(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 299 832 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.08.2024 Bulletin 2024/32

(21) Application number: **22181454.4**

(22) Date of filing: **28.06.2022**

(51) International Patent Classification (IPC):
D21H 19/38 *(2006.01)* ***D21H 19/58*** *(2006.01)*
D21H 19/60 *(2006.01)* ***D21H 21/16*** *(2006.01)*
D21H 27/10 *(2006.01)* ***D21H 27/30*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D21H 19/385; D21H 19/58; D21H 19/60; D21H 21/16; D21H 27/10; D21H 27/30

(54) **SINGLE COATED PAPERBOARD**

EINZELN BESCHICHTETER KARTON

CARTON REVÊTU UNIQUE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
03.01.2024 Bulletin 2024/01

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of pigment-coated paperboard.

BACKGROUND

[0002] Pigment-coated paperboard is commonly provided with at least two coating layers, including a base coating and a top coating, in order to induce certain surface properties. The base coating is used to prime the surface while the top coating is used to adapt the surface properties to specific applications. A barrier coating might also be added.

[0003] For some applications such as liquid packaging board (LPB), the pigment-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. When the laminate is used, it is important that the PE layer adheres firmly to the pigment coating, i.e., that delamination is avoided.

[0004] EP3388575 A1 describes a coated paperboard comprising a base board having a top side provided with a pigment coating, which pigment coating comprises a pigment mixture, a binder and a rheology modifier. The pigment mixture comprises, by dry weight, 7-17 % of clay, 65-85 % of a first calcium carbonate pigment and 5-25 % of a second calcium carbonate pigment. The particle size distribution of the first calcium carbonate pigment is broader than the distribution of the second calcium carbonate pigment.

[0005] WO2010/114467 A1 describes a pigment coated paperboard adapted for sterilizable packages and comprising one or more layers, with a pigment coated top layer of bleached kraft pulp. The pigment coating comprises a pigment, a binder, and a rheology modifier, and the pigment comprises at least 50 wt.% calcium carbonate, the binder comprises an acrylic co-polymer, and the rheology modifier comprises an acrylic co-polymer.

SUMMARY

[0006] The present inventors have realized that there is a need to reduce the cost of paperboard manufacturing while maintaining other properties, such as PE-adhesion and surface roughness, at an acceptable level.

[0007] Accordingly, the present disclosure provides a coated paperboard comprising a paperboard substrate and a coating layer applied directly to a surface of a first side of the paperboard substrate, wherein:

- the coating layer comprises a polymeric binder and a calcium carbonate pigment in a dry weight ratio between 10:100 and 17:100;
- the polymeric binder and the calcium carbonate pigment amount to at least 85% of the dry weight of the coating layer;
- the particle size distribution (% < 2 μm) of said calcium carbonate pigment is between 50 and 70;
- the weight median particle size d_{50} of the calcium carbonate pigment is 1.1-1.7 μm;
- the polymeric binder is a styrene-butadiene copolymer or a styrene-acrylate copolymer; and
- the coating layer is the only pigment-based coating applied to the first side of the coated paperboard.

[0008] "Pigment-based coating" refers to a coating comprising at least 75% by dry weight of pigment.

[0009] The coating layer is present on one side of the paperboard substrate and is present as a single layer with no other pigment-based coating layers on said side. The paperboard according to the present disclosure has an improved PE-adhesion, which is advantageous since it prevents delamination during forming of packages from the paperboard.

[0010] The calcium carbonate pigments of the present disclosure are relatively large and give rise to a coated paperboard having lower surface roughness than what is obtained with single layer coatings comprising finer calcium carbonate pigments.

[0011] In one embodiment, the coating layer is the only pigment-based coating applied to any side of the coated paperboard.

[0012] In an embodiment, the coating layer is applied by dispersion coating and the coated paperboard comprises no other coating layer applied by dispersion coating on the same side of the paperboard as the coating layer.

[0013] In an embodiment, the calcium carbonate pigment is a ground calcium carbonate (GCC).

[0014] In a further embodiment, the coat weight of the coating layer is at least 10 g/m^2, preferably at least 12 g/m^2. A suitable upper limit for the coat weight is 18 g/m^2 or 20 g/m^2. In one embodiment, the coat weight of the coating layer is 12-16 g/m^2. The single coating layer can be applied in a coat weight similar to the coat weight of the base coating layer in conventional coated paperboards comprising at least two coating layers. Thus, as the coating layer is present as a single pigment-based coating layer, it is possible to reduce the total amount of coating used compared to conventional coating materials comprising at least two coating layers and thereby reduce the cost. Furthermore, production of a single-

coated product requires one coater and is hence less costly from an investment and operational perspective.

