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(54) **PIGMENT COATED BOARD**

(57) There is provided a coated paperboard material for use in packages adapted for shelf-life extending heat treatment, for example with steam as a heat medium, comprising a base board provided with a pigment coating to form a surface for printing, which pigment coating comprises a pigment mixture, at least one binder and a zirconium-based compound, wherein the pigment mixture comprises at least 40 wt. % calcium carbonate and at least 10 wt. % clay.

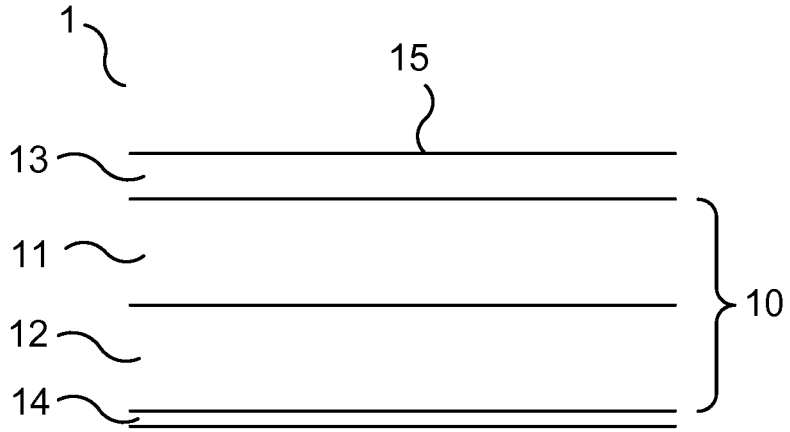

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Fig. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to coated paper materials for use in packages adapted for shelf-life extending heat treatment, e.g. with steam as a heat medium.

BACKGROUND

[0002] In the field of paper packaging, print quality is often a desired property. The printing surface of paper or paperboard may be improved by applying a pigment coating onto the surface to be printed. In addition to the pigment, such a pigment coating often comprises a binder. An alternative or complementary way of improving the printing surface is calendering.

[0003] In many fields, it is necessary to sterilize paper packages. One efficient sterilization method is heat sterilization with steam as a heat medium. The heat sterilization is often carried out under pressure such to reach temperatures above 100 °C. Such steam sterilization is sometimes referred to as retort.

[0004] Heat treatment at a temperature below 100 °C is sometimes referred to as pasteurization.

[0005] Pigment coatings are normally sensitive to sterilization with steam. For example, the coatings may absorb water during the harsh sterilization conditions.

[0006] WO 2010/114467 addresses the problem of providing producing pigment coated paperboard that can withstand steam sterilization. The suggested solution to the problem is a hydrophobized paperboard coated with a composition comprising calcium carbonate pigment, a binder and a rheology modifier.

SUMMARY

[0007] It has been noted that the print appearance after steam sterilization of printed and laminated paperboard according to WO 2010/114467 sometimes has been unsatisfactory.

[0008] Accordingly, it is an object of the present disclosure is to preserve the appearance of print on pigment-coated paperboard during steam sterilization.

[0009] Further, it has been noted that some pigment-coated and printed paperboard yellows, resulting in less appealing packages.

[0010] Accordingly, it is an object of some embodiments of the present disclosure to prevent yellowing of pigment-coated and printed paperboard.

[0011] The following itemized listing presents various embodiments of the present disclosure as well as their combinations.

1. A coated paperboard material for use in packages adapted for shelf-life extending heat treatment, e.g. with steam as a heat medium, comprising a base board having a top side provided with a pigment coating to form a surface for printing, which pigment coating comprises a pigment mixture, at least one binder and a zirconium-based compound, wherein the pigment mixture comprises at least 40 wt.% calcium carbonate and at least 10 wt.% clay, such as kaolin clay, such as delaminated kaolin clay.

2. The coated paperboard according to item 1, wherein the base board comprises at least two paper layers and wherein a top paper layer of the base board is provided with the pigment coating.

3. The coated paperboard according to item 2, wherein the top paper layer of the base board is bleached and optionally comprises titanium dioxide.

4. The coated paper of item 2 or 3, wherein the top layer is formed from Kraft pulp, such as bleached Kraft pulp.

5. The coated paperboard according to any one of items 2-4, wherein the base board comprises a bottom paper layer formed from unbleached pulp.

6. The coated paperboard according to any one of the previous items, wherein the grammage (ISO 536) of the base board is between 120 and 290 g/m^2, such as between 160 and 290 g/m^2, such as between 210 and 250 g/m^2.

7. The coated paperboard according to any one of the previous items, wherein the thickness (ISO 534) of the base board is between 230 and 390 μm, such as between 255 and 325 μm.

8. The coated paperboard according to any one of the previous items, wherein the density (ISO 534) of the base board is between 600 and 900 kg/m^3, such as between 650 and 850 kg/m^3, such as between 680 and 810 kg/m^3, such as between 700 and 780 kg/m^3.

9. The coated paperboard according to any one of the previous items having a grammage (ISO 536) between 150 and 300 g/m^2, such as between 200 and 300 g/m^2, such as between 220 and 270 g/m^2.

