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(54) COATED PAPERBOARD

(57) The present disclosure provides a coated paperboard comprising a paperboard substrate and a coating layer wherein:

- the coating layer comprises a pigment mixture and a binder in a dry weight ratio within the range of from 100:14 to 100:25;

- the pigment mixture comprises a calcium carbonate pigment and a clay pigment in a dry weight ratio within the range of from 98:2 to 92:8; and

- the calcium carbonate pigment has a particle size distribution (wt. % < 2 µm) within the range of from 75 to 95.

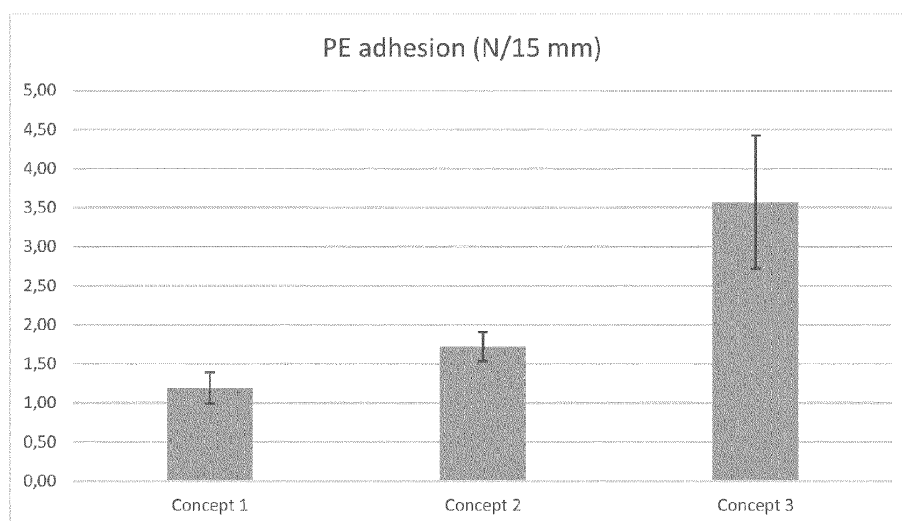


Fig 2.

EP 4 365 369 A1

Description

TECHNICAL FIELD

5 [0001] The present disclosure relates to the field of coated paperboards.

BACKGROUND

10 [0002] Paperboard is commonly coated with one or more coatings prior to use. Some coatings may induce barrier properties against oxygen or water while others induce surface properties such as improved printability and gloss. Paperboards are most commonly coated with multiple coatings.

[0003] For some applications such as liquid packaging board (LPB), the coated paperboard is covered with a layer of polyethylene (PE) such that a laminate is formed. The purpose of the PE layer is normally to provide a barrier and/or to facilitate heat-sealing when a package is formed from the laminate. During use of the laminate, it is important that the PE layer adheres firmly to the coated paperboard, i.e., that delamination is avoided.

15 [0004] Furthermore, in applications such as LPB, there is a desire to have a good printability of the final packaging material. The printability is determined by several different factors, wherein one is the roughness of the surface intended to be printed on, i.e., the surface of the coated paperboard.

20 SUMMARY

[0005] The present inventors have realised that there is a need to improve the polyethylene (PE) adhesion and the surface roughness of coated paperboards while simultaneously optimizing the binder usage.

25 [0006] Accordingly, the present disclosure provides a coated paperboard comprising a paperboard substrate and a coating layer wherein:

- the coating layer comprises a pigment mixture and a binder in a dry weight ratio within the range of from 100:14 to 100:25;
- 30 - the pigment mixture comprises a calcium carbonate pigment and a clay pigment in a dry weight ratio within the range of from 98:2 to 92:8; and
- the calcium carbonate pigment has a particle size distribution (wt. % < 2 μm) within the range of from 75 to 95.

35 [0007] The coated paperboard according to the present disclosure surprisingly led to an improved PE adhesion and a reduced surface roughness. The combination of fine calcium carbonate pigment together with a small amount of platy clay pigment enables an optimal binder usage resulting in an improved PE adhesion and reduced surface roughness of the coated paperboard.

[0008] The calcium carbonate pigment and the clay pigment may comprise 100 wt. % of the pigment mixture.

40 [0009] The binder used in the present disclosure may be a styrene-acrylic copolymer or a styrene-butadiene copolymer. The binder is preferably a styrene-acrylic copolymer.

[0010] The binder may be a starch-based binder. The use of a starch-based binder has the advantage of being bio-based and hence has a lower environmental impact.

45 [0011] The coating layer may further comprise a co-binder such as polyvinyl alcohol (PVOH), carboxymethyl cellulose (CMC) and/or starch.

[0012] The calcium carbonate pigment may be ground calcium carbonate. The fact that the calcium carbonate pigment is ground calcium carbonate may further improve the binder usage.

[0013] The coating layer of the present disclosure may be a top coating layer. The top coating layer may be in direct contact with a PE layer if the paperboard is laminated.