[0015] The grammage according to ISO 536:2019 of the paperboard substrate may for example be between 100 and 400 g/m^2, e.g. between 120 and 300 g/m^2, such as between 125 and 260 g/m^2.

[0016] In an embodiment, the coated paperboard is a liquid packaging board.

[0017] In a further embodiment, the paperboard substrate of the liquid packaging board comprises at least two, such as at least three layers and each layer comprises hydrophobic size. The hydrophobic size may be alkenyl succinic anhydride (ASA), alkyl ketene dimer (AKD) and/or rosin size, and each layer of the paperboard substrate may comprise at least 1.5 kg/tonne fibre of the hydrophobic size. Preferably, each layer comprises at least one of AKD and ASA.

[0018] The hydrophobic size is preferably added as internal sizing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig 1 shows surface properties of samples of coated paperboard produced in a pilot trial.

Fig 2 shows surface properties of samples of coated paperboard produced in a (full-scale) machine trial.

Fig 3 shows the PE-adhesion values of samples of coated paperboard produced in the (full-scale) machine trial.

DETAILED DESCRIPTION

[0020] The present disclosure relates to a coated paperboard comprising a paperboard substrate and a coating layer applied directly to a first surface of said paperboard substrate.

[0021] In one embodiment, the paperboard substrate comprises at least two layers, such as at least three layers wherein the top layer of the paperboard substrate is provided with the pigment coating. The top layer of the paperboard substrate is typically bleached. Each layer of the paperboard substrate may comprise hydrophobic size such as ASA, AKD and/or rosin size. The amount of added hydrophobic size may be 1.5 kg/tonne fibre.

[0022] The paperboard substrate may comprise other conventional additives such as fillers and colouring agents, however, it is not necessary.

[0023] The coating layer comprises a polymeric binder and a calcium carbonate pigment.

[0024] The polymeric binder is a styrene-butadiene copolymer or a styrene-acrylate copolymer. The styrene-acrylate copolymer is preferred, e.g. form an environmental perspective.

[0025] The calcium carbonate pigment has a particle size distribution (% < 2 μm) between 50 and 70. Here, "%" means percent by weight. Furthermore, the calcium carbonate pigment has a weight median particle size d_{50} of 1.1-1.7 μm, such as 1.2-1.6 μm. Particle size distribution values can be determined using a SediGraph 5100 or 5120 device from the company Micromeritics, USA.

[0026] Hence, the skilled person understands that "a particle size distribution (% < 2 μm) between 50 and 70" means that between 50 wt.% and 70 wt.% of the particles has an equivalent spherical diameter below 2 μm.

[0027] "% < 2 μm" is a cut-off value commonly used in the field to define the particle size of a pigment product. As an example, in the product name "Hydrocarb 60" (a calcium carbonate pigment quality from Omya), "60" represents the weight percentage of particles having a diameter below 2 μm. Similarly, in the product "Hydrocarb 90" (Omya), "90" represents the weight percentage of particles having a diameter below 2 μm.

[0028] Preferably, the calcium carbonate pigment is ground calcium carbonate (GCC).

[0029] The coating layer comprises the polymeric binder and the calcium carbonate pigment in a dry weight ratio between 10:100 and 17:100, preferably 12:100-17:100.

[0030] The polymeric binder and the calcium carbonate pigment, together, amount to at least 85% of the dry weight of the coating layer, preferably at least 90 % of the dry weight of the coating layer, more preferably at least 95% of the dry weight of the coating layer.

[0031] In one embodiment, the coating layer only comprises a binder, calcium carbonate pigment and optionally a rheology modifier, in dry form.

[0032] The coating layer is applied directly to a first surface of the paperboard substrate. Said surface is preferably the print side of the paperboard substrate. There is no additional pigment-based coating layer present between the paperboard substrate and the coating layer, hence no "base coating" layer is applied. The coating layer of the present disclosure is a single coating layer that serves the purposes of both a "base coating" layer and a "top coating" layer.

[0033] In one embodiment, the coating layer is the only pigment-based coating applied to any side of the coated paperboard.