10. The coated paperboard according to any one of the previous items having a thickness (ISO 534) between 230 and 400 μm, such as between 255 and 325 μm.

11. The coated paperboard according to any one of the previous items having a density (ISO 534) between 700 and 950 kg/m^3, such as between 800 and 880 kg/m^3, such as between 820 and 860 kg/m^3.

12. The coated paperboard according to any one of the previous items, wherein the coat weight of the pigment coating on the top side is 5-30 g/m^2, such as 8-30 m^2, such as 10-30 m^2, such as 17-23 g/m^2.

13. The coated paperboard according to any one of the previous items, wherein a reverse side of the base board is provided with the pigment coating, which optionally lacks the zirconium-based compound.

14. The coated paperboard according to item 13, wherein the coat weight on the reverse side of the base board has a coat weight of 1-30 g/m^2, such as 1-9 g/m^2, such as 3-8 g/m^2.

15. The coated paperboard according to any one of the previous items, wherein the pigment mixture amounts to 75-95 %, such as 80-88 %, of the dry weight of the pigment coating.

16. The coated paperboard according to any one of the previous items, wherein the at least one binder amounts to 10-20 %, such as 12-18 %, of the dry weight of the pigment coating.

17. The coated paperboard according to any one of the previous items, wherein the zirconium-based compound amounts to 0.3-3 %, such as 0.6-1.5 %, such as 0.75-1.0 % of the dry weight of the pigment coating.

18. The coated paperboard material according to any one of the previous claims, wherein a pre-coating layer is provided between the top side of the base board and the pigment coating forming the surface for printing.

19. The coated paperboard according to any one of the previous items, wherein the pigment coating further comprises at least one rheology modifier.

20. The coated paperboard according to item 19, wherein the at least one rheology modifier amounts to 0.05-2.0 %, such as 0.1-1.0 %, of the dry weight of the pigment coating.

21. The coated paperboard according to item 19 or 20, wherein the at least one rheology modifier is CMC or an acrylic co-polymer, such as an alkali-swellable acrylate polymer.

22. The coated paperboard according to any one of the previous items, wherein the base board is hydrophobized from a sizing agent treatment, such as treatment with alkyl ketene dimer (AKD), alkenyl succinic anhydride (ASA) or a combination thereof.

23. The coated paperboard according to any one of the previous items, wherein the pigment mixture comprises layered silicate mineral, hydrated magnesium silicate, titanium dioxide or satin white.

24. The coated paperboard according to any one of the previous items, wherein the pigment mixture comprises at least 50 wt.% calcium carbonate and at least 15 wt.% clay.

25. The coated paperboard according to any one of the previous items, wherein the zirconium-based compound is a zirconium-based cross-linker, e.g. a zirconium carbonate, such as ammonium zirconium carbonate or potassium zirconium carbonate.

26. The coated paperboard according to any one of the previous items, wherein the at least one binder is/are selected

from the group consisting of co-polymers, acrylic resins, polyvinyl acetate, polyvinyl alcohol, proteins, and polysaccharides, such as starches.

27. The coated paperboard according to item 26, wherein the at least one binder is/are selected from synthetic co-polymers, such as acrylic co-polymers, styrene-butadiene co-polymers and methyl methacrylate-butadiene co-polymers.

28. The coated paperboard according to item 27, wherein the at least one binder is a styrene/acrylate co-polymer.

29. The coated paperboard according to any one of the previous items, wherein the base board comprises 2, 3 or 4 paper layers.

30. The coated paperboard according to any one of the previous items, wherein the surface for printing is printed.

31. A method of producing a coated paperboard, comprising applying a pigment coating composition on a top side of a base board, which top side is optionally coated with a pre-coating, characterized in that the pigment coating composition comprises the components defined in anyone of items 1-30.

32. A package comprising the coated paperboard according to any one of items 1-30, wherein the package is a tray, a pod or a capsule.

33. A package according to claim 32, characterized in that it is adapted for pre- or post printing in for example flexography, offset and lithography.

34. Use of a coated paperboard according to any one of claims 1-30 for producing a package adapted for sterilization.

35. Use of a coated paperboard according to any one of claims 1-30 for producing a package adapted for co-sterilization of the package and its contents.

36. Use according to claim 34 or 35, wherein the sterilization is carried our using steam as the heating medium.

37. Use of a coated paperboard according to any one of claims 1-30 for producing a package adapted for shelf-life extending heat treatment with steam as a heat medium.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Fig 1 shows a coated paperboard according to two embodiments of the present disclosure comprising a base paper and coatings.

DETAILED DESCRIPTION

[0013] The present disclosure provides a coated paperboard material for use in packages adapted for shelf-life extending heat treatment. The heat treatment is preferably carried out with steam as a heat medium, but other heat mediums, such as hot air or hot water are also possible. Examples such shelf-life extending heat treatments with steam as a heat medium are retort and steam autoclave treatments. Thus, the treatment is normally carried out at an overpressure and a temperature above 100 °C, such as above 110 or 121 °C, such as 121-140 °C. Examples of packages adapted for shelf-life extending heat treatment with steam as a heat medium are those marketed under the name Tetra Recart.