50 [0014] The coat weight of the coating layer may be 5-16 g/m², preferably 6-10 g/m².

[0015] The coated paperboard may further comprise a pre-coating arranged between the paperboard substrate and the coating layer. The pre-coating preferably primes the surface.

[0016] The coat weight of the pre-coating and the coating layer together may be 10-18 g/m², preferably 12-16 g/m². It was surprisingly found by the present inventors that by using a coating layer according to the present disclosure, that the pre-coating and/or coating layer may be applied at lower coat weights than conventional coatings and still maintain or improve the coated paperboard properties such as surface roughness and PE adhesion. The lower coating weights may reduce the cost of the coated paperboard and its environmental impact.

55 [0017] The coated paperboard may have a Parker Print Surf (PPS) roughness of 3.2 μm or less such as 3.2-0.5 μm ,

preferably 3 μm or less such as 3-0.5 μm . The PPS roughness is measured according to ISO 8791-4. Furthermore, the coated paperboard may have a Bendtsen roughness of 250 ml/min or less such as 250-25 ml/min, preferably 200 ml/min or less such as 200-25 ml/min. The Bendtsen roughness is measured according to ISO 8791-2. The low surface roughness as demonstrated by the PPS and Bendtsen values may lead to an improved printability of the coated paperboard.

[0018] The paperboard may be a liquid packaging board (LPB).

[0019] Furthermore, according to a second aspect of the present invention the paperboard substrate of the liquid packaging board comprises at least two, such as at least three plies. Optionally, each ply comprises hydrophobic size. The hydrophobic size may be alkenyl succinic anhydride (ASA), alkyl ketene dimer (AKD) and/or rosin size, and each ply of the paperboard substrate may comprise at least 1.5 kg/tonne fibre of the hydrophobic size. Preferably, each ply comprises at least one of AKD and ASA.

[0020] The hydrophobic size is preferably added as internal sizing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Aspects and embodiments are now described, by way of example, with reference to the accompanying drawings, in which:

Fig 1a shows the Parker-Print Surf roughness for the coated paperboards in Example 1.

Fig 1b shows the Bendtsen roughness for the coated paperboards in Example 1.

Fig 2 shows the PE-adhesion of the coated paperboards in Example 1.

Fig 3 shows the topology of the coated paperboards as determined by Optitopo measurements.

DETAILED DESCRIPTION

[0022] The present disclosure relates to a paperboard coated with a coating layer having a pigment mixture comprising fine calcium carbonate pigment and a small amount clay pigment.

[0023] The paperboard substrate may comprise at least two plies, such as at least three plies, wherein the top ply of the paperboard substrate is provided with the coating. The top ply of the paperboard substrate is typically bleached. Each ply of the paperboard substrate may comprise hydrophobic size such as ASA, AKD and/or rosin size. The amount of added hydrophobic size may be at least 1.5 kg/tonne fibre.

[0024] The paperboard substrate may comprise other conventional additives such as fillers and colouring agents, this is however optional.

[0025] The coating layer comprises a pigment mixture and a binder in a dry weight ratio of from 100:14 to 100:25. The skilled person understands that per 100 parts of pigment, 14-25 parts of binder may be added to the coating layer.

[0026] The binder may be a synthetic binder and/or a bio-based binder. Suitable bio-based binders may include polysaccharides such as cellulose and starch-based binders. Suitable synthetic binders may include styrene copolymers and polyvinyl alcohols.

[0027] The synthetic binder is preferably a styrene copolymer such as a styrene-acrylic copolymer or a styrene-butadiene copolymer. Styrene-butadiene copolymers may be a less expensive alternative while styrene-acrylic copolymers have been found advantageous in applications with taste and odour requirements such as food packaging. A styrene-acrylic copolymer is also preferred from e.g. an environmental and health perspective.

[0028] The bio-based binder is preferably a starch-based binder. An example of a starch-based binder is a biolater comprising cross-linked starch nanoparticles.

[0029] The binder is often the most expensive component of a coating, and it is therefore desirable to optimize its usage to decrease the needed amount of binder. The pigment mixture of the present disclosure enables an optimal usage of the binder, i.e., due to the specific pigment mixture, a reduction in the binder amount could be obtained while maintaining or improving the PE-adhesion and surface roughness.

[0030] Without being bound by any theory, it is believed that the pigment mixture according to the present disclosure provides a good cohesion between the binder and the pigments by utilizing the binder in a highly effective way. This results in an improved resistance against damage inflicted by forces acting upon the coating such as during delamination of a laminated PE layer. This optimized usage of the binder is likely due to an improved interface between the binder and the pigment particles, which reduces the number of weak spots (parts of the coating where pigments are not bound to the paperboard surface) in the coating. The coating layer of the present disclosure, hence, enables a good cohesion between the binder and the pigment particles, improving the resistance of the coating against damage and thereby also improving the PE adhesion to the coating layer.