[0034] It was surprisingly found that by applying the coating layer, as disclosed herein, as a single coating layer on a

paperboard substrate, an increase in PE-adhesion can be obtained.

[0035] Furthermore, it has unexpectedly been found that when the coating layer is used as a single coating layer as the present disclosure entails, calcium carbonate pigments of larger average particle size (50%-70% < 2 μm) give rise to a coated paperboard having lower Parker Print Surf (PPS) and Bendtsen roughness than what is obtained when using coatings comprising finer calcium carbonate pigments.

[0036] The coating layer may further comprise a rheology modifier (RM) such as acrylic copolymer emulsions, which may facilitate the application of said coating layer to the paperboard substrate. The amount of rheology modifier is typically 0.05-2 % such as 0.1 %-1% of the dry weight of the coating.

[0037] In a further embodiment, the coat weight of the coating layer is at least 10 g/m^2 (e.g. 10-20 g/m^2, such as 10-18 g/m^2), preferably at least 12 g/m^2 (e.g. 12-20 g/m^2, such as 12-18 g/m^2). The single coating layer can be applied in a coat weight similar to the coat weight of the base coating layer in conventional coated paperboards comprising at least two coating layers. Thus, as the coating layer is present as a single pigment-based coating layer, it is possible to reduce the total amount of coating used compared to conventional coating materials comprising at least two coating layers and thereby reduce the cost. Furthermore, production of a single-coated product requires one coater and is hence less costly from an investment and operational perspective.

[0038] The coating layer may be applied to the first surface of the paperboard substrate by dispersion coating, wherein the dispersion coating comprises a latex binder and a calcium carbonate pigment in an aqueous medium. The coating layer is preferably the only coating layer applied by dispersion coating on the first surface.

[0039] In an embodiment, the coated paperboard is a liquid packaging board.

EXAMPLES

Example 1

[0040] A pilot trial was performed by coating uncoated paperboard (LPB) substrates. The paperboard substrate had a grammage of ~220 g/m^2 and comprised three layers, wherein the top layer was bleached. All layers comprised hydrophobic size (AKD + rosin size).

[0041] Six different coating concepts were evaluated, see Table 1. The coatings were applied using a blade coater and air dryer. Three concepts had a double coating structure (concepts 1-3) and three concepts had a single coating structure (concepts 4-6), all the tested coatings comprised a polymeric binder and pigments. Concepts 1-5 are comparative and concept 6 is inventive.

[0042] A reference paperboard was prepared by coating the paperboard substrate with a base coating and a top coating, having a total coat weight of 20 g/m^2.

Table 1. Coating concepts used in the pilot trial. Concepts 1-5 are comparative and concept 6 is inventive.

	Ref.	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6
	Base coat	*Base coat*	*Base coat*	*Base coat*	-	-	-
HC 90 (parts)	80	80	80	-	-	-	-
CC 75 (parts)	-	-	-	-	-	-	-
HC60 (parts)	-	-	-	100	-	-	-
Clay (parts)	20	20	20	-	-	-	-
SA latex (parts)	14	14	14	14	-	-	-
RM (parts)	0.5	0.5	0.5	0.5	-	-	-
Viscosity (cP)	1400	1400	1400	1400	-	-	-
Dry content (wt %)	65	65	65	65	-	-	-
Coat weight (g/m^2)	8.5	8.5	8.5	8.5	-	-	-
	Top coat	*Top coat*	*Top coat*	*Top coat*	*Single coat*	*Single coat*	*Single coat*
HC 90 (parts)	70	80	80	80	80	20	-
CC75 (parts)	20	20	20	20	20	-	-
HC60 (parts)	-	-	-	-	-	50	100

(continued)

	Top coat	*Top coat*	*Top coat*	*Top coat*	*Single coat*	*Single coat*	*Single coat*
Clay (parts)	10	-	-	-	-	30	-
SA latex (parts)	17	17	17	17	17	18	14
RM (parts)	0.55	0.55	0.55	0.55	0.55	0.55	0.5
Viscosity (cP)	1300	1300	1300	1300	1300	1300	1400
Dry content (wt %)	63	63	63	63	63	63	65
Coat weight (g/m^2)	11.5	11.5	7	7	14	14	14
Total coat weight (g/m^2)	20	20	15.5	15.5	14	14	14

[0043] The used pigments were calcium carbonate and clay. The calcium carbonate pigments were Hydrocarb 90 ("HC 90") having a d_{50} of 0.7 μm, Covercarb 75 ("CC 75") having a d_{50} of 0.63 μm and Hydrocarb 60 ("HC 60") having a d_{50} of 1.4 μm and a particle size distribution (% < 2 μm) of 60. The calcium carbonate pigments were all from Omya. The clay pigment was a flaky clay pigment. The polymeric binder was a styrene-acrylate binder used as a latex (SA latex). The recipes for the different concepts are given in "parts", which means parts by weight.

