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(54) Title: PACKAGING MATERIAL

(57) Abstract: A compostable and eco-sustainable multi-layer packaging material comprising: - a paper layer 1 and a barrier layer (3, 5) on one or both sides of the paper layer, wherein, said barrier layer comprises from 51 to 99% wt., preferably 90-10% wt., more preferably 95–98% wt. of a polymeric component selected from the group consisting of a polyhydroxyalkanoate polymer or copolymer, proteins from milk, fungi or legumes, polylactic acid, polybutylene succinate or polybutylene succinate copolymers, thermoplastic blends of starch and aliphatic polyesters, chitosan, carrageenan, pectin alginates and lipids and mixtures thereof and from 49 to 1% wt., preferably 1-10% wt., more preferably 2-5% wt. of a filler selected from the group consisting of layered double hydroxides, nanocellulose, silicates and clays, preferably phyllosilicates, and mixtures thereof, the percentage by weight being referred to 100 parts by weight of the polymeric component and the filler.

Packaging Material

The present invention relates to a multi-layer paper-based packaging material, particularly for use in packaging confectionary products, comprising a paper layer and at least a barrier coating layer.

Barrier coatings are required and widely used in food packaging to preserve the food organoleptic properties. Barrier properties for flexible packaging materials, particularly for a confectionary product, include a low permeability to O2 and water vapor, as well as low permeability to volatile aroma compounds and low light permeability. Particularly, for packaging materials for use in the packaging of confectionary products it is desirable to achieve an oxygen transmission rate (OTR) lower than 100 or preferably lower than 0.1 cc/m2 24h, measured at 23 °C at 40-50% RH and a water vapor transmission rate (WVTR) lower than 10 or preferably lower than 0.1 g/m2 24 h at 38°C at 90% RH.

Currently used solutions to obtain the desirable barrier properties for the packaging of confectionary products include lamination with a polyolefin film (PE, PP, PET) coupled with metallization or the use of a barrier coating layer including clay and polymeric components.

There is however a need for paper-based packaging materials that are eco-sustainable, allowing the paper-based packagings to be compostable and/or easily recyclable. Moreover, there is a need for packaging materials that combine the required barrier properties and the eco-sustainability properties, with mechanical properties that allow their use in modern high-speed packaging machines such as for instance flow-pack and flow-wrap machines and twist-wrap machines. Particularly desirable as mechanical properties are tensile strength and resistance to pierce, which can be also represented with the bursting strength leveraging the T403 analytical method.

The purpose of the invention is to provide a multi-layer paper-based packaging material that combines the above-mentioned requirements.

Summary of the invention

In view of the above-mentioned purpose, the subject-matter of the invention is a multi-layer packaging material as defined in the appended claims.

The dependent claims relate to preferred embodiments of the invention.

Further characteristics and advantages of the packaging material of the invention will become clear from the detailed description that follows, made with reference to the attached drawings, provided by way of non-limiting example.

Brief description of the drawings

In the attached drawings:

- Fig. 1 is a schematic sectional representation showing the layout of a plurality of embodiments (a) to (g) of the packaging material, wherein a surface layer of the multi-layer structure has heat sealing properties;
- Fig. 2 is a schematic sectional representation showing the layout of a plurality of embodiments (a) to (g), wherein the multi-layer structure includes a surface layer having cold sealing properties, and
- Fig. 3 is a schematic sectional representation of a plurality of exemplified embodiments (a) to (e); and
- Fig. 4 is a schematic sectional representation of a plurality of exemplified embodiments (a) to (e).

In the annexed drawings, the reference numerals indicate the following structural features:

1 paper layer (substrate)

3 barrier layer, extrusion coated or laminated onto the paper layer 1;

5 barrier layer coating the paper layer 1 or the barrier layer 3, obtained by applying a lacquer;

7 optional layer, obtained by applying a heat sealable lacquer;

9 optional continuous or discontinuous cold sealable layer (also indicated CS in the

drawings);

11 optional continuous or discontinuous printed layer;

13 optional layer obtained from a release varnish;

15 extrusion coated layer consisting of a PHA.

Detailed description of the invention

The invention relates to packaging materials having a multi-layer structure and comprising a paper-based layer 1, that generally constitutes the core layer of the packaging material, and at least a barrier layer 3, 5 comprising or obtained from sustainable and/or natural materials suitable to provide packagings that are compostable and that achieve higher scorings in the recyclability certification tests.

The terms “paper layer” or “paper-based layer” is intended to mean a layer comprising or consisting essentially of cellulose fibers and includes paperboard and cardboard.

The wording, used in the present description, relating to the use of a material "comprising" cellulose or cellulose fibers or "consisting essentially of cellulose or cellulose fibers" does not exclude the presence of additives, for example of the type conventionally used in the production of paper or additives functional for obtaining barrier effects to gases and liquids or for improving the mechanical properties. For example, such terms include the case where the material comprises from 70 to 99.9% by weight of cellulose fibers on an anhydrous basis, preferably from 90 to 99.9% by weight and from 0.1 to 30% by weight on an anhydrous basis of additives, preferably from 0.1 to 10% by weight.

Possible additives may include starches, alkyl ketene dimers, resins and inert fillers, such as clays.

Recycled cellulose fibers can be used, preferably totally free of MOSH and MOAH.