[0031] The pigment mixture comprises a calcium carbonate pigment and a clay pigment. The dry weight ratio between the calcium carbonate and clay is within the range of from 98:2 to 92:8.

[0032] The calcium carbonate pigment and the clay pigment may be the only pigments in the pigment mixture and hence comprises 100 wt. % of the pigment mixture, i.e. meaning that 100% of the pigment present in the coating is the calcium carbonate pigment and the clay pigment as defined herein. Furthermore, the calcium carbonate pigment may be the only calcium carbonate pigment present in the pigment mixture.

[0033] The calcium carbonate pigment has a particle size distribution (wt. % < 2 μm) within the range of from 75 to 95. Optionally, the calcium carbonate pigment has a particle size distribution (wt. % < 2 μm) within the range of from 80 to 95. The calcium carbonate pigment may have a D_{50} (number average) of $0.7 \mu\text{m} \pm 0.6 \mu\text{m}$. Furthermore, the calcium carbonate pigment may have a D_{98} (number average) of $3.2 \mu\text{m} \pm 0.5 \mu\text{m}$.

[0034] The skilled person understands that "a particle size distribution (wt. % < 2 μm) between 75 and 95" means that between 75 wt.% and 95 wt.% of the particles have an equivalent spherical diameter below 2 μm .

[0035] "wt. % < 2 μm " is a cut-off value commonly used in the field to define the particle size of a pigment product. For example, in the product "HydroCarb 90" from Omya, "90" represents the weight percentage of particles having a diameter below 2 μm . "Hydrocarb 90" is considered to comprise fine particles.

[0036] The calcium carbonate pigment may be ground calcium carbonate (GCC).

[0037] The coating layer comprising a fine calcium carbonate pigment and a small amount of clay has been shown to provide excellent PE adhesion where delamination occurs in the paperboard rather than at the interface of the coating layer and the PE layer. This may be particularly important when used in applications such as liquid packaging boards. In addition to the improved PE adhesion, using the coating layer according to the present disclosure further gives rise to a reduced surface roughness i.e., reduced PPS and Bendtsen roughness values. The low surface roughness of the coated paperboard may improve the printability of the final material.

[0038] The paperboard may comprise one or more additional coatings arranged between the paperboard and the coating layer. The additional coatings arranged between the paperboard and the coating layer may be pre-coating layer/s and/or barrier layer/s. The pre-coating/s may be added to prime the paperboard and smooth the paperboard surface prior to application of the coating layer. The pre-coating/s preferably comprises coarser particles and more clay than the coating layer. The barrier layers may be applied to induce a barrier towards water and/or oxygen to the coated paperboard.

[0039] Preferably, the coated paperboard comprises a pre-coating arranged between the paperboard and the coating layer. The pre-coating may comprise binder and pigments. The binder is preferably a styrene copolymer such as styrene-acrylic copolymer or styrene-butadiene copolymer. The pigments are preferably calcium carbonate and/or clay.

[0040] The coat weight of the coating layer may be 5-16 g/m², preferably 7-10 g/m². Further, the coating layer may be a top coating layer and may be arranged so that it is in direct contact with a PE layer if present.

[0041] If a pre-coating is present, the combined coat weight of the pre-coating and the coating layer may be 10-18 g/m², preferably 12-16 g/m². Preferably, the coat weight of the coating layer is higher than the coat weight of the pre-coating such as at least 1 g/m² higher. The pigment mixture according to the present disclosure, enables application of the coatings at a lower coat weight than conventional coating materials which may lead to a cost reduction as well as a lower environmental impact.

[0042] The coating layer and/or any additional coatings may comprise a co-binder such as polyvinyl alcohol (PVOH), carboxymethyl cellulose (CMC) and/or starch.

[0043] The coating layer and/or any additional layer may further comprise rheology modifiers such as alkali swellable emulsion based on acrylates, starch and/or CMC.

[0044] The additives present in the coating layer such as co-binders and/or rheology modifiers, may be present in a pigment to additive ratio in the range of from 100:5 to 100:0 wherein the pigment to co-binder ratio maybe in the range of from 100:3 to 100:0.

[0045] According to the present disclosure starch may be used as a binder, a co-binder and/or a rheology modifier. Two or three different starches may be used as the different components. As an example, a starch-based binder may be used together with a starch-based co-binder and a starch-based rheology modifier, the three starches being three different starches. When used as a binder, the amounts of the starch added is within the binder to pigment ratio according to the present disclosure, while when used as a co-binder or rheology modified, the amounts are typically within the range of from 100:3 to 100:0 and from 100:2 to 100:0, respectively.