[0014] During the above-mentioned retort or steam autoclave treatments, water may be sprayed onto the package. Accordingly, both steam and water may be applied in the shelf-life extending heat treatment.

[0015] In another embodiment, the shelf-life extending heat treatment comprises filling a package with a product having a temperature of at least 80 °C, but below 100 °C. The package is then closed and sealed. Finally, the filled and sealed package is kept at a temperature of at least 80 °C, but below 100 °C for a predetermined period, such as 1-30 min, by contact with a heat medium, such as steam or a hot gas, such as hot air.

[0016] The heat treatment may for example co-sterilize the package and package content, such a foodstuff.

[0017] The coated paperboard of the first aspect comprises a base board. The baseboard is a paperboard. The base board has a top side provided with a pigment coating forming a surface for printing. As discussed below, a pre-coating layer may be provided between the top side of the base board and the pigment coating forming the surface for printing.

In any case, the coated paperboard is adapted for printing, such as printing by flexography, offset and lithography. Accordingly, in one the surface for printing may be printed.

[0018] Further, the printed side may be covered by a barrier coating, such as a plastic coating. Such a plastic coating may for example comprise polyethylene, polypropylene or polyester.

[0019] The base board may for example comprise at least two paper layers, such as two, three, four or five layers. In such case, the top paper layer of the base board is provided with the pigment coating. In one embodiment, the top paper layer of the base board is bleached. It may also comprise titanium dioxide for additional whitening. The bleached board is preferably formed from bleached Kraft pulp, such as a mixture of bleached hardwood sulphate pulp and bleached softwood sulphate pulp. In an alternative embodiment, the top layer may however be unbleached and obtained from, for example, unbleached Kraft pulp.

[0020] In an alternative embodiment, the base board is solid, which means that it is composed of only one paper layer.

[0021] As the reverse side of the coated paperboard is normally not printed, the bottom layer may be formed from unbleached pulp. However, the bottom layer may also be bleached. In a package, the reverse side normally faces the inside of the package.

[0022] The base board may be hydrophobized from a sizing agent treatment, such as treatment with alkyl ketene dimer (AKD), alkenyl succinic anhydride (ASA) or a combination thereof. If the base board comprises more than one layer, each layer may be hydrophobized from the sizing agent treatment.

[0023] The base board may for example have the following characteristics: grammage (ISO 536) between 120 and 290 g/m^2, such as between 210 and 250 g/m^2;
thickness (ISO 534) between 230 and 390 μm, such as between 255 and 325 μm; and/or
density (ISO 534) between 600 and 900 kg/m^3, such as between 650 and 850 kg/m^3, such as between 680 and 810 kg/m^3, preferably between 700 and 780 kg/m^3.

[0024] The pigment coating of the present disclosure may also be used in a material intended for pouches. Such a material typically is typically thinner and more flexible than the material intended for Tetra Recart. Accordingly, the base board may also have the following characteristics:

grammage (ISO 536) between 50 and 120 g/m^2, such as between 55 and 90 g/m^2, such as between 65 and 80 g/m^2.
thickness (ISO 534) between 80 and 125 μm, such as between 85 and 120 μm; and/or
density (ISO 534) between 600 and 770 kg/m^3, such as between 630 and 740 kg/m^3.

[0025] This thinner base board typically consists of one or two layers. Further, at least one of the layers of the thinner base board is preferably formed from bleached pulp, such as bleached Kraft pulp.

[0026] In one embodiment, the base board of the present disclosure comprises at least one paper layer that is formed from a paper material having a stretchability (ISO 1924/3) of at least 5 % in both the machine direction (MD) and the cross direction (CD), such as at least 7 % in both the machine direction (MD) and the cross direction (CD). For example, all paper layers of the base board may be formed from such a stretchable paper material. The stretchability enables packages of more complex shapes.

[0027] The pigment coating of the first aspect comprises:

a pigment mixture;
at least one binder; and
a zirconium-based compound.

[0028] The pigment mixture comprises calcium carbonate and clay. The clay may be kaolin clay, such as delaminated kaolin clay. Calcium carbonate amounts to at least 40 %, preferably at least 50 %, such as at least 60 %, of the dry weight of the pigment mixture. Clay amounts to at least 10 %, preferably at least 15 %, of the dry weight of the weight of the pigment mixture.

[0029] Clay and calcium carbonate together preferably amounts to at least 80 %, such as at least 90 %, of the dry weight of the pigment mixture.

[0030] The pigment mixture may for example amount to 75-95 %, such as 80-88 %, of the dry weight of the pigment coating. The at least one binder may for example amount to 10-20 %, such as 12-18 %, of the dry weight of the pigment coating. The zirconium-based compound may for example amount to 0.3-3 %, such as 0.6-1.5 %, such as 0.75-1.0 %, of the dry weight of the pigment coating.

[0031] The presence of zirconium in a coating layer may for example be detected using X-ray Photoelectron Spectroscopy (XPS).

[0032] The presence of the zirconium-based compound in the pigment coating is particularly important when the pigment coating layer is to be printed and the resulting coated and printed paperboard is for use in a package that is heat treated with steam as the heat medium, in particular when the steam condenses on the package during the heat

treatment.