Preferably, the paper-based layer 1 has a grammage (weight) in the range of from 35 to less than 120 g/m^2, and is flexible, whereby the multi-layer packaging material is equally flexible; however , the invention includes, within its scope, packaging materials wherein the

paper-based layer is a sheet having a weight of from 120 to 400 g/m2 which are suitable to be shaped by heat and pressure to provide shaped packagings.

Said barrier coating layer applied on one or both sides of the substrate preferably comprises:
from 51 to 99% wt., preferably 90-10% wt., more preferably 95 - 98 % wt. of a polymeric component selected from the group consisting of a polyhydroxyalkanoate polymer (PHA) or copolymer, a proteinaceous material selected from proteins from milk or from vegetables, such as legumes or fungi, or gelatin, polylactic acid, polybutylene succinate or its copolymers, polybutylene adipate terephthalate (PBAT), thermoplastic blends of starch and aliphatic polyesters, chitosan, carrageenan, pectin, alginates, lipids polyacrylic polymers, polyurethane and mixtures thereof, and
from 49 to 1% wt., preferably 1-10% wt., more preferably 2-5% wt. of a filler selected from the group consisting of a layered double hydroxide, nanocellulose, silicates and clays, preferably phyllosilicates, and mixtures thereof, the percentages by weight being referred to 100 parts by weight of the polymeric component and the filler and sum up to 100%.

The term barrier layer, as used herein, indicates a layer that provides a barrier to water vapor, oxygen, aroma or carbon dioxide; it may further provide grease or moisture resistance and/or water absorption resistance. It was found that said barrier layer, as herein described, also enhances the material mechanical properties (e.g., tensile, tear, impact or burst strength). In some embodiments, the disclosed barrier layer also provides a packaging material with the ability to maintain deformation upon twisting, cold forming properties and thermoforming, while keeping the original material properties of the substrate.

In one embodiment of the invention, the packaging material has a barrier layer 3 on both sides of the paper layer and it is extrusion coated or laminated onto the paper layer (fig 1(e), (f) and (g)).

In another embodiment, the barrier layer, identified with 5 in the drawings, is obtained by applying and drying a lacquer comprising one of more of the mentioned polymeric components and the previously disclosed filler or fillers in water or in solvent vehicles (fig. 1(a), 1(b) and 1(d)).

In one embodiment, said barrier layer 5, obtained from a lacquer, is on both sides of the paper layer (fig 1(c)).

In another embodiment, the multi-layer structure may comprise a barrier coating layer 3 (extrusion coated or laminated onto the paper layer) and a barrier layer 5 obtained from a lacquer on the other side of the paper layer (fig 1(d)).

In another embodiment, the multi-layer structure may comprise said barrier layer 5, obtained from a lacquer, as described above, above a barrier layer 3 which is extrusion coated or laminated onto the paper layer (fig. 1 (f)) or, if said barrier layer 3 is extrusion coated or laminated onto both sides of the paper layer, said barrier coating layer 5, obtained from a lacquer, may be placed on both extrusion coated or laminated layers (fig. 1 (g)).

The polymeric components for use in the barrier layers of the invention are (bio) degradable materials comprising:

- a) Polyhydroxyalkanoate (PHA) polymers or copolymers, preferably medium chain length PHAs with 6-14 carbon atoms in their monomer units, that are soft and elastomeric with low melting points, typically from 50 to 170°, preferably from 100 to 160°; however, the term PHAs also includes short chain length and long chain length PHAs and/or mixtures thereof.

Examples of poly (hydroxyalkanoate) polyesters that can be used within the scope of the invention include, but are not limited to, poly (3-hydroxybutyrate) (3HB), poly (4-hydroxybutyrate) (4HB), poly (3- hydroxyvalerate)(3HV); particularly preferred are copolymers of hydroxybutyrate and hydroxyvalerate or hydroxyhexanoate which have a melting temperature of 120 to 160 ° C, including poly (3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV), poly (hydroxybutyrate-co-hydroxyhexanoate)(PHBH), poly (3 -hydroxy-co-4-hydroxybutyrate). PHBH and PHBV are preferred.

Also included are PHAs blends including a PHA, preferably poly(3-hydroxybutyrate-co-4-hydrobutyrate) and biodegradable polymers selected from cellulose, starch or starch acetate, poly(lactic acid), polycaprolactone.

- b) Polybutylene succinate (PBS) and its copolymers; suitable copolymers of PBS include: poly(1,4-butylene succinate-co-adipate), poly(1,4-butylene succinate-co-1,4-butylene azelate), poly(1,4-butylene succinate-co-1,4-butylene terephthalate), poly(1,4-butylene succinate-co-1,4-butylene sebacate-co-1,4-butylene terephthalate), poly(1,4-butylene adipate-co-1,4-butylene succinate-co-1,4- butylene terephthalate), poly(1,4-butylene azelate-co-1,4-butylene succinate-co-1,4-butylene terephthalate). Also included are polyhydroxyalkanoate-polybutylene succinate copolymers.
- c) a proteinaceous material selected from proteins from milk or from legumes, such as pea and lentil, proteins from fungi or gelatin;
- d) pectin, alginates and lipids, optionally in combination with the above-mentioned proteinaceous substances and/or with polysaccharides.

Also included as suitable polymeric components are:
- e) polylactic acid, thermoplastic blends of starch and aliphatic polyesters, chitosan, and carrageenan.