[0044] The Parker Print Surf (PPS) roughness and the Bendtsen roughness were measured according to ISO 8791-4 and ISO 8791-2 respectively and the results can be-seen in Fig 1.

[0045] An increase in PPS and Bendtsen roughness was observed between the reference and concept 1. The difference between these concepts is that the top coating in concept 1 does not have clay but rather a higher amount of HC 90, which indicates that the incorporation of clay in a coating composition used in double coating structures reduces the PPS and Bendtsen roughness of the surface of a coating layer formed from the composition.

[0046] Reducing the coat weight of the top coating from 11.5 g/m^2 to 7 g/m^2 (concept 1 compared to concept 2) did not give rise to an effect in Bendtsen roughness but did give rise to a small increase in PPS.

[0047] Changing the base coating composition by increasing the amount of coarser particles and removing the clay (concept 3) did not significantly change the PPS nor the Bendtsen roughness.

[0048] As expected, the concepts having a single coating structure (concept 4-6) all had higher PPS and Bendtsen roughness compared to the concepts having a double coating structure (concepts 1-3 and reference). This may be due to the concepts 4-6 only having one coating layer in comparison to the reference and concepts 1-3 having two coating layers. In addition, the double coating concepts have higher coat weights (20 g/m^2 and 15.5 g/m^2) compared to the single coating concepts (14 g/m^2).

[0049] Interestingly, when comparing the single coating concepts to each other, a significantly lower surface roughness was observed for concept 6 compared to concept 4 and 5. Concepts 4 and 5 had calcium carbonate pigments of a smaller average particle size which, in theory, should give rise to a smoother surface. However, in contradiction to this, concept 6, having coarser particles, has a lower PPS and Bendtsen roughness.

[0050] In addition, in the case of a single coating structure, the inclusion of clay appears to give rise to an increase in PPS and Bendtsen roughness (see the slightly higher Bendtsen and PPS values for concept 5 compared to concept 4 and the significantly lower Bendtsen and PPS values for concept 6 compared to concept 5).

[0051] The single coating structures in this trial, thus, seem to behave differently compared to double coating structures in the trial; changes in the different compositions, such as altering the particle size of the pigments or incorporating clay, give rise to different effects.

Example 2

[0052] A machine trial was performed by coating uncoated paperboard (LPB) substrates. The paperboard substrate had a grammage of ~220 g/m^2 and comprised three layers wherein the top layer was bleached. All layers comprised hydrophobic size (AKD + rosin size).

[0053] Two different coating concepts (concepts 3 (comparative) and 6 (inventive) from the pilot trial/Example 1 were evaluated and compared with the reference coating concept from the pilot trial/Example 1. The coatings were applied using a blade coater and air dryer. As shown by Table 1, the reference and concept 3 had a double coating structure whereas concept 6 had a single coating structure.

[0054] The coatings were applied using a blade coater and air dryer.

[0055] The Parker Print Surf (PPS) roughness and the Bendtsen roughness were measured according to ISO 8791-4

and ISO 8791-2 respectively and the results can be seen in Fig 2.

[0056] As expected, concept 6 had a higher PPS and Bendtsen roughness than the reference and concept 3. As stated above, this could possibly be attributed to concept 6 only having a single coating layer and a lower coat weight.

[0057] The paperboards in the machine trial were laminated with a layer of polyethylene (PE) on the coated side and the PE-adhesion was tested according to ISO 6133. The results can be seen in Fig 3.

[0058] The PE-adhesion test showed significantly higher values for both concept 3 and concept 6 compared to the reference.

[0059] Surprisingly, it was found that concept 6, which had the single coating and coarser pigments, had superior PE-adhesion compared to the reference and concept 3. It appears as if the single coating combined with the use of calcium carbonate pigment with larger average particle size give rise to an improved PE-adhesion.

