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(71) Applicants:
• **Neenah Gessner GmbH**
83052 Bruckmühl (DE)
• **Mativ Luxembourg**
5326 Contern (LU)

(72) Inventors:
• **Niederhuber, Armin**
83052 Bruckmühl (DE)
• **Cherkas, Oxana**
29393 Quimperle (FR)
• **Hervé, Raoul**
29393 Quimperle (FR)
• **Alvarez, Hugues**
29393 Quimperle (FR)
• **Le Lan, Gwendal**
29393 Quimperle (FR)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) **LOW OPACITY PAPER**

(57) A low grammage and low opacity paper is disclosed. The low opacity paper is made from a fibrous web containing highly refined cellulose fibers. The fibrous web is coated with a bio-based wax, such as a coco-

nut-based, palm-based, or soy-based wax. The resulting product can have a relatively low basis weight and can have a relatively low opacity. Thus, the product can have excellent transparent or translucent characteristics.

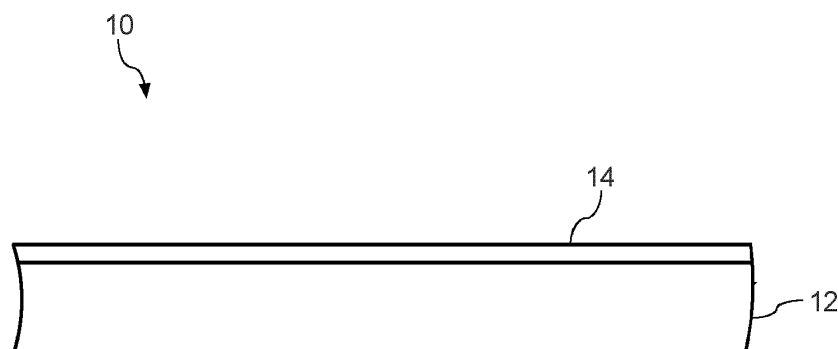


FIG. 1

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Description

BACKGROUND

[0001] Transparent or translucent materials are used in all different types of applications. Transparency, for instance, is a highly desirable quality in packaging materials. For example, although packaging materials are necessary to protect products during shipping and sales, consumers prefer to be able to view the product through the packaging.

[0002] In the past, most transparent or translucent materials, including packaging materials, were formed from plastic materials, such as polyester polymers and polyolefin polymers. These plastic materials, however, are derived from non-renewable, fossil resources, including petroleum-based resources. These resources are not sustainable, are not renewable, and produce polymer products that do not readily degrade. Thus, efforts have been made in the past in an attempt to produce transparent or translucent materials from renewable resources, such as cellulose materials.

[0003] For example, low opacity or transparent papers have been developed and produced in the past. Transparent paper products, for instance, have been used in the form of tracing paper, clear windows for envelopes, and more recently packaging paper for cereals, pasta, or bakery products.

[0004] In many instances, in order to produce a transparent or translucent paper, non-renewable resources or components that do not readily biodegrade were combined with the paper. For example, one type of paper produced in the past was manufactured from wood pulp fibers that may have been combined with an enzyme, such as xylanase. These substrates typically had a relatively high basis weight in order to provide sufficient strength or other mechanical properties. In order to reduce the thickness of the cellulose paper, densify the paper, and produce transparent properties, the paper was combined with petroleum-based chemicals or synthesized resins and then fed through a supercalendering process. As used herein, during supercalendering, a paper is first calendered by pressing it between metal cylinders or rollers. Afterwards, the paper is sent through an additional set of calendars to produce an even smoother and glossier paper, referred to as a supercalendered paper. The supercalender includes several cylinders alternating between polished metal and soft resilient surfaces. The supercalender applies pressure, heat, and friction to glaze both surfaces of the paper to make the paper smooth and/or glossy.

[0005] Transparent or translucent papers made in the past as described above have various drawbacks and deficiencies. For instance, as stated above, even though the fibers used to produce the paper are obtained from renewable resources and are biodegradable and compostable, the papers are typically combined with petroleum-based chemicals or other synthetic resins that can

frustrate the goal of producing bio-sourced materials. In addition, although supercalendering can be very effective at changing the properties of the paper, the process is very energy intensive.

[0006] Barrier properties to water, water vapor, and grease are also important for packaging materials. Usually, these properties are only achieved with petroleum-sourced materials.

[0007] In view of the above, a need currently exists for a low opacity paper that can be greater than 90% bio-sourced and can be biodegradable and compostable. A need also exists for a low opacity paper that can be produced without supercalendering and possibly using less materials, such as less cellulose fibers. A need also exists for a low opacity paper that has good barrier properties.

SUMMARY

[0008] It is an object of the present invention to provide an alternative to plastic films currently on the market. More particularly, the present disclosure is directed to a low opacity paper that can be made at relatively low basis weights, without containing any petroleum-based resources, and without having to supercalender the paper, thus reducing the energy requirements needed to make the product. The low opacity paper of the present disclosure can also be formulated to be completely biodegradable and compostable. In addition, the low opacity paper can have an excellent balance of properties including high transparency, low permeability for providing high barrier properties, and good mechanical properties for converting and handling.

[0009] In one aspect, the present disclosure is directed to a paper product with low opacity characteristics. The paper product comprises a fibrous web containing cellulose fibers. The cellulose fibers contained in the web can be refined to a relatively high degree as may be measured according to a freeness value. The freeness value ($^{\circ}$ SR) measures generally the rate at which a dilute suspension of refined fibers may be drained. The freeness is measured by the Schopper Riegler Method for drainability. As used herein, freeness can be measured according to DIN EN ISO 5267-1 :2000. The cellulose fibers contained in the web can have a degree of refining of greater than about 60° SR, such as greater than about 70° SR. The fibers generally have a freeness value of less than about 100° SR, such as less than about 90° SR. The fibrous web can also have a relatively low basis weight. The basis weight of the fibrous web for use in the present invention is less than about 30 g/m^2 , preferably less than about 24 g/m^2 , more preferably less than about 22 g/m^2 and most preferably less than about 20 g/m^2 , and generally greater than about 10 g/m^2 . In a preferred embodiment, the basis weight of the fibrous web is in the range of 10 to 24 g/m^2 and preferably 10 to 18 g/m^2 . The fibrous web defines a first surface and a second surface. As will be readily understood by the skilled person, the first surface and the second surface are the main surfaces of the fibrous web,

which may also be referred to as "upper" and lower" surface and are located opposite to each other. In accordance with the present invention, the paper product comprises a coating on at least one, preferably one, of the first surface and/or the second surface of the fibrous web. The coating comprises a transparency agent. The transparency agent comprises a bio-based wax or oil. Paper products made in accordance with the present disclosure can display an opacity of less than about 40% when tested according to ISO 2471:2008. For example, the opacity can be less than about 30%, such as less than about 25%, such as less than about 23%, such as less than about 20%, such as less than about 18%.