The fillers for use in the barrier coating layers of the invention are selected from layered double hydroxides (LDH), nanocellulose, natural and synthetic phyllosilicates and mixtures thereof. Preferred LDH include hydrotalcite and hydrotalcite-like minerals.

Preferred nanocellulose materials include cellulose nanofibers (CNF), nanocrystalline cellulose (CNC) or bacterial nanocellulose (BNC); the term nanocellulose also includes nanocellulose modified in the CH_2OH groups, for example by esterification or amidation or etherification.

Preferred phyllosilicates include montmorillonite bentonite, hectorite, smectite and mica.
The adopted fillers typically have a particle size with the following features:
One dimension 1-40 micron
Other dimension: 1 nm – 2 micron,
aspect ratio: 1.20 – 20,000.

The barrier coating layers are normally applied in a weight range of from 0.5 to 10 g/m^2,

preferably 1-5 g/m^2, more preferably 1-3 g/m^2.

In a preferred embodiment of the invention, the laminated or extrusion coated barrier layer 3 is heat-sealable, in which case the polymeric component is preferably a polyhydroxyalkanoate (as previously described), polybutylene succinate, polybutylene adipate terephthalate or polylactic acid, in combination with a filler which is preferably selected from a layered double hydroxide and nanocellulose.

In a further embodiment which allows to obtain a heat-sealable barrier layer, which is a surface layer of the multi-layer-material, the polymeric component is selected from the group consisting of proteinaceous materials, preferably selected from milk, fungal and pea proteins, as well as gelatin.

If the barrier layer is not heat sealable, a heat sealable layer 7 obtained from a heat sealable lacquer may be applied as an external layer (fig 1 (c)); the polymers for the heat sealable lacquer are the same low melting polymers disclosed for the barrier layer, but this layer 7 does not include a filler.

The multilayer packaging material may further include one or more primer layers (not shown in the drawings) that are applied to one or both sides of the paper layer, in between the surface of the paper layer and said barrier coating layers; primer layers may be used to improve the spreading or adhesion of the subsequent coating.

Primers for the purpose of the present invention may be selected from the group consisting of acrylic acid copolymers, polyesters, polyhydroxyalkanoates, native and chemically modified starches, xylan and chemically modified xylan, polyvinylidene dichloride, polyvinyl alcohol, ethyl-vinyl alcohol, vinyl acetate, ethyl-vinyl acetates, cellulose nitrate, silanes, polyurethanes, or combinations thereof.

In case the multilayer packaging material of the invention does not include a surface layer which is heat-sealable, a cold sealable layer 9 may be applied as a surface coating, optionally in limited areas of the packaging material.

Cold sealable layers are normally formulated from a latex or non-allergenic latex suspension; water-based acrylic or synthetic latex systems could alternatively be used. Cold sealable layers may include additives or pigments (e.g., 0.1-5% by weight relative to the resin).

Typically, the multi-layer structure includes a surface printed layer 11 that is applied using conventional printing inks and conventional printing techniques, such as offset printing or rotogravure.

The printed layer may be further coated with a protective varnish; protective varnishes are applied to protect inks or coatings from damage during the lifetime of the packaging. Damage could occur from moisture or solvent attack or by mechanical stress or abrasion. A protective varnish is applied by the same technology used to apply the printing ink.

Typically, protective varnishes comprise a resin, additives/stabilizers/modifiers and solvent. Suitable solvents may be water, ethanol, ethyl acetate. Resins can be selected from nitro- or other modified cellulose, acrylic polymers and polyurethane.

Particularly in those embodiments, wherein the multi-layer structure includes a cold sealable surface layer, a release coating layer 13 may be applied to cover the printed layer, on the side of the multi-layer structure opposite to the cold sealable layer, to provide release properties.

Release varnishes are applied to facilitate the unwinding of the printing reels and to prevent cold seal from adhering to other parts of the packaging structure. The release varnishes to be considered have the same constituents as a protective varnish but include an additional slip or release agent. Slip or release agent can be selected from silicone-containing compounds, fatty acids or fatty acid esters, vegetable or other plant-based oils, carnauba or other bio-based waxes and paraffin waxes.

A preferred embodiment of the invention includes a multi-layer packaging material wherein the barrier layer is heat-sealable and comprises:

- from 50 to 85% wt., preferably from 50 to 70% wt. of a heat sealable polyhydroalkanoate (PHA),
- from 20 to 40% wt. of polybutylenesuccinate (PBS) or polylactic acid (PLA) or mixtures thereof, and
- from 0.5 to 3% wt. of a nanocellulose (preferably CNC) and optionally up to 9.5% wt. of conventional additives, wherein the sum of the wt. percentages is 100%.

In a further preferred embodiment, wherein the barrier coating layer is heat-sealable and is laminated or extrusion coated, said barrier layer comprises:

- from 50 to 60% wt. of a heat sealable PHA,
- from 20 to 30% wt. of PBS or PLA or mixtures thereof,
- from 0.5 to 10% wt. of a dispersed layered double hydroxide, preferably hydrotalcite or hydrotalcitge-like minerals and, optionally,

from 5 to 9.5% wt. of conventional additives, the sum of said percentages being 100% wt. In the above embodiments PHA may be replaced by a proteinaceous material, as previously described.

Conventional additives relate to additives that are conventionally included in said plastics materials.