[0033] The pigment mixture may consist of calcium carbonate and clay only. However, the pigment mixture can also, in addition to calcium carbonate and clay, comprise layered silicate mineral, hydrated magnesium silicate, titanium dioxide or satin white.

[0034] The at least one binder is/are for example selected from the group consisting of co-polymers, acrylic resins, polyvinyl acetate, polyvinyl alcohol, proteins, and polysaccharides, such as starches. Preferably, the at least one binder is/are selected from synthetic co-polymers, such as acrylic co-polymers, styrene-butadiene co-polymers and methyl methacrylate-butadiene co-polymers. Most preferably, the at least one binder is a styrene/acrylate co-polymer. When the pigment coating composition is prepared, such a binder is added in the form of styrene/acrylate latex.

[0035] The zirconium-based compound may for instance be a zirconium-based cross-linker, e.g. a zirconium carbonate, such as ammonium zirconium carbonate or potassium zirconium carbonate.

[0036] In embodiments of the first aspect, the pigment coating may further comprise at least one rheology modifier. The purpose of such an addition would be to adjust the viscosity of the pigment coating composition. If added, the at least one rheology modifier may for example amount to 0.05-2.0 %, such as 0.1-1.0 %, of the dry weight of the pigment coating.

[0037] The at least one rheology modifier may for example be CMC and/or an acrylic polymer, such as an alkali-swellable acrylate polymer or an hydrophobically modified alkali-swellable acrylate polymer. If the rheology modifier is CMC, it typically amounts to 0.5-2 % of the dry weight of the pigment composition. If the rheology modifier is an acrylic polymer, it typically amounts to 0.05-0.5 % of the dry weight of the pigment composition. Other examples of rheology modifiers are starch and polyvinyl alcohol. One or more pre-coating layers may be provided between the top side of the base board and pigment coating forming the printing surface. It is not necessary that such a pre-coating layer includes the zirconium-based cross-linker and the above-mentioned pigment mixture.

[0038] A pre-coating layer preferably comprises:

a) a pigment or a pigment mixture, such as a mixture of 40-90 wt.% calcium carbonate and 10-60 wt.% clay;
b) at least one binder, such as any one of the binders discussed above, preferably a styrene/acrylate co-polymer;
c) optionally the zirconium-based compound; and
d) optionally at least one rheology modifier, such as any one of the rheology modifiers discussed above, preferably an acrylic polymer.

[0039] The pigment or pigment mixture may for example amount to 75-95 %, such as 80-88 %, of the dry weight of the pre-coating layer. The at least one binder may for example amount to 10-20 %, such as 12-18 %, of the dry weight of the pre-coating layer. When included, the zirconium-based compound may for example amount to 0.3-3 %, such as 0.6-1.5 %, such as 0.75-1.0 %, of the dry weight of the pre-coating layer. When included, the at least one rheology modifier may for example amount to 0.05-2.0 %, such as 0.1-1.0 %, of the dry weight of the pre-coating layer.

[0040] The coat weight of the pigment coating forming the surface for printing may for example be 5-30 g/m^2, such as 8-30 m^2, such as 10-30 m^2, such as 17-23 g/m^2.

[0041] If a pre-coating layer is provided, the coat weight of the pigment coating forming the printing surface is preferably 5-15 g/m^2. In such case, the coat weight of the pre-coating layer is preferably 5-15 g/m^2.

[0042] The reverse side of the base board may also be provided with a coating. The reverse side coating may have the same composition as the above-mention pigment coating, which comprises the pigment mixture, the binder, the zirconium-based compound and optionally the rheology modifier. However, as the reverse side is normally not printed, it may also be a coating lacking the zirconium-based compound. Accordingly, in one embodiment the reverse side coating may comprise the pigment mixture, the binder and optionally the rheology modifier, but no zirconium-based compound. In one embodiment, the reverse side coating has the same composition as the pre-coating layer. The coat weight of the coating on the reverse side may for example be of 1-30 g/m^2, such as 1-9 g/m^2, such as 3-8 g/m^2.

[0043] When base board is coated, the grammage increases. Accordingly, the coated paperboard of the first aspect may for example have a grammage (ISO 536) of 150-320 g/m^2, such as 200-300 g/m^2, such as 220-270 g/m^2. Further, the coated paperboard may have a thickness (ISO 534) of 200-400 μm, 230-400 μm, such as 255-325 μm and/or a density (ISO 534) of 700-950 kg/m^3, such as 800-880 kg/m^3, such as 820-860 kg/m^3.

[0044] As a second aspect of the present disclosure, there is provided a method of producing a coated paperboard, comprising applying a pigment coating composition on a top side of a base board. The pigment coating composition of the second aspect is preferably water-based and comprises a pigment mixture, at least one binder, a zirconium-based compound and optionally a rheology modifier. The components of the coating composition are discussed and exemplified above in connection with the first aspect. Accordingly, the embodiments of the first aspect apply *mutatis mutandis* to the second aspect. The viscosity of the pigment coating composition is preferably 200-2000 mPa*s, such as 270-1800 mPa*s, measured at 23°C with a rheometer, such as the Paar Physica UDS 200 in cup-bob C25 geometry at 25S-1 constant shea. The pigment coating composition may be applied directly on the top side of the base board. Alternatively,

the pigment coating composition is applied on top of a previously applied coating layer, which may lack the zirconium-based compound, as discussed above. The method of the second aspect may further comprise the step of applying a coating on a reverse side of the base board. Such a reverse side coating may also lack the zirconium-based compound, as discussed above.