The low surface roughness, as demonstrated by the PPS and Bendtsen values, has been found by the present inventors to improve the printability of the coated paperboard. The coated paperboard of the present disclosure may have a Parker Print Surf roughness of 3.2 μm or less such as 3.2-0.5 μm , preferably 3 μm or less such as 3-0.5 μm and a Bendtsen roughness of 250 ml/min or less such as 250-25 ml/min, preferably 200 ml/min or less such as 200-25 ml/min. The PPS and Bendtsen surface roughness was measured according to ISO 8791-4 and ISO 8791-2 respectively.

[0046] The coating layer according to the present disclosure gives rise to an improved PE adhesion by utilizing a pigment mixture comprising CaCO₃ with a specific particle size distribution and a small amount of clay. The improved PE adhesion will lower the risk of delamination during package formation. In addition, a smoother surface, lower surface

roughness, can be obtained than with conventional coatings at similar or lower coat weights. The smoother surface of the coating layer according to the present disclosure may furthermore give rise to improved printability.

EXAMPLES

Example 1

[0047] A machine trial was performed by coating uncoated paperboard (LPB) substrate. The paperboard had a grammage of ~175 gsm and comprised three plies wherein the top ply was bleached. All layers comprised hydrophobic size (AKD + rosin size).

[0048] Two different coating structures were evaluated. The first comprised a single coating (concept 1) wherein the paperboard substrate was coated with only one coating. The second coating structure comprised two coating layers (concept 2 and 3) wherein the paperboard substrate was first coated with a pre-coating followed by a coating layer (referred to as the top coating henceforth). The coating recipes used in the machine trial can be seen in Table 1.

[0049] The pre-coating (applied in concept 2 and 3) was applied with a blade coater directly onto the paperboard substrate and with a coat weight of 6 g/m². The top coating (applied in all three concepts) was also applied with a blade coater either directly onto the paperboard substrate (concept 1) or onto the pre-coating (concept 2 and 3) in a coat weight of 8 g/m². The recipes and the coating structures can be found in Table 1 and 2 respectively. It was ensured that the top coating covered the entire surface well since a poor coverage may impact negatively on the surface roughness.

Table 1. Coating recipes used in example 1.

	Pre-coating	Top coating 1	Top coating 2
Binder (parts)	14	17	18
Calcium carbonate 1 (parts)	80	-	-
Calcium carbonate 2 (parts)	-	75	95
Calcium carbonate 3 (parts)	-	25	-
Clay (parts)	20	-	5
RM (parts)	0.42	0.42	0.42
Viscosity (mPas)	1100	1100	1000
Dry content (wt.%)	65	64	64

Table 2. Coating concepts used in example 1.

	Concept 1 (g/m ²)	Concept 2 (g/m ²)	Concept 3 (g/m ²)
Pre-coating	-	6	6
Top coating 1	8	8	-
Top coating 2	-	-	8
Total coat weight (g/m ²)	8	14	14

[0050] As example, the coating components used in the machine trial were:

- Binder - Acronal S 728, a styrene-acrylic latex.
- Calcium carbonate 1 - Hydrocarb 60 ("HC 60"). HC 60 has a d_{50} of 1.4 μm and a particle size distribution (% < 2 μm) of 60;
- Calcium carbonate 2 - Hydrocarb 90 ("HC 90"). HC 90 has a d_{50} of 0.7 μm , d_{98} of 3.2 μm and a particle size distribution (wt. % < 2 μm) of 90;
- Calcium carbonate 3 - Covercarb 75 ("CC 75"). CC 75 has a d_{50} of 0.63 μm , d_{98} of 2.8 μm and a particle size

distribution (wt. % < 2 μm) of 90;

- Clay - Capim BK1. Capim BK1 has a d_{50} of 0.75, an aspect ratio of 22 and a particle size distribution (wt. % < 2 μm) of 85.
- RM - Archroma Cartacoat RM 15, an alkali soluble emulsion.

[0051] The calcium carbonate pigments were obtained from Omya, the clay pigment was obtained from Imerys and the binder was obtained from BASF. The recipes for the different concepts are given in "parts", which means parts by weight. The total amount of pigments always amounts to 100 parts while the other ingredients are added to this. For instance, the recipe for concept 3 contains 100 parts pigment (95 parts calcium carbonate 2 and 5 parts clay), 18 parts binder and 0.42 parts rheology modifier. In total the recipe contains 118.42 parts.

[0052] Of the evaluated concepts, concept 3 falls within the scope of the present disclosure while concept 1 and 2 are references.

[0053] The Parker-Print Surf (PPS) roughness and Bendtsen roughness were measured for all three concepts according to the standard method ISO 8791-4 and ISO 8791-2 respectively. The results can be seen in Fig 1a and Fig 1b. The PPS and the Bendtsen roughness followed the same trend over the three concepts and will be evaluated simultaneously and referred to as "surface roughness".

[0054] As can be seen in Fig 1a and Fig 1b, the single coated paperboard had the highest surface roughness (PPS and Bendtsen) of the three evaluated concepts. This may be due to the low coat weight of concept 1 (8 g/m²) compared to concept 2 and 3 (14 g/m²).