In a further embodiment of the invention the multi-layer structure comprises an extrusion coated layer 15 consisting of a PHA polymer or copolymer, that is applied as a direct coating onto the paper layer, thereby to reduce the paper porosity, (fig 3(c)) and (d)), or onto the barrier layer 3 or 5 (fig 3(d)) or as a primer layer between the paper layer and said barrier layer 3 or 5 (fig 3(e)).

The multi-layer packaging material is further disclosed by the following examples 1 - 5 relating to flexible materials:

Example 1 and 2

The multi-layer structure of example 1 and 2 is shown in fig 3 (a) and (b), together with the

weights of the layers; a PHA coating formulation including CNC (or a nanocellulose) is applied to a paper substrate (internal side Fig 3 (a), external side figure 3 (b)), wherein PHA is preferably PHBH and the concentration of nanocellulose in the PHA polymer is 2%.

A coating layer obtained from a heat sealable lacquer comprising a biodegradable polyester (PHBH) is applied as a surface layer on the internal side.

Example 3

The multi-layer structure of example 3 is shown in fig 3 (c), together with the weights of the layers; the structure and compositions correspond to that of example 2, wherein, however, the layer from the heat sealable lacquer is replaced by a coated or laminated layer of PHA 15. The PHA layer provides for improved barrier properties and reduces the paper porosity. The use of a heat sealable PHA, such as PHBH is preferred to guarantee the heat-sealing properties.

Example 4

The multi-layer structure of example 4 is shown in fig 3 (d), together with the weights of the layers; the structure and compositions correspond to that of example 3, wherein, however, an additional extrusion coated layer of PHA is applied onto the PHA and CNC barrier layer. The latter additional PHA layer protects the barrier layer, thus reducing delamination, increasing resistance to break from breaking under mild creasing and increasing resistance to flow packing lines.

Example 5

The multi-layer structure of example 5 is shown in fig 3 (e), together with the weights of the layers; the structure and compositions correspond to that of example 4, wherein, however, the PHA extrusion coated layer 15 is used as a primer between the paper layer 1 and the PHA and nanocellulose barrier layer, thus allowing to reduce its weight from 15 g/m2 to 5 g/m2.

The multi-layer structures of examples 1 to 5 allow to achieve an OTR lower than 0.5 cc/m2 24h, measured at 23 °C at 40-50% RH and a water vapor transmission rate (WVTR) lower than 20 g/m2 24 h at 38°C at 90% RH.

Examples 6-10

Examples 6-10 shown in figures 4(a) to (e) relate to multi-layer structures corresponding to those of examples 1 to 5, wherein the paper layer is a sheet having a weight of from 120 to 400 g/m2 thus making the packaging material suitable for forming.

Example 6 and 7:
WVTR from 50 to 15 g/m2 24 h at 38°C at 90% RH, and
OTR from 20 to <10 cc/m2 24h, measured at 23 °C at 40-50% RH.

Example 8:
WVTR from 25 to 10 g/m2 24 h at 38°C at 90% RH, and
OTR from 15 to 5 cc/m2 24h, measured at 23 °C at 40-50% RH.

Example 9:
WVTR from 25 to <10 g/m2 24 h at 38°C at 90% RH, and
OTR from 10 to <1 cc/m2 24h, measured at 23 °C at 40-50% RH.

Example 10:
WVTR from 25 to <10 g/m2 24 h at 38°C at 90% RH, and
OTR from 10 to <1 cc/m2 24h, measured at 23°C at 40-50 RH.

CLAIMS

1. A multi-layer packaging material comprising:

- a paper layer 1 and a barrier layer (3, 5) on one or both sides of the paper layer, wherein, said barrier layer comprises

from 51 to 99% wt., preferably 90-10% wt., more preferably 95–98% wt. of a polymeric component selected from the group consisting of a polyhydroxyalkanoate polymer or copolymer, proteinaceous materials selected from proteins from milk, proteins from fungi or proteins from legumes, or gelatin, polylactic acid, polybutylene succinate or polybutylene succinate copolymers, polybutylene adipate terephthalate, thermoplastic blends of starch and aliphatic polyesters, chitosan, carrageenan, pectin, alginates and lipids and mixtures thereof and

from 49 to 1% wt., preferably 1-10% wt., more preferably 2-5% wt. of a filler selected from the group consisting of layered double hydroxides, nanocellulose, silicates and clays, preferably phyllosilicates, and mixtures thereof, the percentage by weight being referred to 100 parts by weight of the polymeric component and the filler.

2. The packaging material of claim 1, wherein said barrier layer (3) is extrusion coated or laminated onto the paper layer (1).

3. The packaging material of claim 1 or 2, wherein said barrier layer is on both sides of the paper layer (1).

4. The packaging material of claim 1, wherein said barrier layer (5) is obtained by applying and drying a lacquer comprising said polymeric component and filler in water or in a solvent vehicle.

5. The packaging material of claim 4, wherein said barrier layer (5), obtained from a lacquer is on both sides of the paper layer (1).

6. The packaging material of claim 1, comprising a barrier layer (3) according to claim 2 on one side of the paper layer and a barrier layer (5) according to claim 4 on the other side

of the paper layer (1).

7. The packaging material of claim 3, comprising an additional barrier layer (5) according to claim 4, above one or both the laminated or extrusion coated barrier coating layers.