[0045] As a third aspect of the present disclosure, there is provided a package comprising the coated paperboard according to any one of items 1-30.

[0046] The package of the third aspect may for example be a tray, a pod or a capsule. In such a package, the base board may comprise at least one layer of a paper material that is stretchable by at least 5 %, such as at least 7 %, in the machine direction (MD) and by at least 5 %, such as at least 7 %, in the cross direction (CD). In one embodiment, the base board of such a package is a laminate wherein all paper layers are formed from paper material that is stretchable by at least 5 %, such as at least 7 %, in the machine direction (MD) and by at least 5 %, such as at least 7 %, in the cross direction (CD). The stretchability is measured according to ISO 1924/3.

[0047] The package of the third aspect may for example be adapted for pre- or post printing, e.g. in flexography, offset and lithography.

[0048] As a first configuration of a fourth aspect of the present disclosure, there is provided a use of a coated paperboard according to the first aspect for producing a package adapted for sterilization.

[0049] As a second configuration of the fourth aspect of the present disclosure, there is provided a use of a coated paperboard according to the first aspect for producing a package adapted for co-sterilization of the package and its contents.

[0050] In the first and second configuration of the fourth aspect, the sterilization or co-sterilization is preferably carried our using steam as the heating medium.

[0051] As a third configuration of the fourth aspect of the present disclosure, there is provided a use of a coated paperboard according to the first aspect for producing a package adapted for shelf-life extending heat treatment, e.g. with steam as a heat medium.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0052] Figure 1a shows a non-limiting embodiment of a coated paperboard 1 according to the present disclosure. The coated paperboard 1 comprises a base board 10 composed of a top layer 11 and a bottom layer 12. The top layer 11 is made from bleached Kraft pulp. The bottom layer 12 is made from unbleached pulp. A top side of the base board 10 is provided with a top pigment coating layer 13 comprising a pigment mixture of $CaCO_3$ and clay, a styrene/acrylate co-polymer acting as a binder, an acrylic rheology modifier (thickener) and ammonium zirconium carbonate acting as a cross-linking agent. A bottom side of the base board 10 is provided with a bottom pigment coating layer 14, which also comprises the pigment mixture, the binder and the thickener, but lacks cross-linking agent. The top pigment coating layer 13 is adapted to maintain the quality of a print on its top surface 15 during retort.

[0053] Figure 1b shows another non-limiting embodiment of a coated paperboard 2 according to the present disclosure. The coated paperboard 2 comprises a base board 20 composed of a top layer 21 and a bottom layer 22. The top layer 21 is made from bleached Kraft pulp. The bottom layer 22 is made from of unbleached pulp. A top side of the base board 20 is provided with a top pigment coating layer 23, which comprises two sub-layers; a pre-coating layer 23a and a top layer 23b. The top layer 23b comprises a pigment mixture of $CaCO_3$ and clay, a styrene/acrylate co-polymer acting as a binder, an acrylic rheology modifier (thickener) and ammonium zirconium carbonate acting as a cross-linking agent. The base layer 23a comprises the pigment mixture, the binder and the thickener, but lacks cross-linking agent. A bottom side of the base board 20 is provided with a bottom pigment coating layer 24, which comprises the same components as the base layer 23a. The top layer 23b is adapted to maintain the quality of a print on its top surface 25 during retort.

EXAMPLES

[0054] In the examples, paperboard of the following characteristics was used:

Number of layers	2
Grammage (ISO 536)	225-245 g/m^2
Thickness (ISO 534)	290-320 μm
Density (ISO 534)	740-800 kg/m^3

[0055] The top layer was formed from a mixture of bleached hardwood sulphate pulp and bleached softwood sulphate pulp and the bottom layer was formed from a mixture of unbleached softwood sulphate pulp and pulped broke. The fibers of the pulps were mechanically treated with high consistency-refining (HC-refining) and/or low consistency-refining

(LC-refining). The board was internally sized with AKD. Other paper chemicals used in board production was TiO_2, alum, bicarbonate, starch and BMA.

Pilot coating trials

[0056] The pilot coating trials were carried out in a pilot coating machine and the uncoated base board used was commercial uncoated board with the above characteristics intended for packages for heat sterilisation. In the pilot coating machine, the base board was pigment coated in two layers, 10 g/m^2 (pre-coating layer) + 10 g/m^2 (top coating layer for printing), on the print/top side and also pigment coated in one layer, 5-8 g/m^2, on the reverse side. The various pigment coating compositions comprised a pigment mixture, a binder and a thickener/rheology modifier. The pigment mixture amounted to 85-87 % of the dry weight of the coating composition. The binder amounted to 12-14 % of the dry weight of the coating composition. In some of the pilot trials, the coating composition applied to the top/printing side further comprised an additive. In one case, only the top layer of the two pigment coating layers applied to the top/printing side of the board comprised the additive. When added, the additive amounted to 0.8-0.9 % of the dry weight of the coating composition.