Claims

1. A coated paperboard comprising a paperboard substrate and a coating layer applied directly to a surface of a first side of the paperboard substrate, wherein:

   - the coating layer comprises a polymeric binder and a calcium carbonate pigment in a dry weight ratio between 10:100 and 17:100;
   - the polymeric binder and the calcium carbonate pigment amount to at least 85% of the dry weight of the coating layer;
   - the particle size distribution (% < 2 μm) of said calcium carbonate pigment is between 50 and 70;
   - the weight median particle size d_{50} of the calcium carbonate pigment is 1.1-1.7 μm;
   - the polymeric binder is a styrene-butadiene copolymer or a styrene-acrylate copolymer; and
   - the coating layer is the only pigment-based coating applied to the first side of the coated paperboard.

2. The coated paperboard of claim 1, wherein the coating layer is applied by dispersion coating and is the only coating layer applied to the first side of the coated paperboard by dispersion coating.

3. The coated paperboard of any one of previous claims, wherein the calcium carbonate pigment is ground calcium carbonate.

4. The coated paperboard of any one of the previous claims, wherein the coat weight of the coating layer is at least 10 g/m^2, preferably at least 12 g/m^2.

5. The coated paperboard of claim 4, wherein the coat weight of the coating layer is 10-20 g/m^2, such as 10-18 g/m^2.

6. The coated paperboard of claim 4, wherein the coat weight of the coating layer is 12-20 g/m^2, such as 12-18 g/m^2, such as 12-16 g/m^2.

7. The coated paperboard of any one of previous claims, which is a liquid packaging board (LPB).

8. The coated paperboard of claim 7, wherein the paperboard substrate comprises at least two, such as at least three, layers and each layer comprises hydrophobic size.

9. The coated paperboard of claim 8, wherein each layer of the paperboard substrate comprises at least 1.5 kg/tonne fibre of hydrophobic size.

10. The coated paperboard of claim 9, wherein the hydrophobic size is ASA, AKD and/or rosin size.

Patentansprüche

1. Beschichteter Karton, aufweisend ein Kartonsubstrat und eine Beschichtungsschicht, die direkt auf eine Oberfläche einer ersten Seite des Kartonsubstrats aufgebracht ist, wobei:

   - die Beschichtungsschicht ein polymeres Bindemittel und ein Calciumcarbonatpigment in einem Trockengewichtsverhältnis zwischen 10:100 und 17:100 aufweist;

- das polymere Bindemittel und das Calciumcarbonatpigment 85 % des Trockengewichts der Beschichtungsschicht ausmachen;
- die Partikelgrößenverteilung (% < 2 um) des Calciumcarbonatpigments zwischen 50 und 70 liegt;
- die gewichtsmittlere Partikelgröße d_{50} des Calciumcarbonatpigments 1,1-1,7 μm beträgt;
- das polymere Bindemittel ein Styrol-Butadien-Copolymer oder ein Styrol-Acrylat-Copolymer ist; und
- Die Beschichtungsschicht die einzige pigmentbasierte Beschichtung ist, die auf die erste Seite des beschichteten Kartons aufgebracht ist.

2. Beschichteter Karton nach Anspruch 1, wobei die Beschichtungsschicht durch Dispersionsbeschichtung aufgebracht ist, und die einzige Beschichtungsschicht ist, die durch Dispersionsbeschichtung auf die erste Seite des beschichteten Kartons aufgebracht ist.

3. Beschichteter Karton nach einem der vorhergehenden Ansprüche, wobei das Calciumcarbonatpigment gemahlenes Calciumcarbonat ist.

4. Beschichteter Karton nach einem der vorhergehenden Ansprüche, wobei das Beschichtungsgewicht der Beschichtungsschicht mindestens 10 g/m^2, vorzugsweise mindestens 12 g/m^2 beträgt.

5. Beschichteter Karton nach Anspruch 4, wobei das Beschichtungsgewicht der Beschichtungsschicht 10-20 g/m^2, beispielsweise 10-18 g/m^2, beträgt.

6. Beschichteter Karton nach Anspruch 4, wobei das Beschichtungsgewicht der Beschichtungsschicht 12-20 g/m^2, beispielsweise 12-18 g/m^2, beispielsweise 12-16 g/m^2, beträgt.

7. Beschichtete Karton nach einem der vorherigen Ansprüche, bei dem es sich um einen Flüssigkeitsverpackungskarton (LPB) handelt.

8. Beschichteter Karton nach Anspruch 7, wobei das Kartonsubstrat mindestens zwei, beispielsweise mindestens drei Schichten, aufweist und jede Schicht hydrophoben Leim aufweist.