8. The packaging material according to claims 3 or 7 wherein said laminated or extrusion coated barrier layer (3) is heat sealable and wherein the polymeric component is selected from the group consisting of a polyhydroxyalkanoate polymer or copolymer, polybutylene succinate, polybutylene adipate terephthalate (PBAT) and polylactic acid and mixtures thereof and the filler is selected from a layered double hydroxide and nanocellulose.

9. The packaging material according to claim 3 or 7, wherein said laminated or extrusion coated barrier layer (3) is heat sealable and wherein the polymeric component is selected from the group consisting of a proteinaceous material selected from milk, fungal and pea proteins, gelatin and mixture thereof and said filler is selected from the group consisting of hydrotalcite, nanocellulose, silicates and clays and mixtures thereof.

10. The packaging material according to claim 8 wherein said barrier layer comprises from 50 to 85% wt., preferably 50 to 70% wt., of a polyhdyroxyalkanoate (PHA), from 20 to 40% wt. of polybutylenesuccinate (PBS) or polylactic acid and mixtures thereof, and from 0,5 to 3% wt. of nanocellulose, preferably CNC and optionally up to 9,5% wt. conventional additives, wherein the sum of the wt. percentages is 100%.

11. The polymeric material according to claim 8, wherein said laminated or extrusion coated barrier layer comprises from 50 to 60% wt. of a polyhdyroxyalkanoate (PHA), from 20 to 30% wt. of polybutylenesuccinate (PBS) or polylactic acid and mixtures thereof, from 0,5 to 10% wt. of dispersed hydrotalcite or hydrotalcite-like minerals and optionally from 5 to 9,5% wt. of conventional additive, the sum of said percentages being 100% wt.

12. The packaging material according to any of the preceding claim further comprising a primer layer applied to one or both sides of the paper layer in between the surface of the

paper layer and said barrier coating layer ((3), (5)).

13. The packaging material according to any of the preceding claims, further comprising an external ink printed layer (11).

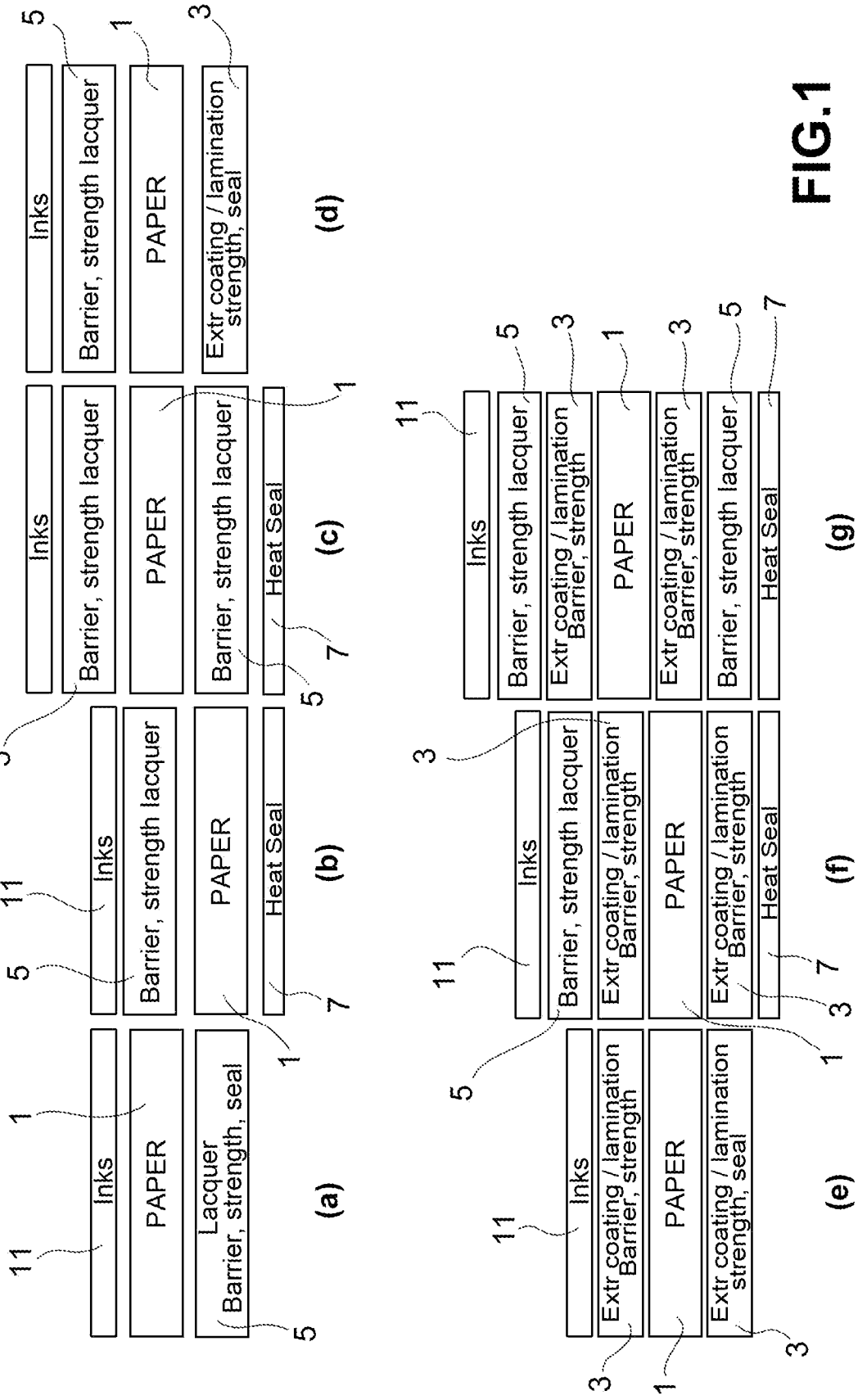
14. The packaging material according to any of the preceding claims, comprising a heat-sealable layer (7) a as surface layer.