[0057] When included, the additive was either polyvinyl alcohol (PvOH) or ammonium zirconium carbonate (AZC). The specific PvOH product was Kuraray Poval 6-98 also known as Mowiol 6/98 from Kuraray Europe Nordic AB Oy and the specific AZC product was Zirlink from Brenntag Nordic AB. Although the trials in this case were performed with the ammonium zirconium carbonate product Zirlink, other chemistries based on the zirconium metal ion could have been used instead. Such other chemistries include, i.a., potassium zirconium carbonate products.

[0058] The pigment mixture in the trials comprised 5-40 wt.% delaminated kaolin clay ("Clay") and 60-95 wt.% calcium carbonate ("$CaCO_3$")

[0059] The binder was either styrene-butadiene copolymer ("SB") provided as styrene-butadiene latex (Styron SB 94378) when the coating composition was prepared or styrene/acrylate co-polymer (SA) provided as styrene/acrylate latex (Styron SA 95085.01) when the composition was prepared. The thickener was either an acrylate polymer (Coatex Rheocoat™ 66, "ASE") provided as an alkali swellable acrylate polymer emulsion when the coating composition was prepared or carboxy methylated cellulose (Finnfix 10 from CP Kelco Oy, "CMC"). When the acrylic thickener was added, it amounted to 0.2 % of the dry weight of the coating composition. When CMC was added, it amounted to 0.8-0.9 % of the dry weight of the coating composition.

[0060] Samples of the pigment coated paperboard from three pilot coating trials ("Pilot 1", "Pilot 2" and "Pilot 3") were provided and tested as described below.

Full scale trials

[0061] The full scale trials were carried out on a two layer paper machine with one bleached top layer and one unbleached bottom layer according to the characteristics above.

[0062] The base board was pigment coated on both sides in a coating section of the paper machine. A pre-coating layer (10 g/m^2) and a top coating layer (10 g/m^2) were applied to the print/top side and one layer of a lower coat weight (5-8 g/m^2) was provided on the reverse side. The pigment coating compositions comprised the pigment mixture, the binder and one of the thickeners described above in connection with the pilot trials. The pigment mixture amounted to 85-86 % of the dry weight of the coating compositions. The binder amounted to 13-14 % of the dry weight of the coating compositions. When the acrylic thickener was added, it amounted to 0.2 % of the dry weight of the coating composition. When CMC was added, it amounted to 0.9 % of the dry weight of the coating composition.

[0063] In five out of six full scale trials, the top coating composition further comprised the additive AZC in an amount corresponding to 0.9 % of the dry weight of the coating composition.

[0064] Samples of the pigment coated paperboard from six full scale trials ("F sc 1" - "F sc 6") were provided and tested as described below.

Testing

[0065] The yellowing of the above samples of pigment coated paperboard was analysed by measuring the optical property b* according to SS-ISO 5631-2 after the samples had been heat treated at 150 °C in an oven for one hour. A b* value below 6 was considered acceptable.

[0066] Samples were also printed and print quality before lamination and retort was evaluated by visual inspection. The print quality before lamination was determined in accordance with the Tetra Pak global standard criteria for print quality evaluation in all packaging material production, including parameters such as dot gain, colour density etc.

[0067] Finally, sample material was laminated and packages were prepared and retorted. In detail, the coated and printed paperboard was laminated to an aluminium foil of 9 μm thickness by melt extrusion lamination with an interjacent

layer of polypropylene. The surface weight of the interjacent layer was about 25 g/m^2. The paperboard was further laminated by melt extrusion coating with an outer, heat-resistant and transparent layer of a polypropylene polymer layer on the printed side, and further with an outer, heat-resistant and transparent layer of a polypropylene polymer layer on the other side (the package inside) of the aluminium foil. The polypropylene layer on the inside was applied by co-extrusion coating onto the aluminium foil, together with an interjacent, about 4 g/m^2 thick, layer of an adhesive polymer, or a socalled "tie" layer of a polyolefin-based polymer having maleic anhydride functional binding groups. The outer, heat-resistant and transparent layer of polypropylene polymer on the printed side, was applied by means of extrusion coating at an average temperature of 275 °C at a web speed of about 300-400 m/ min, and at a surface weight of about 30 g/m^2. The outer layer of polypropylene applied on the other side, the inside, of the packaging material was applied at a surface weight of about 35 g/m^2.

[0068] Packaging containers were formed from the laminated packaging material, thermo-sealed, filled with water and sealed as described above. The packaging containers were then subjected to maximal severe retort treatment at an over-pressure of up to 4 bar with a total process time of up to about 2 hours. Steam and a steam-water mixture were used for heating the packages during the retort cycle, and water was used for cooling the packages.

[0069] Delamination of ink in retorted packages was evaluated by visual inspection according to the following:

> Out of 1000 packages, a maximum of 16 % are allowed to have defects in the printed decor layer (decorative artwork) that can be described in the following general manner: Faintly visible to clearly visible, i.e. having defects of size up to around 4 mm long and 2 mm wide.