[0010] In one aspect, the fibrous web of the paper product has a basis weight of from about 12 g/m² to about 24 g/m², preferably to about 22 g/m² and displays an opacity of less than about 25%, such as less than about 23%, such as less than about 20%. In another aspect, the fibrous web of the paper product has a basis weight of from about 12 g/m² to about 22 g/m² and displays an opacity of less than about 23%, such as less than about 20%, such as less than about 18%. In yet another aspect, the fibrous web of the paper product has a basis weight of from about 12 g/m² to about 20 g/m² and displays an opacity of less than about 20%, such as less than about 19%, such as less than about 18%.

[0011] In one aspect, the transparency agent included in the coating is a plant or animal derived wax or oil. For example, in one aspect, the transparency agent is a plant derived wax or oil. In particular embodiments, the transparency agent can be a coconut-based wax, a palm-based wax, and/or a soy-based wax.

[0012] In one aspect, the fibrous web can comprise a wetlaid web. The fibrous web can contain wood pulp fibers alone or in combination with bast fibers. The wood pulp fibers, for instance, can be softwood fibers, hardwood fibers, or combinations thereof. The paper product can be produced without containing any paraffins, mineral oils, or hydrocarbon oils. Thus, in one aspect, the paper product can be repulpable and compostable.

[0013] The paper product can contain cellulose fibers generally in an amount greater than about 50% by weight, such as in an amount greater than about 60% by weight, such as in an amount greater than about 65% by weight, such as in an amount greater than about 70% by weight, such as in an amount greater than about 75% by weight, such as in an amount greater than about 80% by weight. Cellulose fibers are generally present in the paper product in an amount less than about 95% by weight, such as in an amount less than about 90% by weight, such as in an amount less than about 85% by weight, such as in an amount less than about 80% by weight.

[0014] The transparency agent can be present in the paper product in an amount greater than about 10% by weight, such as in an amount greater than about 15% by weight, such as in an amount greater than about 17% by weight, such as in an amount greater than about 20% by weight. The transparency agent is present in the paper

product generally in an amount less than about 50% by weight, such as in an amount less than about 40% by weight, such as in an amount less than about 30% by weight, such as in an amount less than about 25% by weight, such as in an amount less than about 20% by weight. In one embodiment, the transparency agent can be water miscible and applied to the fibrous web as an aqueous composition.

[0015] In one particular embodiment, the fibrous web can contain first cellulose fibers blended with second cellulose fibers. The first cellulose fibers can have an average fiber length that is shorter than the average fiber length of the second cellulose products. The first cellulose fibers, for instance, can be contained in the fibrous web in an amount from about 30% to about 70% by weight and the second cellulose fibers can be present in the fibrous web in an amount from about 70% to about 30% by weight based upon the total weight of fibers contained in the web. The first cellulose fibers, for instance, can have an average fiber length of from about 2.5 mm to about 5 mm.

[0016] The paper product of the present disclosure can have a combination of beneficial properties. For instance, the paper product can be relatively thin having a thickness of less than about 50 μ m, such as less than about 45 μ m, such as less than about 40 μ m, and generally greater than about 20 μ m. Thickness is measured according to EN ISO 534:2011. The paper product can also have a Gurley air permeability measured according to ISO 5636-5:2003 of less than about 45,200 seconds, such as less than about 20,000 seconds, such as less than about 10,000 seconds, such as less than about 1000 seconds, and generally greater than about 200 seconds. The paper product can also have a water drop resistance of greater than about 10 min according to TAPPI T 432 cm-09 (2 μ L of water volume is used in test). The paper product can have a water vapor barrier at 23°C and 50%HR of less than 100 g/m²/day, such as less than 80 g/m²/day and generally greater than about 0.1 g/m²/day according to ASTM E96/E96M - 15:2014.

[0017] The paper product of the present disclosure can be used in numerous and diverse applications. In one aspect, the present disclosure is directed to a packaging paper made from the paper product.

[0018] The present disclosure, in another aspect, is also directed to a method for producing a low opacity paper product as described above. The method includes coating a fibrous web with an aqueous composition containing a transparency agent. The transparency agent can comprise a bio-based wax or oil, such as a coconut-based wax, a palm-based wax and/or a soy-based wax. In one aspect, the fibrous web is impregnated with the aqueous composition containing the transparency agent using a size press. In other embodiments, however, the transparency agent can be applied to the fibrous web by using an applicator roll, by knife coating, by spraying, or by using any other suitable coating technique.

[0019] In one aspect, the fibrous web can be a wetlaid

web. The method of making the product can include generating an aqueous suspension of cellulose fibers; refining the cellulose fibers; depositing the aqueous suspension of fibers onto a porous forming surface to form a fibrous web; and coating the fibrous web with an aqueous composition containing the transparency agent.

[0020] Other features and aspects of the present disclosure are discussed in greater detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] A full and enabling disclosure of the present disclosure is set forth more particularly in the remainder of the specification, including reference to the accompanying figures, in which:

Figure 1 is a cross-sectional schematic view of one embodiment of a low opacity paper made in accordance with the present disclosure.

[0022] Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.

DEFINITIONS

[0023] As understood herein, a "coating" on the surface(s) of the fibrous web can be obtained by applying a generally liquid coating agent on the surface(s) of the fibrous web by means of any suitable coating, impregnation or saturation technique, such as for example air knife coating, roll-to-roll coating, blade coating, spray coating, Mayer rod coating, direct gravure printing, offset gravure printing, reverse gravure printing, smooth roll coating, curtain coating, bead coating, slot coating, fill press coating or impregnation via a size press. The coating can be a continuous coating or a discontinuous coating. Accordingly, along the lateral dimension of the fibrous web, the coating can be present in a part of or the complete fibrous web. When applying the coating composition to the fibrous web, it will penetrate into some of the internal spaces and pores between the fibers of the fibrous web resulting in saturation and/or impregnation of the fibrous web with the coating (composition). That is, in the present invention the coating will permeate into the fibrous web, in particular internal spaces and pores therein, and apart from this it can cover and preferably does cover at least part of the first and/or the second surface of the fibrous web in the form of a surface coating. In other words, a "coating" as understood herein covers the saturation and impregnation of the fibrous web.