9. Beschichteter Karton nach Anspruch 8, wobei jede Schicht des Kartonsubstrats mindestens 1,5 kg/Tonne Fasern mit hydrophoben Leim aufweist.

10. Beschichteter Karton nach Anspruch 9, wobei der hydrophobe Leim ASA, AKD und/oder Kolophoniumleim ist.

Revendications

1. Carton enduit comprenant un substrat en carton et une couche de revêtement appliquée directement sur la surface d'une première face du substrat en carton, dans lequel :

- la couche de revêtement comprend un liant polymère et un pigment de carbonate de calcium dans un rapport en poids sec compris entre 10:100 et 17:100 ;
- le liant polymère et le pigment de carbonate de calcium représentent au moins 85 % du poids sec de la couche de revêtement ;
- la distribution de la taille des particules (% < 2 μm) dudit pigment de carbonate de calcium est comprise entre 50 et 70 ;
- la taille médiane en poids du pigment de carbonate de calcium d_{50} est comprise entre 1,1 et 1,7 um ;
- le liant polymère est un copolymère de styrène et de butadiène ou un copolymère de styrène et d'acrylate ; et
- la couche de revêtement est le seul revêtement à base de pigments appliqué sur la première face du carton couché.

2. Carton enduit selon la revendication 1, dans lequel la couche de revêtement est appliquée par dispersion et est la seule couche de revêtement appliquée sur la première face du carton couché par dispersion.

3. Carton enduit selon l'une quelconque des revendications précédentes, dans lequel le pigment de carbonate de calcium est du carbonate de calcium broyé.

4. Carton enduit selon l'une quelconque des revendications précédentes, dans lequel le grammage de la couche de revêtement est d'au moins 10 g/m^2, de préférence d'au moins 12 g/m^2.

5. Carton enduit selon la revendication 4, dans lequel le grammage de la couche de couchage est compris entre 10 et 20 g/m^2, notamment compris entre 10 et 18 g/m^2.

6. Carton enduit selon la revendication 4, dans lequel le poids de la couche de revêtement est compris entre 12 et 20 g/m^2, par exemple compris entre 12 et 18 g/m^2, par exemple compris entre 12 et 16 g/m^2.

7. Carton enduit selon l'une quelconque des revendications précédentes, qui est un carton pour emballage de liquides (LPB).

8. Carton enduit de la revendication 7, dans lequel le substrat de carton comprend au moins deux, telles qu'au moins trois, couches et chaque couche comprend une taille hydrophobe.

9. Carton enduit selon la revendication 8, dans lequel chaque couche du substrat de carton comprend au moins 1,5 kg/tonne de fibres de taille hydrophobe.