[0070] Out of 1000 packages, 0 % are allowed to have defects that can be described in the following general manner: Clearly visible, i.e. having a size around 4-5 mm long and 4 mm wide. Non-allowable defects will thus lead to a judgement of the quality being "not acceptable".

[0071] It is believed that cohesive breakages within the printed decor layer, are resulting in visual contrast differences at stressed locations of the packaging material, such that these defects are seen on the packages after lamination and retort treatment.

[0072] The results are shown in the tables below.

Table 1

	Trial	Pigment mixt. pre-coating		Pigment mixt. top coating		Binder	Thickener	Additive
		Cla y (%)	$CaCO_3$ (%)	Clay (%)	$CaCO_3$ (%)			
1	Pilot 1	5	95	5	95	SA	ASE	-
2	Pilot 1	30	70	50	50	SB	CMC	-
3	Pilot 1	30	70	50	50	SA	ASE	-
4	Pilot 1	10	90	10	90	SA	ASE	-
5	Pilot 1	10	90	10	90	SA	ASE	-
6	Pilot 1	10	90	20	80	SA	ASE	-
7	Pilot 1	10	90	50	50	SA	ASE	-
8	Pilot 1	10	90	10	90	SA	ASE	-
9	Pilot 2	5	95	5	95	SB	CMC	-
10	Pilot 2	30	70	50	50	SA	ASE	AZC
11	Pilot 2	30	70	50	50	SA	ASE	PvOH
12	Pilot 2	5	95	5	95	SB	ASE	-
13	Pilot 2	30	70	50	50	SA	CMC	PvOH
14	Pilot 3	30	70	15	85	SA	ASE	AZC
15	Pilot 3	30	70	5	95	SA	ASE	AZC
16	Pilot 3	30	70	15	85	SA	ASE	AZC in top coat
17	Pilot 3	30	70	50	50	SA	CMC	AZC
18	F sc 1	30	70	50	50	SA	CMC	-

(continued)

	Trial	Pigment mixt. pre-coating		Pigment mixt. top coating		Binder	Thickener	Additive
		Cla y (%)	$CaCO_3$ (%)	Clay (%)	$CaCO_3$ (%)			
19	F sc 2	30	70	50	50	SA	ASE	AZC
20	F sc 3	30	70	5	95	SA	ASE	AZC
21	F sc 4	30	70	50	50	SA	ASE	AZC
22	F sc 5	30	70	15	85	SA	ASE	AZC
23	F sc 6	30	70	25	75	SA	ASE	AZC

Table 2

	Trial	Yellowing after heat treatment	Delamination of ink in retorted packages	Print quality before lamination and retort
1	Pilot 1	Accept.	Not accept.	N/A
2	Pilot 1	Significant	Accept.	N/A
3	Pilot 1	Accept.	Not accept.	N/A
4	Pilot 1	Accept.	Not accept.	N/A
5	Pilot 1	Accept.	Not accept.	N/A
6	Pilot 1	Accept.	Not accept.	N/A
7	Pilot 1	Accept.	Not accept.	N/A
8	Pilot 1	Accept.	Not accept.	N/A
9	Pilot 2	Significant	Accept.	Not accept.
10	Pilot 2	Accept.	Accept.	Accept.
11	Pilot 2	Accept.	Not accept.	Not accept.
12	Pilot 2	Significant	Accept.	Not accept.
13	Pilot 2	Accept.	Accept.	Not accept.
14	Pilot 3	Accept.	Accept.	N/A
15	Pilot 3	Accept.	Accept.	N/A
16	Pilot 3	Accept.	Accept.	N/A
17	Pilot 3	Accept.	Accept.	N/A
18	F sc 1	Accept.	Not accept.	N/A
19	F sc 2	Accept.	Accept.	Accept.
20	F sc 3	Accept.	Not accept.	Accept.
21	F sc 4	Accept.	Accept.	Accept.
22	F sc 5	Accept.	Accept.	Accept.
23	F sc 6	Accept.	Accept.	Accept.

[0073] As can be seen in the tables above, both "print quality before lamination and retort" and "delamination of ink after retort" were acceptable when AZC was added in the top side coating, provided that the amount of clay in the pigment mixture was higher 5 %. Here, acceptable delamination refers to insignificant delamination. In addition, no significant yellowing was obtained after heat treatment of samples having AZC added in the coating. However, the lack of AZC resulted in unacceptable print quality before retort, unacceptable ink-delamination after retort and/or significant yellowing after heat treatment. Successful results were obtained with both types of rheology modifiers ("ASE" and "CMC"). However,

the acrylic rheology modifier is generally considered to be preferred as CMC sometimes causes more yellowing. Further, CMC has been associated with more ink-delamination than the acrylic rheology modifier in one experiment.

Claims

1. A coated paperboard material for use in packages adapted for shelf-life extending heat treatment, for example with steam as a heat medium, comprising a base board having a top side provided with a pigment coating to form a surface for printing, which pigment coating comprises a pigment mixture, at least one binder and a zirconium-based compound, wherein the pigment mixture comprises at least 40 wt.% calcium carbonate and at least 10 wt.% clay.