[0024] As used herein, the term "low opacity" means transparent or translucent. A product is considered to have low opacity when the product displays an opacity of, e.g., less than about 45% when tested according to ISO 2471:2008. Low opacity characteristics refer to the characteristics which provide a paper product with transparency or translucency, such as the presence of a transparency agent.

[0025] As used herein, the term "transparency agent" refers to an agent which decreases the opacity of fibrous web when applied inside or on the fibrous web. Examples include plant or animal derived waxes or oils, such as a coconut-based wax, a palm-based wax, and/or a soy-based wax. Plant or animal derived components as understood herein can be obtained from biomass.

[0026] As used herein, the term "biomass" is broadly understood as encompassing all kinds of plant and animal material and material derived from the same. Biomass does not include petroleum or petroleum-derived products.

[0027] The biomass for use in the present invention may comprise macromolecular compounds, examples of which are lignin and polysaccharides, such as starch, cellulose, hemicellulose.

[0028] As will be appreciated, certain kinds of biomass may include both plant and animal-derived material. As examples, manure (dung), night soil and sewage sludge can be mentioned. While the biomass for use in the present invention is preferably plant biomass, i.e. biomass of or derived from plants, certain contents of animal biomass (i.e. biomass of or derived from animals) may be present therein. For instance, the biomass may contain up to 30 % of animal biomass. According to a preferred embodiment, the biomass for use in the present disclosure, which is preferably plant biomass, contains more than 70 wt%, most preferably more than 90 wt%, of polysaccharides and lignines in terms of the solid contents of the biomass.

[0029] For instance, the plant biomass may be agricultural plant material (e.g. agricultural wastes) or all kinds of wood material. Biomass may be in the form of waxes and oils, including coconut, palm, and soy waxes and oil.

[0030] As used herein, a "biodegradable" component is a component that is capable of being decomposed by living organisms, such as bacteria or fungi. A biodegradable component can thus be decomposed by the action of microorganisms such as bacteria or fungi with or without oxygen. In one aspect, a biodegradable component fulfills the requirements of at least one of the international industrial standards ISO 14855:2018, ISO 14853:2017, and ASTM D5338:2015.

[0031] As used herein, the term "compostable" refers to components that can disintegrate into non-toxic, natural elements. Compostable components, for instance, can degrade at a rate consistent with similar organic materials. Compostable components degrade when exposed to microorganisms, humidity, and/or heat to yield a finished compost product. Coated papers made according to the present disclosure can be formulated to meet international industrial standards ISO 17088:2021, DIN EN 13432:2007, DIN EN 14995:2007, and/or ASTM 6400:2021 defines the requirements for industrially compostable components.

[0032] The term "pulp" as used herein refers to fibers from natural sources such as woody and non-woody plants. Woody plants include, for example, deciduous

and coniferous trees. Non-woody plants include, for example, cotton, flax, esparto grass, milkweed, straw, jute, hemp, sisal, abaca and bagasse. Pulp fibers can include hardwood fibers, softwood fibers, and mixtures thereof.

[0033] As used herein, the term "fibrous web" refers to a sheet made from the pulp by a wetlaid process without coating.

[0034] As used herein, the term "bio-based wax or oil" refers to wax or oil which have a bio-based content more than 90% by weight. The "bio-based wax or oil" is preferably derived from plant biomass. Examples include coconut-based wax, a palm-based wax and/or a soy-based wax.

DETAILED DESCRIPTION

[0035] It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only and is not intended as limiting the broader aspects of the present disclosure.

[0036] In general, the present disclosure is directed to a low opacity paper. In one aspect, the paper can be transparent. Alternatively, the paper can be formulated to be translucent. The low opacity paper of the present disclosure can be formed exclusively from sustainable resources that meets all of the requirements for entering the paper recycle stream after use. In the past, for instance, transparent papers typically contained components derived from fossil-based resources, such as petroleum-derived products. The low opacity paper of the present disclosure, however, can be produced having over 90% bio-based content. In addition, in one aspect, the low opacity paper can be formulated to be paraffin-free. Consequently, the low opacity paper can be constructed in order to meet all of the requirements for food contact and food handling.

[0037] Also of advantage is that the low opacity paper of the present disclosure can be constructed so as to minimize the use of materials while still having sufficient mechanical properties for handling, processing, and end use applications. For instance, the low opacity paper of the present disclosure can be constructed at relatively low basis weights.

[0038] In one aspect, the low opacity paper of the present disclosure is formed from a fibrous web containing cellulose fibers that have been refined to a relatively high degree. In accordance with the present disclosure, the fibrous web is combined with a transparency agent, which can be a bio-based wax or oil. The transparency agent not only increases the barrier characteristics of the paper but also lowers the opacity characteristics of the paper. Ultimately, a paper can be produced that has an opacity of less than about 40% when tested according to ISO 2471:2008. For instance, the opacity of the paper products can be less than about 35%, such as less than about 30%, such as less than about 25%, such as less than about 20%, such as less than about 18%, such as even less than about 16%. The actual opacity can depend

upon various factors and is generally greater than 1%, such as greater than about 5%.

[0039] For instance, the basis weight of the fibrous web used to construct the low opacity paper can influence the opacity. In one aspect, the fibrous web of the paper product has a basis weight of from about 12 g/m² to about 24 g/m² and displays an opacity of less than about 25%, such as less than about 23%, such as less than about 20%. In another aspect, the fibrous web of the paper product has a basis weight of from about 12 g/m² to about 22 g/m² and displays an opacity of less than about 23%, such as less than about 20%, such as less than about 18%. In yet another aspect, the fibrous web of the paper product has a basis weight of from about 12 g/m² to about 20 g/m² and displays an opacity of less than about 20%, such as less than about 19%, such as less than about 18%.