10. Carton enduit selon la revendication 9, dans lequel le calibre hydrophobe est un calibre ASA, AKD et/ou colophane.

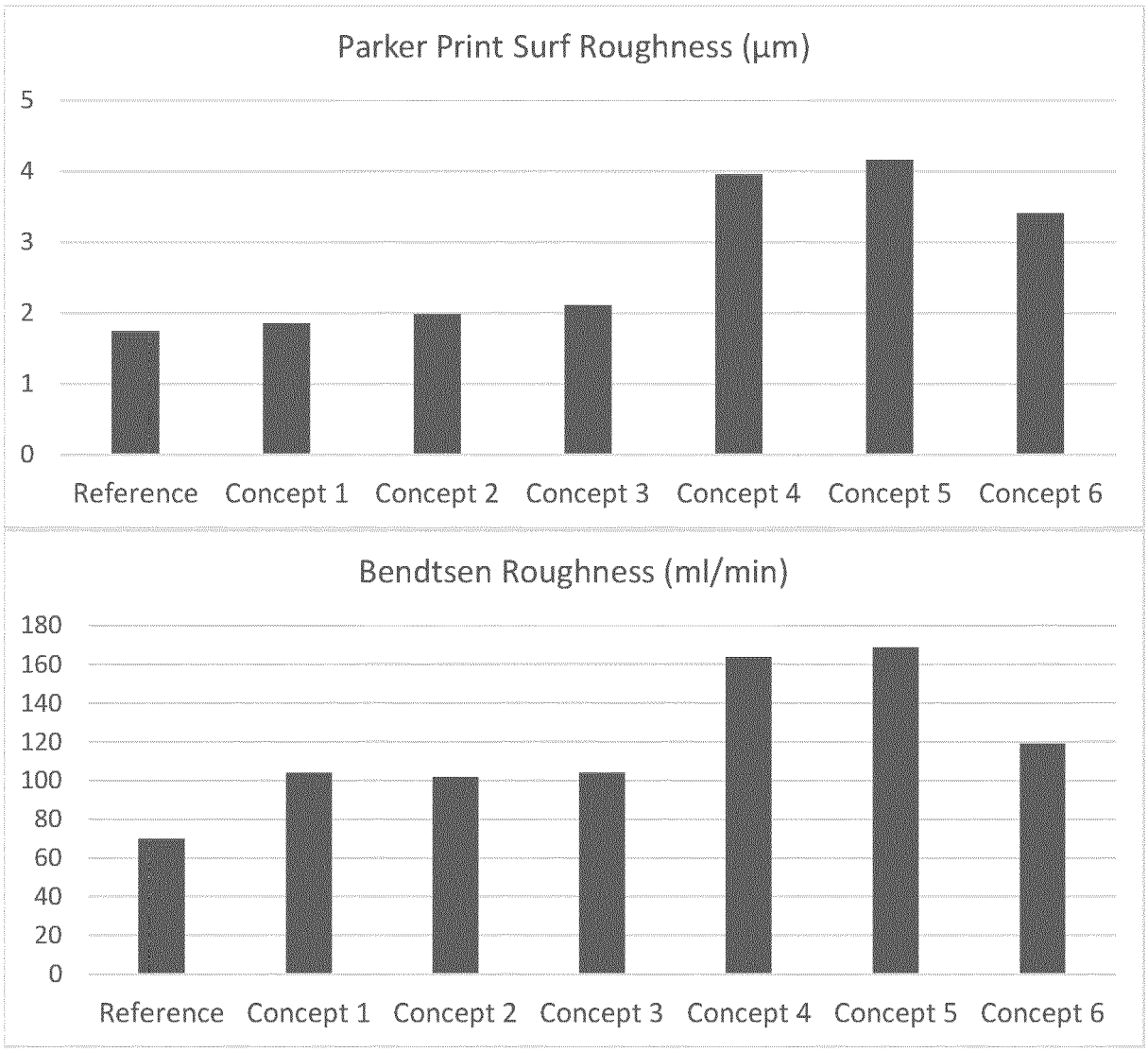
Parker Print Surf Roughness (µm)
5
4
3
2
1
0
Reference
Concept 1
Concept 2
Concept 3
Concept 4
Concept 5
Concept 6
Bendtsen Roughness (ml/min)
180
160
140
120
100
80
60
40
20
0
Reference
Concept 1
Concept 2
Concept 3
Concept 4
Concept 5
Concept 6