[0055] Concept 3 which comprised a pigment mixture of 95 wt. % Calcium carbonate 2 and 5 wt.% clay, exhibited the smoothest surface of the tested concepts. The major difference between concept 2 and 3 is the pigment mixture. Concept 2 comprised a mixture of two different calcium carbonates, Calcium carbonate 2 (which is also present in concept 3) and Calcium carbonate 3 which is a finer calcium carbonate with a narrow particle size distribution compared to calcium carbonate 2 while the pigment mixture in concept 3 only comprised Calcium carbonate 2 and a small amount of clay. This clearly indicates that the use of the specific pigment mixture in concept 3 improves the surface roughness of the coated paperboard.

[0056] Paperboards according to concepts 1-3 were laminated with a layer of polyethylene (PE) on the coated side of the paperboard and the PE-adhesion was tested according to the standard method ISO 6133.

[0057] The PE-adhesion was tested on a 5 cm long strip of laminated paperboard with a width of 15 mm. The delamination of the PE-film from the paperboard was tested using a tensile tester and the results are averages of 8 samples.

[0058] The results can be seen in Fig 2.

[0059] Concept 3 exhibited an average F_{max} of 3.57 N/15 mm while the F_{max} of concept 2 was 1.72 N/15 mm. The F_{max} of concept 3 was thus approximately twice as high as the F_{max} of concept 2. As mentioned above, the major difference between concept 2 and 3 is the pigment mixture of the top coating wherein the pigment mixture of concept 3 had slightly coarser calcium carbonate particles than the pigment mixture of the top coating in concept 2. The pigment mixture of concept 3 also comprised a small amount clay. Concept 1 exhibited an F_{max} of 1.19 N/15mm and thereby had the lowest F_{max} . Concept 1 comprised the same coating as the top coating in concept 2, however, it did not comprise a pre-coating and thereby had a lower coat weight.

[0060] Surprisingly, the increase of the amount of the coarser calcium carbonate pigment and the addition of a small amount of clay significantly improved the PE-adhesion of the coated paperboard.

[0061] The topology of the coated paperboards was further assessed using OptiTopo. The L&W OptiTopo is an instrument for measuring surface roughness. This method, in addition to the PPS and Bendtsen measurements, may enable predicament of the printability of the coated paperboards. The results are disclosed in Table 3. The obtained values from the OptiTopo measurements are the OptiTopo standard deviation ("OSD") which is a measurement of fine scale surface deviations and the crater values at -1.5, -3 and -5 μm i.e. % of the surface which has craters that are -1.5, -3 and -5 μm deep.

Table 3. The topological results obtained from OptiTopo measurements.

	Position	OSD (μm)	Crater -1.5 μm (%)	Crater -3 μm (%)	Crater -5 μm (%)
Concept 1	Edge	0.686	4.19	0.495	0.035
	Mid	0.603	3.07	0.276	0.0144
	Edge	0.689	4.28	0.515	0.037

(continued)

	Position	OSD (μm)	Crater -1.5 μm (%)	Crater -3 μm (%)	Crater -5 μm (%)
5	Concept 2	Edge	0.352	0.336	0.00452
		Mid	0.336	0.167	0.00212
		Edge	0.358	0.361	0.00510
10	Concept 3	Edge	0.316	0.19	0.00367
		Mid	0.311	0.158	0.008
		Edge	0.325	0.211	0.00379

[0062] The OptiTopo measurements showed that concept 1 had the highest OSD and crater values and that these values were significantly lower for concept 2 and 3. Low crater values are desired as crater values predict the risk of missing dots and uncovered print area. Concept 3 exhibited the lowest OSD and in most cases the lowest crater values of the tested concepts.

[0063] The results obtained for the surface roughness, PE adhesion and topology of the evaluated concepts show that concept 3, which comprised the pigment mixture of the present disclosure, exhibited a lower surface roughness, improved PE adhesion and a topology more suitable for printing than reference concepts 1 and 2.

[0064] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the scope being defined by the following claims.

Claims

1. A coated paperboard comprising a paperboard substrate and a coating layer wherein:

- the coating layer comprises a pigment mixture and a binder in a dry weight ratio within the range of from 100:14 to 100:25;
- the pigment mixture comprises a calcium carbonate pigment and a clay pigment in a dry weight ratio within the range of from 98:2 to 92:8; and
- the calcium carbonate pigment has a particle size distribution (wt. % < 2 μm) within the range of from 75 to 95.

2. The coated paperboard according to claim 1, wherein the calcium carbonate pigment and the clay pigment comprise 100 wt.% of the pigment mixture.

3. The coated paperboard according to any one of claims 1 or 2, wherein the binder is a styrene-acrylic copolymer or styrene-butadiene copolymer.