[0040] Referring to **FIG. 1**, one embodiment of a low opacity paper or paper product **10** made in accordance with the present disclosure is shown. **FIG. 1** represents a cross-sectional schematic view of the product **10**. As shown, in this embodiment, the low opacity paper **10** includes a paper base sheet **12** which is a fibrous web formed from cellulose fibers. The fibrous web **12**, for instance, can be a wetlaid paper web. In other embodiments, however, the fibrous web **12** can be made using any suitable papermaking technique. The fibrous web **12** includes a first surface opposite a second surface. Applied to the first surface of the fibrous web **12** is a coating **14**. The coating **14** contains a transparency agent that lowers the opacity of the paper product **10**. The coating **14** is shown as a separate layer in **FIG. 1** but it will also become impregnated into the fibrous web **12** as explained above. As will be described in greater detail below, the coating **14** can be made from a bio-based oil or wax. In one particular aspect, for instance, the coating **14** is formed from a coconut-based, palm-based and/or soy-based wax.

[0041] As shown in **FIG. 1**, the low opacity paper **10** can be made exclusively from a single layer of a fibrous web in combination with the coating **14**. Alternatively, the low opacity paper **10** can include a second coating (not shown) applied to the opposite surface of the fibrous web, such as a heat-sealable coating.

[0042] As described above, in one embodiment, the fibrous web **12** can be a wetlaid paper web formed from cellulose fibers. For example, the fibrous web can be formed from an aqueous suspension of fibers. The cellulose fibers contained in the fibrous web can be pulp fibers including wood pulp fibers, plant waste fibers, or other plant fibers. In forming the fibrous web, the aqueous suspension of fibers can be deposited onto a porous forming surface that allows water to drain thereby forming the fibrous web.

[0043] In one aspect, the fibrous web is made primarily from plant derived or natural fibers. Natural (plant derived) fibers may be selected from chemical pulp, such as sulphate and sulphite pulp, organosolv pulp, recycled

fibers, and/or mechanical pulp, Kraft wood pulp, mdf-fibers, nanocellulose, and modifications and combinations thereof. The pulp may be a bleached or non-bleached pulp. The pulp may originate from hardwood or softwood, including birch, beech, aspen such as European aspen, alder, eucalyptus, maple, acacia, mixed tropical hardwood, pine such as loblolly pine, fir, hemlock, larch, spruce such as Black spruce or Norway spruce, and mixtures thereof.

[0044] Non-wood plant fibers can also be used, such as seed hair fibers, leaf fibers, and bast fibers. Plant fibers can be provided from e.g. straws of grain crops, wheat straw, reed canary grass, reeds, flax, hemp, kenaf, jute, ramie, seed, sisal, abaca, coir, bamboo, bagasse, cotton kapok, milkweed, pineapple, cotton, rice, reed, esparto grass, *Phalaris arundinacea*, or combinations thereof.

[0045] The fibrous web can be primarily formed from the cellulose fibers without being combined with other components, such as fillers. For instance, the fibrous web (prior to coating) can comprise cellulose fibers in an amount greater than about 90% by weight, such as in an amount greater than about 95% by weight. Particular cellulose fibers well suited to producing the fibrous web include softwood fibers, hardwood fibers, birch fibers, hemp fibers, or mixtures thereof. For example, in one embodiment, the fibrous web can be made exclusively from softwood fibers alone or in combination with hardwood fibers. Alternatively, the fibrous web can be made from a blend of wood pulp fibers, such as softwood fibers, with bast fibers, such as hemp or flax fibers. The cellulose fibers can be selected, for instance, in order to produce a web that can be efficiently drained from aqueous fluids during formation and that can produce a relatively low opacity paper at lower basis weights while still retaining mechanical properties needed for processing and handling.

[0046] Once a suitable fiber furnish is selected for producing the fibrous web, in one aspect, the fibers used to form the web after pulping can be fed through a refining process in order to increase the freeness value expressed in the unit of "° SR" as measured by the Schopper Riegler Method for drainability (ISO 5267-1:2000). As used herein, refining the cellulose fibers is different than producing pulp fibers. In pulping, the lignin is removed from the cellulose fibers. During refining, on the other hand, the nap of individual fibrils making up the outer surface or wall of the fiber is raised which is sometimes referred to as defibrillation. Refining is the mechanical and/or chemical action which causes defibrillation.

[0047] In one aspect, in preparing the fibers for producing the fibrous web, the fibers can first go through a suitable pretreatment, such as washing, and can also be chopped especially if using bast fibers. In addition, the fibers can be fed through a hammermill or subjected to various different chemical treatments.

[0048] The cellulose fibers can be mixed with an aqueous solution or solvent which can occur in a refiner, such as a twin screw machine. If desired, wetting agents, ac-

ids, or alkalis can also be added in order to soften the cellulose fibers. In addition, one or more alcohols can also be added to the fibers including methyl alcohol, ethyl alcohol, or mixtures thereof.

[0049] The aqueous suspension can be fed to or formed in a refiner and subjected to a mechanical refining action. The consistency of the fibers in the refiner can be from about 1% to about 30% solids content. In the refiner, such as a twin screw refiner, the pulp suspension is subjected to mechanical action that produces the formation of greater fibrils within each fiber.

[0050] It should be understood that any suitable refining device may be used in order to increase the freeness value of the fibers and that a twin screw refiner merely represents one instrument, process or technique that may be used.

[0051] After exiting one or more refiners, in accordance with the present disclosure, the cellulose fibers have a freeness value of greater than about 60° SR, such as greater than about 65° SR, such as greater than about 67° SR, such as greater than about 70° SR. In one aspect, the cellulose fibers have been refined to greater than about 72° SR, such as greater than about 74° SR, such as greater than about 76° SR, such as greater than about 78° SR, such as greater than about 80° SR. The freeness value of the fibers is generally less than about 95° SR, such as less than about 90° SR, such as less than about 88° SR, such as less than about 85° SR such as less than about 80° SR. It was discovered that refining the fibers to the extent described above not only can improve drainage of the web during production but can also lower the opacity characteristics of the paper. Refining the cellulose fibers can also allow for a reduction in the thickness of the sheet while still providing good mechanical properties. Reduction in thickness for a given basis weight, for instance, has been found to unexpectedly improve transparency while still maintaining an excellent balance with mechanical properties. Adjusting the level of refining of the cellulose fibers can also allow for adjustments to the barrier properties of the low opacity paper. For instance, refining of the fibers can be used to adjust air permeability and to develop air barrier properties, water barrier properties, oil barrier properties, or the like.