Fig. 1

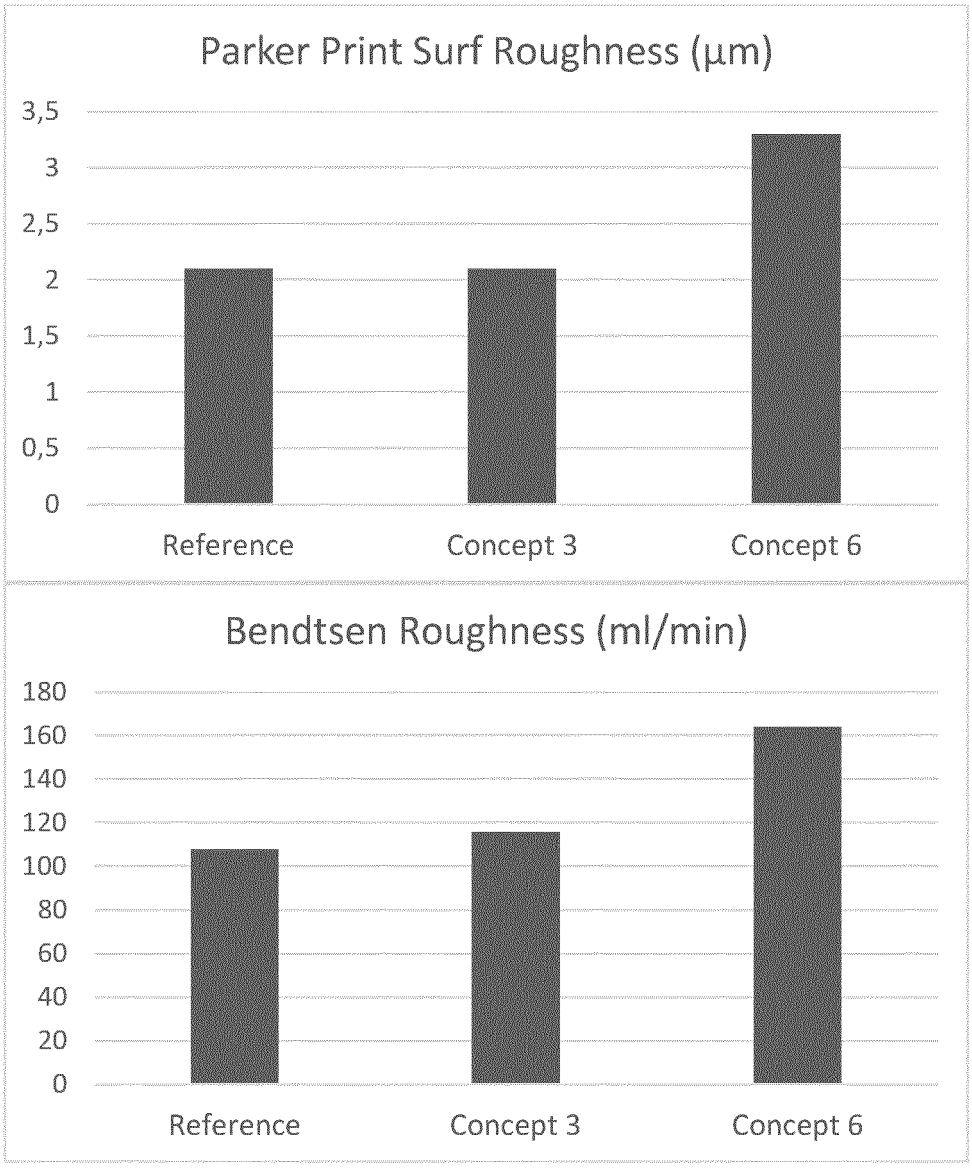
Parker Print Surf Roughness (µm)
3,5
3
2,5
2
1,5
1
0,5
0
Reference
Concept 3
Concept 6
Bendtsen Roughness (ml/min)
180
160
140
120
100
80
60
40
20
0
Reference
Concept 3
Concept 6

Fig. 2

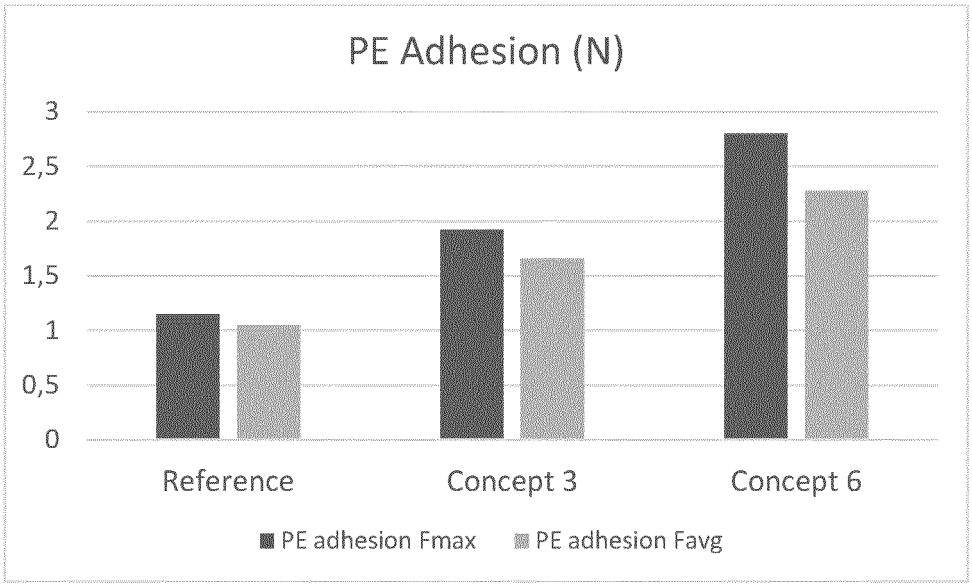
PE Adhesion (N)
3
2,5
2
1,5
1
0,5
0
Reference
Concept 3
Concept 6
PE adhesion Fmax
PE adhesion Favg

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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- WO 2010114467 A1 **[0005]**