2. The coated paperboard according to claim 1, wherein the coat weight of the pigment coating on the top side is 5-30 g/m^2, such as 8-30 m^2, such as 10-30 m^2, such as 17-23 g/m^2.

3. The coated paperboard according to any one of the previous claims, wherein a reverse side of the base board is provided with a pigment coating, which optionally lacks the zirconium-based compound.

4. The coated paperboard according to any one of the previous claims, wherein the pigment mixture amounts to 75-95 %, such as 80-88 %, of the dry weight of the pigment coating.

5. The coated paperboard according to any one of the previous claims, wherein the at least one binder amounts to 10-20 %, such as 12-18 %, of the dry weight of the pigment coating.

6. The coated paperboard material according to any one of the previous claims, wherein a pre-coating layer comprising pigment and a binder is provided between the top side of the base board and the pigment coating forming the surface for printing.

7. The coated paperboard according to any one of the previous claims, wherein the pigment coating further comprises at least one rheology modifier.

8. The coated paperboard according to any one of the previous claims, wherein the base board is hydrophobized from a sizing agent treatment, such as treatment with alkyl ketene dimer (AKD), alkenyl succinic anhydride (ASA) or a combination thereof.

9. The coated paperboard according to any one of the previous claims, wherein the pigment mixture comprises at least 50 wt.% calcium carbonate and at least 15 wt.% clay, such as kaolin clay, such as delaminated kaolin clay.

10. The coated paperboard according to any one of the previous claims, wherein the zirconium-based compound is a zirconium-based cross-linker, e.g. a zirconium carbonate, such as ammonium zirconium carbonate or potassium zirconium carbonate.

11. The coated paperboard according to any one of the previous claims, wherein the at least one binder is/are selected from the group consisting of co-polymers, acrylic resins, polyvinyl acetate, polyvinyl alcohol, proteins, and polysaccharides, such as starches.

12. The coated paperboard according to claim 11, wherein the at least one binder is a styrene/acrylate co-polymer.

13. A method of producing a coated paperboard, comprising applying a pigment coating composition on a top side of a base board, **characterized in that** the pigment coating composition has the components defined in any one of claims 1-12.

14. A package comprising the coated paperboard according to any one of claims 1-12, wherein the package is a tray, a pod or a capsule.

15. Use of a coated paperboard according to any one of claims 1-12 for producing a package adapted for shelf-life extending heat treatment, for example with steam as a heat medium.

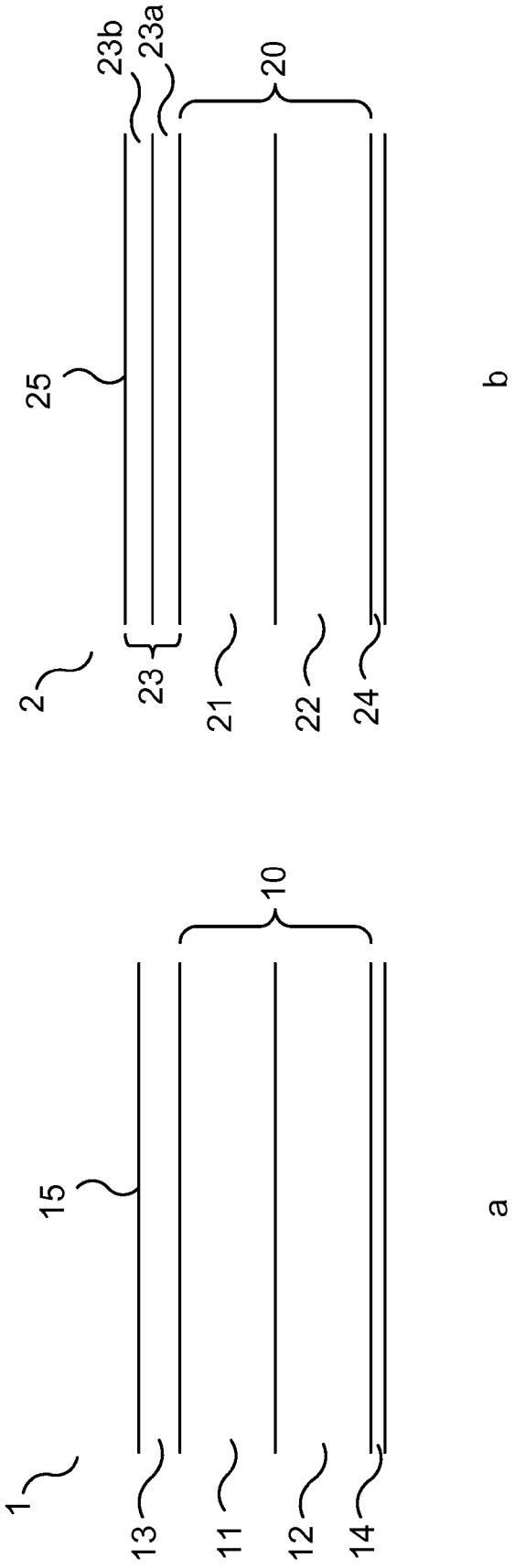

Fig. 1

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Application Number
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The present search report has been drawn up for all claims

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Munich	13 December 2016	Karlsson, Lennart

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