[0052] Once the cellulose fibers have been refined, the fibers are formed into a web. In one aspect, the basis weight of the web is relatively low. For instance, the basis weight of the fibrous web can be less than about 30 g/m², such as less than about 24 g/m², such as less than about 23 g/m², such as less than about 22 g/m², such as less than about 21 g/m², such as less than about 20 g/m², such as less than about 18 g/m², such as less than about 16 g/m². The basis weight is generally greater than about 10 g/m², such as greater than about 12 g/m². In one particular aspect, the basis weight of the fibrous web is from about 12 g/m² to about 22 g/m², including all increments of 1 g/m² therebetween.

[0053] In accordance with the present disclosure, a coating is applied to the fibrous web. The coating can

form a layer on one side of the fibrous web or can be impregnated into the web. In one aspect, a portion of the coating can be impregnated into the web while the coating also forms a surface layer on the web.

[0054] In accordance with the present disclosure, the coating comprises a transparency agent that is applied to the fibrous web. The transparency agent can comprise a bio-based wax or oil. The bio-based wax or oil, for instance, can be derived from animal or plant biomass. In one aspect, the transparency agent can be a bio-based wax or oil derived from at least 80% by weight vegetable oils, such as at least about 90% by weight vegetable oils, such as up to 100% by weight vegetable oils. The bio-based wax or oil can be paraffin-free and can be free of mineral oil saturated hydrocarbons and mineral oil aromatic hydrocarbons. Of particular advantage, the transparency agent can meet all government requirements for food contact and food handling. For instance, the low opacity paper of the present disclosure can meet all of the requirements of FDA 21 CFR § 176.180 which is directed to components of paper and paperboard that is in contact with dry food. Similarly, the transparency agent and the low opacity paper can also meet all of the requirements of European Commission Regulation No. 1935/2004 regarding materials and articles intended to come in contact with food.

[0055] The bio-based wax, in one embodiment, can have a melting point of from about 25°C to about 75°C, including all increments of 1°C therebetween. The melting point of the bio-based wax can be less than about 70°C, such as less than about 65°C, such as less than about 60°C, such as less than about 55°C, such as less than about 50°C, such as less than about 45°C, such as less than about 40°C. The melting point of the bio-based wax can be greater than about 25°C, such as greater than about 30°C, such as greater than about 35°C, such as greater than about 40°C, such as greater than about 45°C, such as greater than about 50°C. A bio-based wax can be selected having a particular melting point that is well suited for a particular application.

[0056] In one particular embodiment, the transparency agent comprises a bio-based wax that is a coconut-based wax, a palm-based wax, a soy-based wax or mixtures thereof.

[0057] In one aspect, for instance, the transparency agent is a coconut-based wax or oil. The coconut-based wax can have a melting point of from about 25 degrees C to about 45 degrees C, such as from about 30 degrees C to about 40 degrees C. The coconut-based wax can be applied to the fibrous web as an anionic, aqueous dispersion.

[0058] In another aspect, the transparency agent can be a palm-based wax or oil. The palm-based wax can have a melting point of from about 50 degrees C to about 70 degrees C, such as from about 55 degrees C to about 65 degrees C. The palm-based wax can be applied to the fibrous web as an anionic, aqueous dispersion.

[0059] Alternatively, the transparency agent can be a

soy-based wax and can be applied in the form of an aqueous cationic emulsion having a melting point of from about 55 degrees C to about 80 degrees C, such as from about 63 degrees C to about 72 degrees C.

[0060] In one aspect, the bio-based wax can be water dispersible or water miscible. Thus, the transparency agent can be incorporated into an aqueous composition for application to the fibrous web in producing the low opacity paper.

[0061] The transparency agent can be applied to the fibrous web using any suitable method or technique. For example, in one embodiment, an aqueous composition containing the transparency agent can be applied to the fibrous web using a size press either at the wet end of the papermaking machine or after the web has been dried. By using a size press, the low opacity paper can be produced in a single process. Alternatively, however, the fibrous web can be formed and then later coated with a composition containing the transparency agent. Coating can be performed using any suitable method including air knife coating, roll-to-roll coating, blade coating, spray coating, Mayer rod coating, direct gravure printing, offset gravure printing, reverse gravure printing, smooth roll coating, curtain coating, bead coating, slot coating, fill press coating, and the like.

[0062] Once the transparency agent has been applied to the fibrous web and dried, the fibrous web can be calendered without being supercalendered. In one aspect, a plain filigree press may be used for a glazing effect on the surface of the product. The calender rolls, for instance, can include a hard roll opposite a soft roll. The pressure applied to the coated paper can be greater than about 200 kPa (2 bar), such as greater than about 400 kPa (4 bar), such as greater than about 500 kPa (5 bar), and generally less than about 1200 kPa (12 bar), such as less than about 1000 kPa (10 bar), such as less than about 800 kPa (8 bar), such as less than about 700 kPa (7 bar). Calendering can occur at ambient temperature or, alternatively, one or both of the calender rolls can be heated.

[0063] The amount of transparency agent incorporated into the low opacity paper can depend upon various factors including the basis weight of the paper and the desired opacity that is to be reached. In general, the transparency agent, such as a bio-based wax, can be present in the coated paper in an amount of from about 10% by weight to about 50% by weight, including all increments of 1% by weight therebetween. For instance, the transparency agent can be incorporated into the coated paper in an amount greater than about 5% by weight, such as in an amount greater than about 10% by weight, such as in an amount greater than about 12% by weight, such as in an amount greater than about 14% by weight, such as in an amount greater than about 16% by weight. The transparency agent can be present in the coated paper, in one aspect, in an amount less than about 50% by weight, such as in an amount less than about 40% by weight, such as in an amount less than about 30% by

weight, such as in an amount less than about 25% by weight, such as in an amount less than about 22% by weight.