4. The coated paperboard according to any one of claims 1 or 2, wherein the binder is a starch-based binder.

5. The coated paperboard according to any one of the preceding claims, wherein the coating layer further comprises a co-binder such as polyvinyl alcohol, carboxymethyl cellulose and/or starch.

6. The coated paperboard according to any one of preceding claims, wherein the calcium carbonate pigment is ground calcium carbonate.

7. The coated paperboard according to any one of the preceding claims, wherein the coat weight of the coating layer is 5-16 g/m².

8. The coated paperboard according to any one of the preceding claims, wherein the coated paperboard comprises a pre-coating arranged between the paperboard substrate and the coating layer.

9. The coated paperboard according to claim 8, wherein the pre-coating comprises binder and pigment. Optionally, the pre-coating comprises coarser pigments than the coating layer.

EP 4 365 369 A1

10. The coated paperboard according to claim 8 or 9, wherein the coat weight of the pre-coating and the coating layer together is 10-18 g/m².
- 5 11. The coated paperboard according to any one of the preceding claims, wherein the coated paperboard has a Parker Print Surf roughness of 3.2 µm or less, as measured according to ISO 8791-4.
12. The coated paperboard according to any one of the preceding claims, wherein the coated paperboard has a Bendtsen roughness of 250 ml/min or less, as measured according to ISO 8791-2.
- 10 13. The coated paperboard according to any one of the preceding claims, which is a liquid packaging board (LPB).
14. The coated paperboard according to claim 13, wherein the paperboard substrate comprises at least two plies, such as three plies.
- 15 15. The coated paperboard according to claim 14, wherein each of the plies comprise hydrophobic size such as alkenyl succinic anhydride (ASA), alkyl ketene dimer (AKD) and/or rosin size.
16. The coated paperboard according to claim 15, wherein each of the plies of the paperboard substrate comprises at least 1.5 kg/tonne fibre of hydrophobic size.
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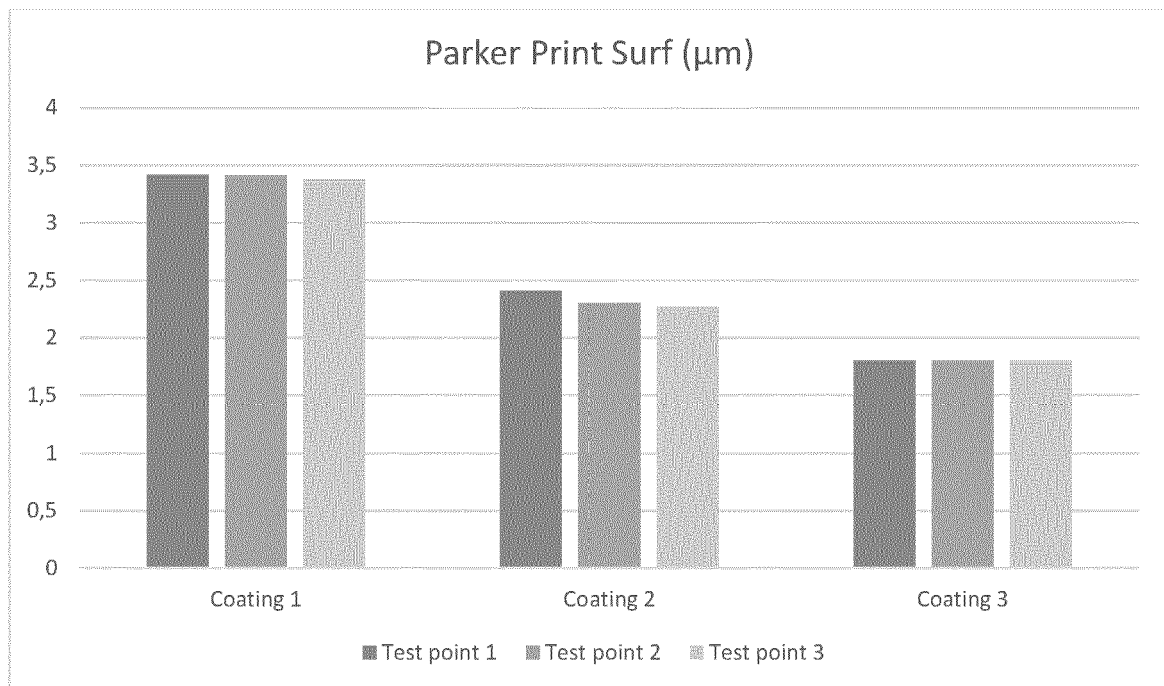


Fig 1a.

