more and 100°C or less.
6. The heat-sealable paper according to any one of claims 1 to 5, wherein the water-dispersible resin binder comprises at least one selected from the group consisting of a styrene-butadiene copolymer and an olefin-unsaturated carboxylic acid copolymer.
7. The heat-sealable paper according to any one of claims 2 to 6, wherein the water-dispersible resin binder comprises a styrene-butadiene copolymer, and the lubricant comprises paraffin wax.
8. The heat-sealable paper according to any one of claims 2 to 6, wherein the water-dispersible resin binder comprises an olefin-unsaturated carboxylic acid copolymer, and the lubricant comprises carnauba wax.
9. The heat-sealable paper according to any one of claims 1 to 8, wherein Canadian standard freeness of pulp constituting the paper substrate is 500 mL or more and 750 mL or less.
10. The heat-sealable paper according to any one of claims 1 to 9, wherein a main component of pulp constituting the paper substrate is needle unbleached kraft pulp.
11. The heat-sealable paper according to any one of claims 1 to 10, wherein a value (Clark stiffness/basis weight)

obtained by dividing a longitudinal and transverse geometric mean of Clark stiffness of the heat-sealable paper by a basis weight (g/m^2) of the heat-sealable paper is $0.20 \text{ m}^2/\text{g}$ or more and $1.20 \text{ m}^2/\text{g}$ or less.

5 **12.** The heat-sealable paper according to any one of claims 1 to 11, wherein a piercing strength of the heat-sealable paper is 10.0 N or more.

13. The heat-sealable paper according to any one of claims 1 to 12, wherein a basis weight of the paper substrate is 50 g/m^2 or more and 150 g/m^2 or less.

10 **14.** The heat-sealable paper according to any one of claims 1 to 13, wherein a basis weight of the heat-sealable layer is 3 g/m^2 or more and 30 g/m^2 or less.

15. The heat-sealable paper according to any one of claims 1 to 14, wherein a basis weight of the heat-sealable paper is 50 g/m^2 or more and 200 g/m^2 or less.

15 **16.** The heat-sealable paper according to any one of claims 1 to 15, wherein the paper substrate is extensible paper.

17. A packaging bag using the heat-sealable paper according to any one of claims 1 to 16.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/021978

A. CLASSIFICATION OF SUBJECT MATTER

D21H 19/22(2006.01)i; **B65D 65/40**(2006.01)i; **D21H 19/20**(2006.01)i; **D21H 27/10**(2006.01)i
 FI: D21H19/22; B65D65/40 D; D21H19/20 A; D21H27/10

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)

D21H19/22; B65D65/40; D21H19/20; D21H27/10

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 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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 2022-24664 A (NIPPON PAPER INDUSTRIES CO., LTD.) 09 February 2022 (2022-02-09)	1-17
A	JP 2022-11705 A (OJI HOLDINGS CORP.) 17 January 2022 (2022-01-17)	1-17
A	JP 2021-188241 A (OJI HOLDINGS CORP.) 13 December 2021 (2021-12-13)	1-17

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

* Special categories of cited documents:

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“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

04 September 2023

Date of mailing of the international search report

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Japan Patent Office (ISA/JP)
 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
 Japan

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/021978

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JP	2022-11705	A	17 January 2022	(Family: none)			
JP	2021-188241	A	13 December 2021	US	2023/0243106	A1	
				WO	2021/241427	A1	
				EP	4159919	A1	
				CN	115667629	A	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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