[0064] The amount of transparency agent applied to the low opacity paper can also be described on a weight per area basis. The transparency agent, for instance, can be applied to the fibrous web in an amount greater than about 3 g/m², such as in an amount greater than about 4 g/m², such as in an amount greater than about 5 g/m², such as in an amount greater than about 6 g/m², such as in an amount greater than about 7 g/m², such as in an amount greater than about 8 g/m², such as in an amount greater than about 9 g/m², such as in an amount greater than about 10 g/m². The transparency agent can be applied to the fibrous web in an amount less than about 25 g/m², such as in an amount less than about 20 g/m², such as in an amount less than about 15 g/m², such as in an amount less than about 10 g/m².

[0065] In one embodiment, coating composition applied to the fibrous web can contain at least one coloring agent. The coloring agent can be a dye, a pigment, or mixtures thereof. In this manner, the final product can display a color and remain translucent.

[0066] The transparency agent can improve various properties and characteristics of the coated paper. For instance, the transparency agent can increase the transparency and/or decrease the opacity of the final product. The transparency agent can also reduce the permeability of the low opacity paper and increase the barrier properties of the paper.

[0067] In addition to having a relatively low opacity, the coated paper of the present disclosure can have a relatively low thickness or caliper. For example, the thickness of the paper can be less than about 50 μm , such as less than about 45 μm , such as less than about 40 μm , such as less than about 35 μm , such as less than about 30 μm , such as less than about 25 μm . The paper generally has a thickness of greater than about 10 μm , such as greater than about 15 μm , such as greater than about 18 μm , such as greater than about 20 μm .

[0068] Low opacity papers made according to the present disclosure not only display low opacity but also display a beneficial blend of other properties. For instance, the coated paper can have a Gurley air permeability of less than about 45,300 seconds, such as less than about 20,000 seconds, such as less than about 10,000 seconds, such as less than about 1000 seconds, and generally greater than about 200 seconds.

[0069] The low opacity paper can also have a water drop resistance greater than 10 min according to TAPPI T 432 cm-09. The paper product can have a water vapor barrier at 23°C and 50%HR of less than 100 g/m²/day, such as less than 50 g/m²/day according to ASTM E96/E96M - 15:2014.

[0070] The low opacity paper of the present disclosure has numerous uses and applications. For instance, the low opacity paper can be used as a packaging material for food, tobacco, cosmetics, or pharmaceuticals. In other

embodiments, the low opacity paper can be used as a packaging of cigarette packs, cigarette cartons, cigars packages, Heat-non-Burn packs and Heat-non-Burn cartons. The low opacity paper, for instance, can be made to be flexible or semi-rigid making the product well suited for constructing packages.

[0071] Alternatively, the low opacity paper can be laminated to a paper or a paperboard and formed into a container, such as a box or a bag.

[0072] In still another embodiment, the low opacity paper can be used as a tracing paper.

[0073] In addition to being directed to a low opacity paper and to products made from the paper, the present disclosure is also directed to a method for producing a low opacity paper. The method includes forming a fibrous web from a fiber furnish. The fibrous web, for instance, can be a wetlaid web. The fibrous web is then coated with an aqueous composition containing the transparency agent as described above. Any suitable technique can be used to coat the fibrous web. For instance, in one aspect, the fibrous web can be coated using a size press or bar coating.

[0074] The coating applied to the fibrous web can be dried and then can be calendered or not. The resulting coated paper can have an opacity of less than about 20% and can have a thickness of less than about 40 μm , such as less than about 37 μm . The basis weight of the coated paper can be less than about 30 g/m², such as from about 19 g/m² to about 24 g/m².

[0075] According to an embodiment of the present invention, a paper product comprises: a fibrous web comprising/containing cellulose fibers, wherein the cellulose fibers are 100% refined softwood fibers, the fibrous web having a basis weight of between 10-24 g/m²; and a transparency agent coating the fibrous web, wherein the transparency agent comprises a coconut-based wax, a palm-based wax or a soy-based wax; wherein the paper product displays an opacity of less than 20%, preferably less than 19%, when tested according to ISO 2471:2008; and wherein the paper product has a basis weight of less than 30 g/m². The thickness of this embodiment of the paper product according to the present invention is preferably 25-40 μm , more preferably 30-40 μm .

[0076] According to another embodiment of the present invention, a paper product comprises: a fibrous web comprising/containing cellulose fibers, wherein the cellulose fibers are 100% refined softwood fibers, the fibrous web having a basis weight of between 10-18 g/m²; and a transparency agent coating the fibrous web, wherein the transparency agent comprises a palm-based wax and colorant; wherein the paper product displays an opacity of less than 20%, preferably less than 18%, when tested according to ISO 2471:2008; and wherein the paper product has a basis weight of less than 20 g/m². The thickness of this embodiment of the paper product according to the present invention is preferably 20-30 μm .

[0077] The present disclosure may be better understood with reference to the following examples.

Example 1

[0078] Low opacity papers were made in accordance with the present disclosure and tested for various properties. Two papers were formed from a fibrous web containing 100% refined softwood fibers. The fibrous web was coated with a transparency agent comprising a coconut-based wax using a bar coating technology.

[0079] The first low opacity paper made in accordance with the present disclosure had a basis weight of about 28 g/m² (22g/m² fibrous web basis weight + 6g/m² wax coating) and a thickness of 38 μm. The opacity of the coated paper was 17.9%. The opacity was reduced 42% in comparison to the fibrous web itself (opacity of fibrous web was 31%). The fibrous web had a Schopper-Riegler freeness value of 82° SR. The coated paper displayed a Gurley air permeability of 45,200 seconds, which was over 44,000% greater than the fibrous web itself (Gurley air permeability of fibrous web was 987seconds). The coated paper displayed a water drop resistance higher than 10 min, which is 1,000% greater than the fibrous web itself (0.8 min for fibrous web). The water vapor transfer rate at 23°C and 50%HR was 50 g/m²/day and was reduced by about 83% in comparison to the fibrous web (the water vapor transfer rate at 23°C and 50%HR of fibrous web was 295 g/m²/day).

[0080] The second low opacity paper made in accordance with the present disclosure had a basis weight of about 19 g/m² (14 g/m² fibrous web basis weight + 5 g/m² wax coating) and a thickness of 30 μm. The opacity of the coated paper was 14%. The opacity was reduced 33% in comparison to the fibrous web itself (opacity of fibrous web was 21%). The fibrous web had a Schopper-Riegler freeness value of 86° SR. The coated paper displayed a Gurley air permeability of 484 seconds, which was over 270% greater than the fibrous web itself (Gurley air permeability of fibrous web was 128 seconds). The coated paper displayed a water drop resistance higher than 10 min, which is 1,000% greater than the fibrous web itself (0.8 min for fibrous web). The water vapor transfer rate at 23°C and 50%HR was 50 g/m²/day and was reduced about 85% in comparison to the fibrous web (the water vapor transfer rate at 23°C and 50%HR of fibrous web was 330 g/m²/day).