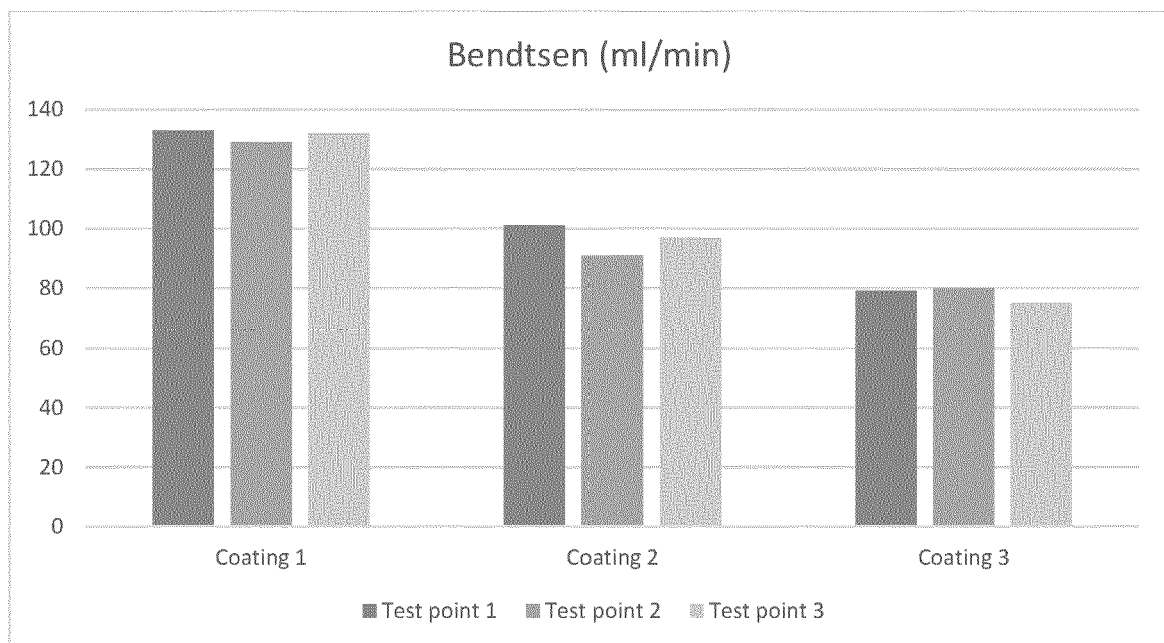


Fig 1b.

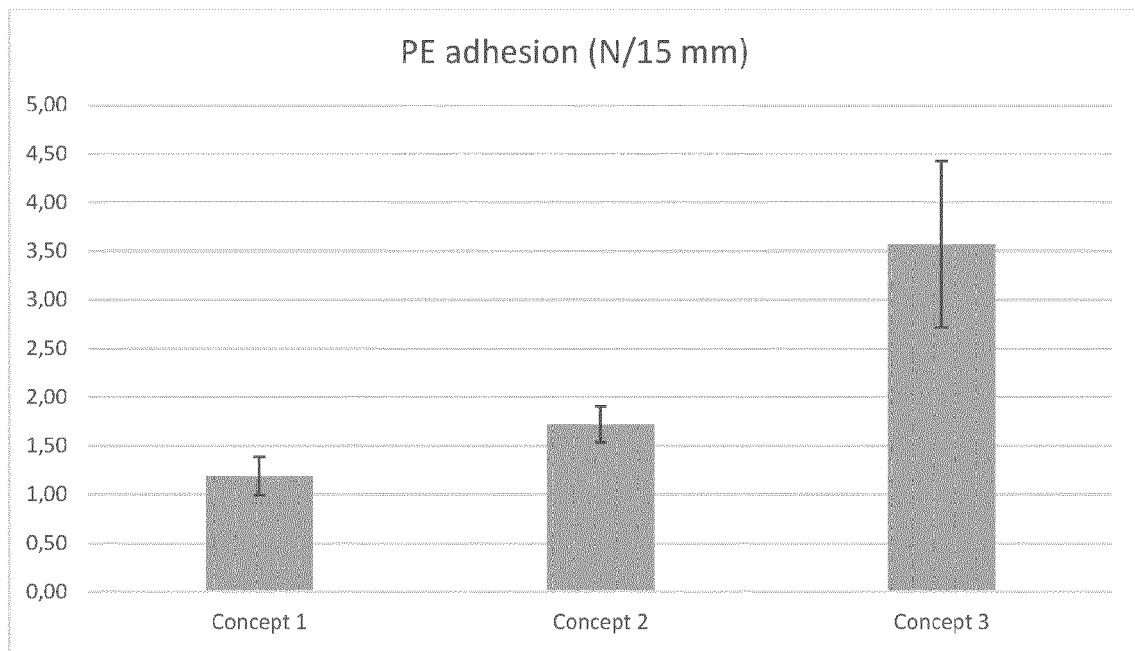


Fig 2.