15. The packaging material according to claim 14, wherein said heat sealable layer (7) comprises a polymeric component selected from the group consisting of polyhydroxyalkanoate, polybutylenesuccinate and polybutylene adipate terephtalate and does not include a filler.

16. The packaging material according to any of claims 1 to 13 comprising as a surface layer a cold sealable layer (9) formulated from a latex suspension, optionally including additives or pigments.

17. The packaging material according to claim 16 comprising as a surface layer a coating of a release varnish.

18. The packaging material according to any of claims 1 to 17 wherein said paper layer is a film having a weight of from 35 to less than 120 g/m2 or is a sheet having a weight of from 120 to 400 g/m2.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(g)

FIG.1

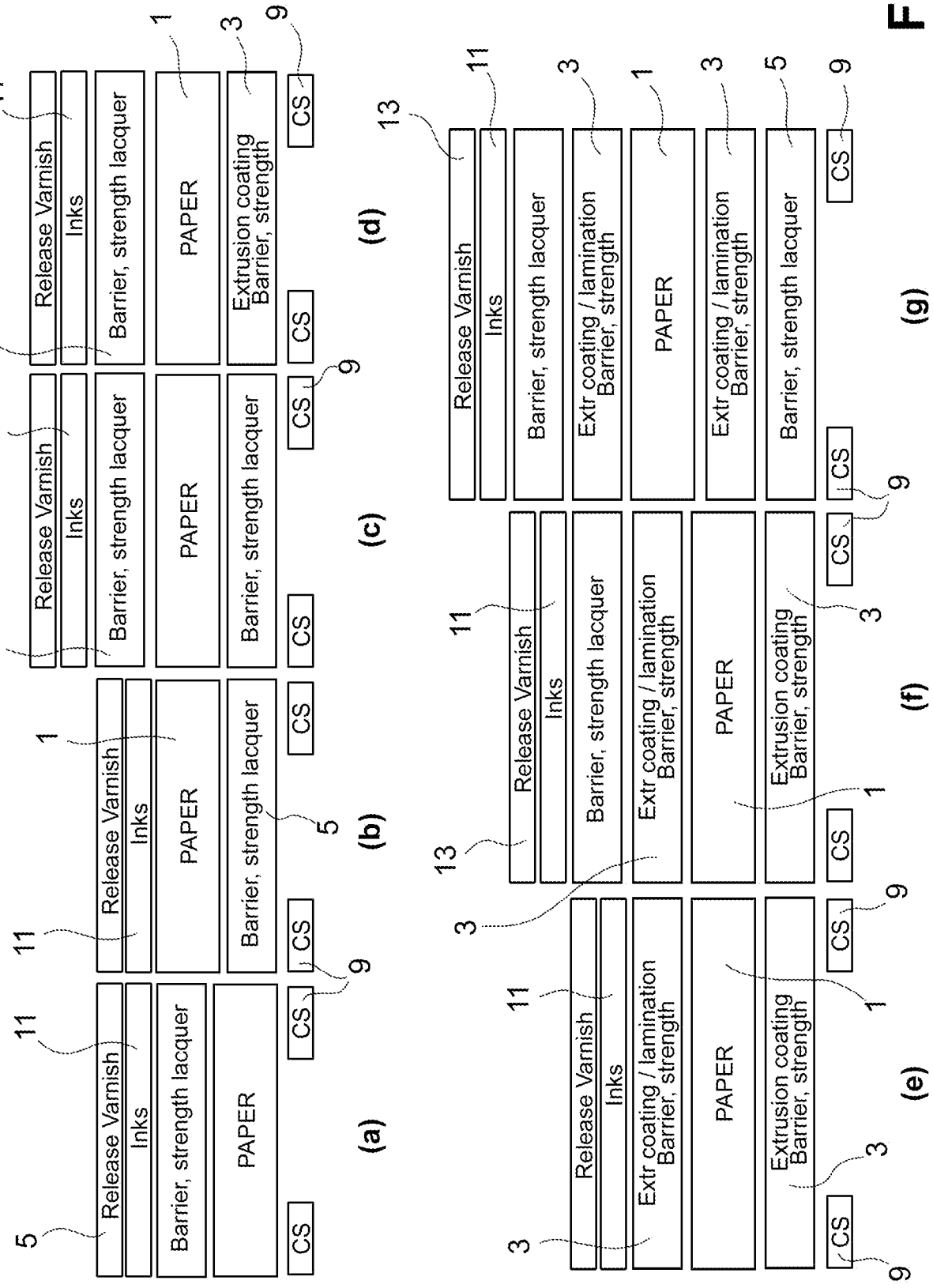
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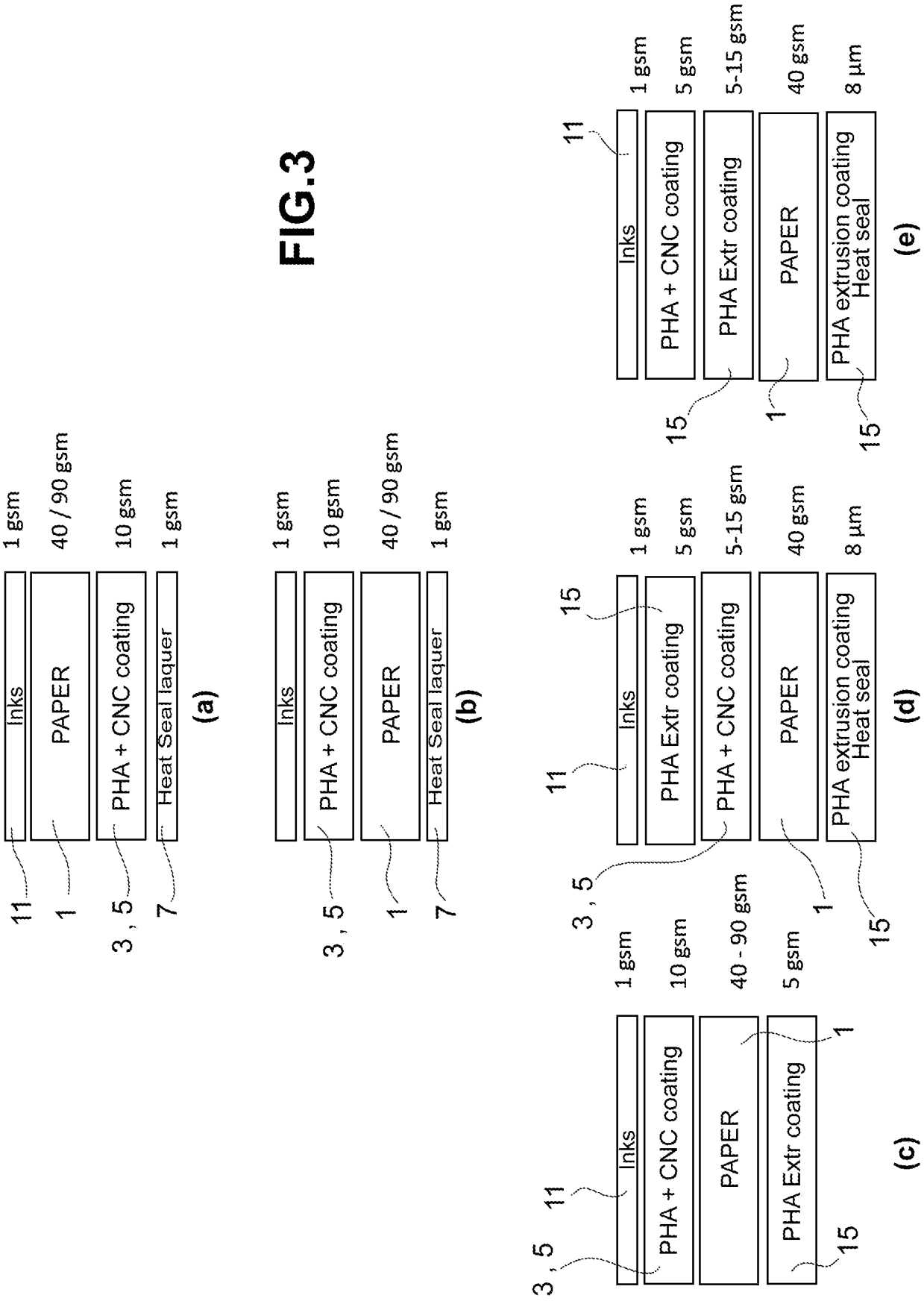
FIG.2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1
15
(d)
Inks
PHA + CNC coating
PHA Extr coating
PAPER
PHA extrusion coating
Heat seal
1 gsm
5 gsm
5-15 gsm
40 gsm
8 µm
11
15
1
15
(e)