Example 2

[0081] A low opacity paper was made in accordance with the present disclosure and tested for various properties. The paper was formed from a fibrous web containing 100% refined softwood fibers and having a Schopper-Riegler freeness value of 86° SR. The fibrous web was coated with a transparency agent comprising a palm-based wax using a bar coating technology.

[0082] The low opacity paper made in accordance with the present disclosure had a basis weight of 19 g/m² (14 g/m² fibrous web basis weight + 5 g/m² wax coating) and a thickness of 32 μm. The opacity of the coated paper

was 14 %. The opacity was reduced by 33% in comparison to the fibrous web itself (opacity of fibrous web was 21%). The coated paper displayed a Gurley air permeability of 617 sec, which was over 380% greater than the fibrous web itself (Gurley air permeability of fibrous web was 128 seconds). The coated paper displayed a water drop resistance higher than 10 min, which is 1,000% greater than the fibrous web itself (0.8 min for fibrous web). The water vapor transfer rate at 23°C and 50%HR was 28 g/m²/day and was reduced about 92% in comparison to the fibrous web (the water vapor transfer rate at 23°C and 50%HR of fibrous web was 330 g/m²/day).

Example 3

[0083] A low opacity paper was made in accordance with the present disclosure and tested for various properties. The paper was formed from a fibrous web containing 100% refined softwood fibers and having a Schopper-Riegler freeness value of 86° SR. The fibrous web was coated with a transparency agent comprising a soy-based wax using a bar coating technology.

[0084] The low opacity paper made in accordance with the present disclosure had a basis weight of 19 g/m² (14 g/m² fibrous web basis weight + 5 g/m² wax coating) and thickness of 37 μm. The opacity of the coated paper was 15 %. The opacity was reduced by 27% in comparison to the fibrous web itself (opacity of fibrous web was 21%). The coated paper displayed a Gurley air permeability of 617 seconds, which was over 380% greater than the fibrous web itself (Gurley air permeability of fibrous web was 128 seconds). The coated paper displayed a water drop resistance higher than 10 min, which is 1,000% greater than the fibrous web itself (0.8 min for fibrous web). The water vapor transfer rate at 23°C and 50%HR was 74 g/m²/day and was reduced by about 78% in comparison to the fibrous web (the water vapor transfer rate at 23°C and 50%HR of fibrous web was 330 g/m²/day).

Example 4

[0085] A low opacity paper was made in accordance with the present disclosure and tested for various properties. The paper was formed from a fibrous web containing 100% softwood fibers and having a Schopper-Riegler freeness value of 86° SR. The fibrous web was coated with a transparency agent comprising a coconut-based wax and colorant.

[0086] The low opacity paper made in accordance with the present disclosure had a basis weight of 19 g/m² (14 g/m² fibrous web basis weight + 5 g/m² colored wax) and a thickness of 27 μm. The colorimetric parameters of the coated paper were L* 37.93, a* 2.19 and b* -3.2 measured according to ISO 5631-1:2022 The opacity of the coated paper was 17%. The opacity was reduced by 19% in comparison to the fibrous web itself (opacity of fibrous web was 21%). The coated paper displayed a Gurley air permeability of 273 seconds, which was over 113 %

greater than the fibrous web itself (Gurley air permeability of fibrous web was 128 seconds). The coated paper displayed a water drop resistance of minimum 10 min, which is 1,000% greater than the fibrous web itself (0.8 min for fibrous web).

[0087] These and other modifications and variations to the present invention may be practiced by those of ordinary skill in the art. Embodiments of the present invention are set forth in the appended claims. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part.

Claims

1. A paper product comprising:

a fibrous web comprising cellulose fibers, wherein the cellulose fibers have a Schopper-Riegler freeness value in the range of 60° SR to 95° SR as measured according to ISO5267:2000, the fibrous web having a basis weight of less than 30 g/m² and defining a first surface and a second surface; and

a coating on the first surface and/or the second surface of the fibrous web, preferably on one of the first surface and the second surface, the coating comprising a transparency agent, the transparency agent comprising at least 95% by weight of a bio-based wax or oil, and wherein the paper product displays an opacity of less than 40% when tested according to ISO 2471:2008.

2. A paper product as defined in claim 1, wherein the cellulose fibers have a Schopper-Riegler freeness value in the range of 70° SR to 90° SR.

3. A paper product as defined in any of the preceding claims, wherein the fibrous web has a basis weight of less than 24 g/m², preferably less than 22 g/m², more preferably less than 20 g/m², and greater than 10 g/m².

4. A paper product as defined in any of the preceding claims, wherein the paper product is calendered, but not supercalendered.

5. A paper product as defined in any of the preceding claims, wherein the bio-based wax or oil is a plant derived wax or oil, which preferably has a melting point of from 25°C to 75°C.

6. A paper product as defined in any of the preceding claims, wherein the bio-based wax or oil is a coconut-based wax, a soy-based wax, a palm-based wax, a rice-based wax or mixtures thereof.

7. A paper product as defined in any of the preceding claims, wherein the paper product has an opacity of less than 30% when tested according to ISO 2471:2008.

8. A paper product as defined in any of the preceding claims, wherein the fibrous web comprises a wetlaid web.

9. A paper product as defined in any of the preceding claims, wherein the paper product is free of paraffins, mineral oil, or hydrocarbon oils.

10. A paper product as defined in any of the preceding claims, wherein the fibrous web comprises wood pulp fibers alone or in combination with bast fibers.

11. A paper product as defined in any of the preceding claims, wherein the paper product has a Gurley air permeability of less than 45,200 seconds, preferably less than 20,000 seconds, more preferably less than 10,000 seconds, even more preferably less than 1000 seconds, and greater than 200 seconds.

12. A paper product as defined in any of the preceding claims, wherein the paper product displays a water vapor resistance at 23°C 50% humidity of lower than 100 g/m², preferably lower than 80 g/m².