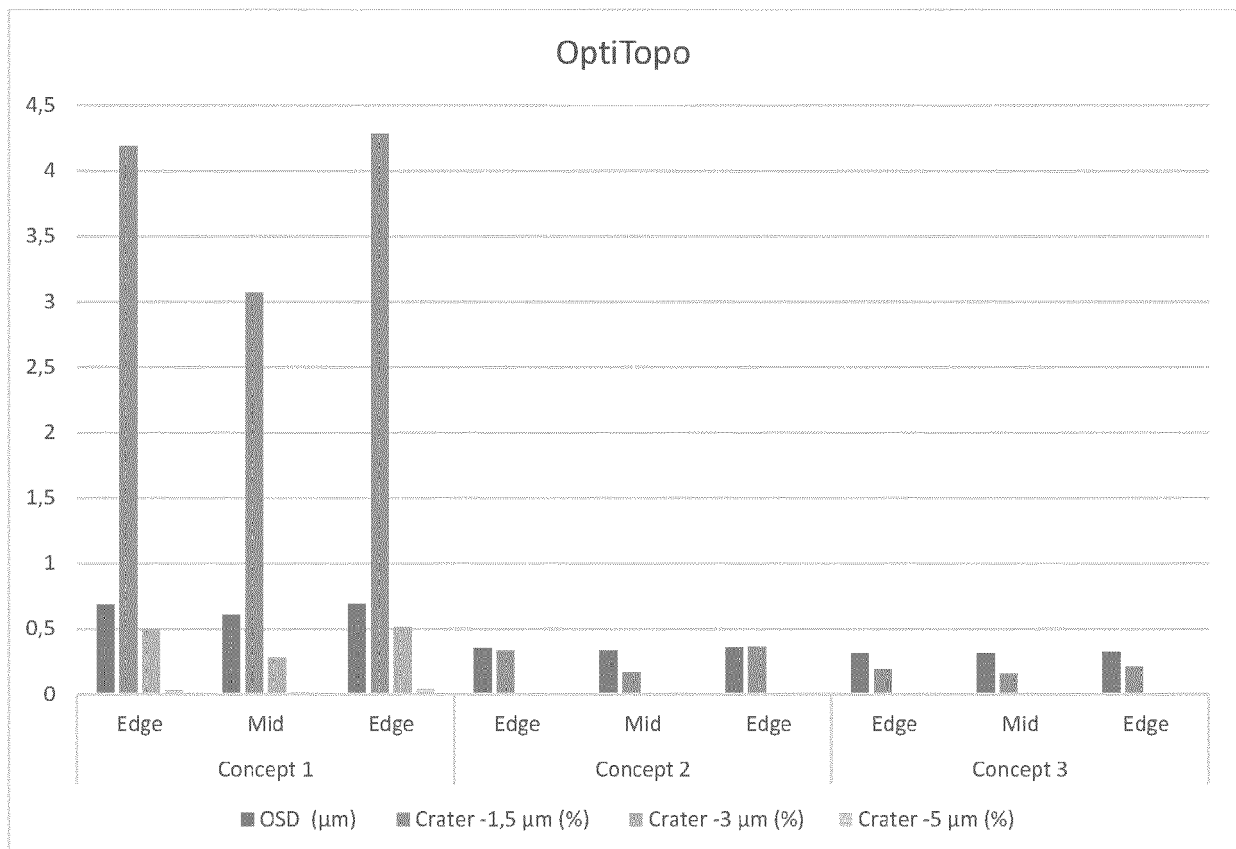


Fig 3.



EUROPEAN SEARCH REPORT

Application Number

EP 22 20 5221

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	WO 2011/114456 A1 (VOITH PATENT GMBH [DE]; KATANO TOSHIHIRO [JP] ET AL.) 22 September 2011 (2011-09-22) * paragraph [0016] * * paragraph [0031] - paragraph [0033] * * claims 1-5 *	1, 4, 5, 11, 12	INV. D21H17/16 D21H17/17 D21H17/62 D21H19/38 D21H19/40 D21H19/44
X	EP 3 388 575 A1 (BILLERUDKORSNAES AB [SE]) 17 October 2018 (2018-10-17) * claims 1-15; figure 1 * * paragraphs [0008], [0012], [0016] *	1-3, 6-16	D21H19/52 D21H19/54 D21H19/60 D21H19/82 D21H21/16
A	EP 2 414 253 B2 (BILLERUDKORSNAES SKOG & IND AKTIEBOLAG [SE]) 13 March 2019 (2019-03-13) * claims 1-19 *	1-16	D21H21/52 D21H27/30 D21H27/36
A	Ridgway Cathy J ET AL: "Bulk density measurement and coating porosity calculation for coated paper samples Introduction", Nordic Pulp & Paper Research Journal, 18 January 2003 (2003-01-18), pages 1-21, XP093034739, Retrieved from the Internet: URL:https://www.omya.com/Documents/Publications/9%20Bulk%20Density%20Measurement%20and%20Coating%20Porosity.pdf [retrieved on 2023-03-24] * page 10; table 1 *	1-16	TECHNICAL FIELDS SEARCHED (IPC) D21H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 March 2023	Examiner Billet, Aina
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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