FIG.3

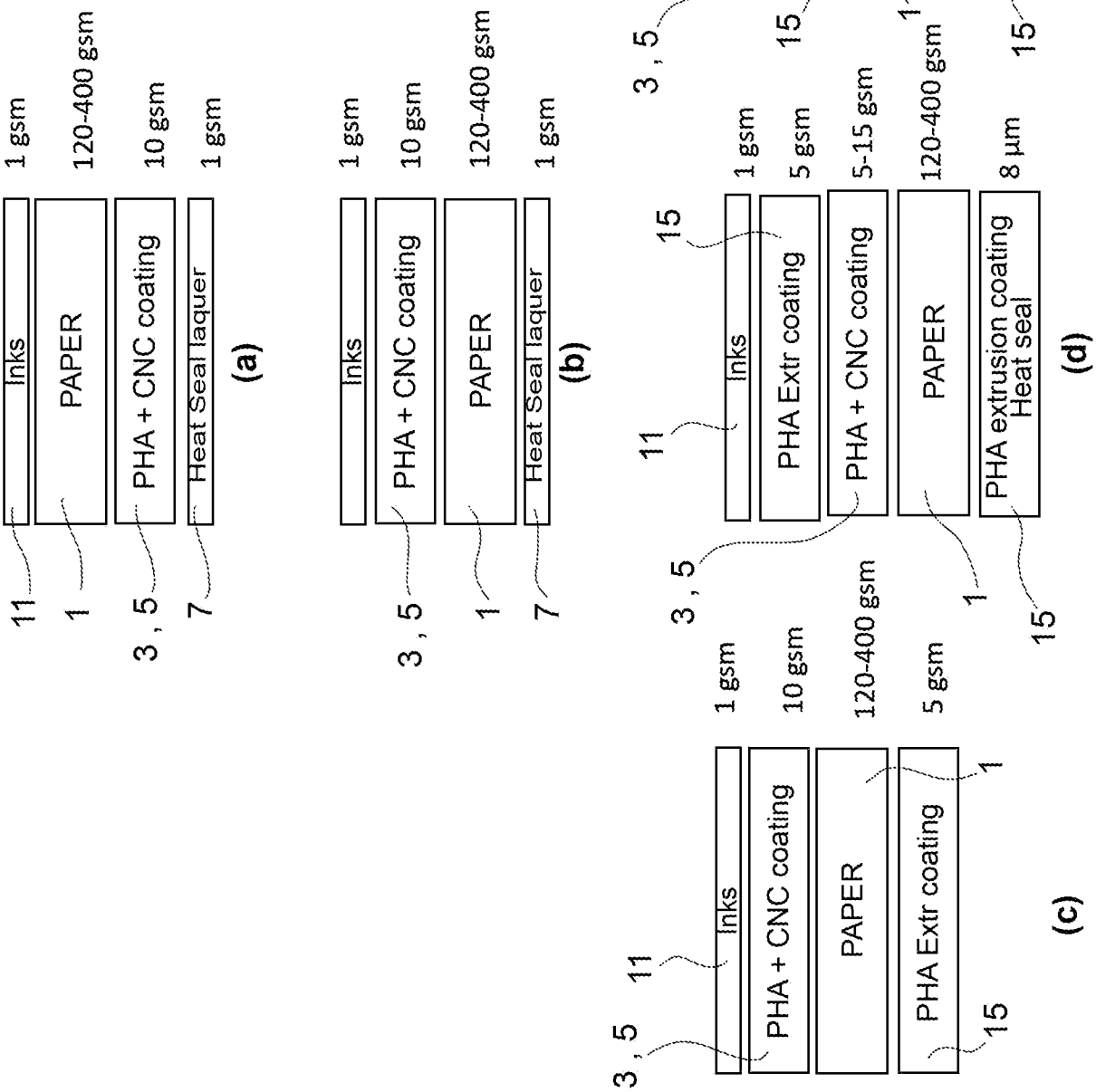
Inks
PAPER
PHA + CNC coating
Heat Seal laquer
1 gsm
120-400 gsm
10 gsm
1 gsm
11
1
3 , 5
7
(a)
Inks
PHA + CNC coating
PAPER
Heat Seal laquer
1 gsm
10 gsm
120-400 gsm
1 gsm
3 , 5
1
7
(b)
PHA + CNC coating
PAPER
PHA Extr coating
1 gsm
10 gsm
120-400 gsm
5 gsm
3 , 5
11
1
15
(c)
Inks
PHA Extr coating
PHA + CNC coating
PAPER
PHA extrusion coating
Heat seal
1 gsm
5 gsm
5-15 gsm
120-400 gsm
8 µm
11
15
3 , 5
1
15
(d)
Inks
PHA + CNC coating
PHA Extr coating
PAPER
PHA extrusion coating
Heat seal
1 gsm
5 gsm
5-15 gsm
120-400 gsm
8 µm
11
3 , 5
15
1
15
(e)

FIG.4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/056263

A. CLASSIFICATION OF SUBJECT MATTER

INV. B65D65/42 D21H11/18 D21H19/38 D21H19/40 D21H19/50
D21H19/60 D21H19/62 D21H19/44 D21H19/52 D21H19/56
D21H19/64 D21H19/82 D21H19/84 D21H21/16 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)
D21H B65D

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013/101855 A1 (CHAM PAK MENG [US] ET AL) 25 April 2013 (2013-04-25)	2
A	claim 29 figure 3 paragraph [0040] - paragraph [0055]	1,3-18

X	WO 2022/219183 A1 (SOREMARTEC SA [LU]) 20 October 2022 (2022-10-20)	1-3,5-8, 10-15,18
Y	figures 1-3	2,16
A	page 2 - page 6 page 14	4,9,17

X	WO 2022/258830 A1 (NESTLE SA [CH]) 15 December 2022 (2022-12-15)	1,4,17
A	claim 1 examples 1-4 figure 1 page 9 - page 11	2,3, 5-16,18

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 September 2024	10/10/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lindner, Claudia

1

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/056263

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 10 494 493 B1 (SUNDARAM JAYA [US] ET AL) 3 December 2019 (2019-12-03) claims 1-16	1-18

Y	US 2023/130087 A1 (GREFENSTEIN ACHIM [DE] ET AL) 27 April 2023 (2023-04-27)	16
A	example 3 paragraph [0017] - paragraph [0076]	1-15,17, 18

A	CA 3 203 630 A1 (NESTLE SA [CH]) 25 August 2022 (2022-08-25) claim 1 example 2 page 9	1-18

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2024/056263

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