13. A paper product as defined in any of the preceding claims, wherein the paper product displays a water drop resistance of greater than 10 min according to TAPPI T432 cm-09.

14. A paper product as defined in any of the preceding claims, wherein the transparency agent is present in the paper product in an amount greater than 5% by weight, preferably in an amount greater than 10% by weight, more preferably in an amount greater than 15% by weight, and in an amount less than 40% by weight, preferably in an amount less than 35% by weight, more preferably in an amount less than 30% by weight.

15. A paper product as defined in any of the preceding claims, wherein the paper product is colored.

16. A use of a paper product as defined in any of the preceding claims, as a packaging paper for food, cosmetics or pharmaceuticals.

17. A use of a paper product as defined in any of the preceding claims as a packaging of cigarette packs, cigarette cartons, cigars packages, Heat-non-Burn packs and Heat-non-Burn cartons.

18. A method for producing the paper product as defined in any of the preceding claims, comprising:

generating an aqueous suspension of cellulose fibers;
refining the cellulose fibers;
depositing the aqueous suspension of fibers onto a porous forming surface to form a fibrous web; and
coating the fibrous web with an aqueous composition containing the transparency agent.

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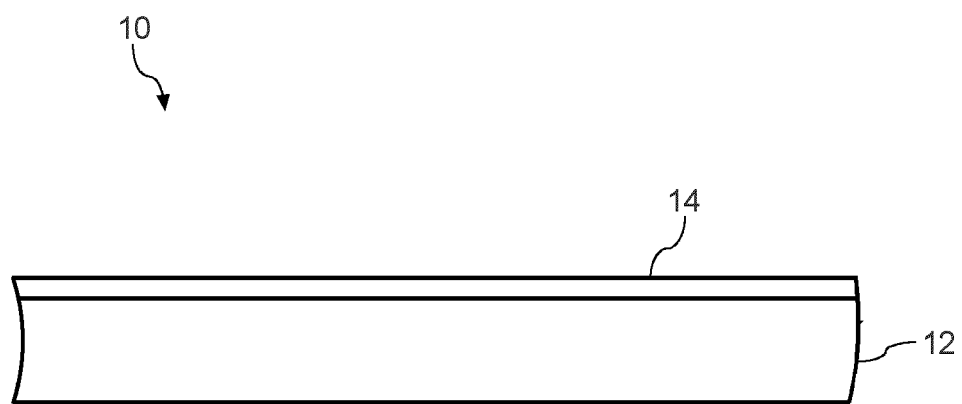


FIG. 1



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 483 337 A1 (ARJO WIGGINS FINE PAPERS LTD [GB]) 15 May 2019 (2019-05-15)	1-18	INV.
Y	* claims 1-18 *	1-18	D21H27/10
	-----		D21H19/18
Y	US 2021/348336 A1 (CERQUEIRA FLÁVIA QUEIROZ [BR] ET AL) 11 November 2021 (2021-11-11)	1-18	D21H11/18
	* paragraph [0021]; claims 1-21 *		D21C9/007
	-----		D21H27/06
A	WO 2022/243445 A1 (NEENAH GESSNER GMBH [DE]) 24 November 2022 (2022-11-24)	1-18	D21H21/16
	* the whole document *		

A	WO 2020/209781 A1 (FERNANDI MUSIK [SE]) 15 October 2020 (2020-10-15)	1-18	
	* the whole document *		

A	WO 2022/219377 A1 (STORA ENSO OYJ [FI]) 20 October 2022 (2022-10-20)	1-18	
	* the whole document *		

A	WO 2021/001751 A1 (STORA ENSO OYJ [FI]) 7 January 2021 (2021-01-07)	1-18	TECHNICAL FIELDS SEARCHED (IPC)
	* the whole document *		D21H
	-----		D21C
A	US 2020/370244 A1 (BECKER DIETER [DE] ET AL) 26 November 2020 (2020-11-26)	1-18	
	* the whole document *		

The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		16 November 2023	Karlsson, Lennart
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 17 7038

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-11-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3483337 A1	15-05-2019	CA 3082035 A1	23-05-2019
		CN 111655929 A	11-09-2020
		EP 3483337 A1	15-05-2019
		EP 3710635 A1	23-09-2020
		ES 2903075 T3	31-03-2022
		ES 2928880 T3	23-11-2022
		KR 20200085858 A	15-07-2020
		US 2020385929 A1	10-12-2020
		WO 2019096848 A1	23-05-2019

US 2021348336 A1	11-11-2021	AU 2021271302 A1	24-11-2022
		BR 112022022940 A2	13-12-2022
		CA 3176806 A1	18-11-2021
		EP 4150152 A1	22-03-2023
		JP 2023524453 A	12-06-2023
		KR 20230009925 A	17-01-2023
		US 2021348336 A1	11-11-2021
		WO 2021229451 A1	18-11-2021

WO 2022243445 A1	24-11-2022	WO 2022242875 A1	24-11-2022
		WO 2022243445 A1	24-11-2022

WO 2020209781 A1	15-10-2020	CA 3132460 A1	15-10-2020
		CN 113661128 A	16-11-2021
		EP 3953269 A1	16-02-2022
		JP 2022528565 A	14-06-2022
		SE 1930122 A1	13-10-2020
		US 2022185558 A1	16-06-2022
		WO 2020209781 A1	15-10-2020

WO 2022219377 A1	20-10-2022	CA 3216689 A1	20-10-2022
		WO 2022219377 A1	20-10-2022
		WO 2022219560 A1	20-10-2022

WO 2021001751 A1	07-01-2021	BR 112021026695 A2	15-02-2022
		CA 3140757 A1	07-01-2021
		CN 114008267 A	01-02-2022
		EP 3994309 A1	11-05-2022
		JP 2022538973 A	07-09-2022
		SE 1950843 A1	05-01-2021
		US 2022363871 A1	17-11-2022
		WO 2021001751 A1	07-01-2021

US 2020370244 A1	26-11-2020	CN 111511987 A	07-08-2020
		DE 102017131277 A1	27-06-2019
		EP 3728735 A1	28-10-2020

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 17 7038

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-11-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		JP 2021507125 A	22-02-2021
		US 2020370244 A1	26-11-2020
		WO 2019121733 A1	27-06-2019

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82