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(71) Applicant: **Billerud Aktiebolag (publ)**

169 27 Solna (SE)

(72) Inventors:

- **WAHLSTRÖM, Lars**
603 70 Norrköping (SE)
- **IVERSEN, Per**
614 33 Söderköping (SE)
- **WESTERHOLM, Erik**
616 33 Åby (SE)

(74) Representative: **Kransell & Wennborg KB**

P.O. Box 27834

115 93 Stockholm (SE)

(54) **A FLUOROCHEMICAL-FREE GREASE-BARRIER PAPER**

(57) The present disclosure provides a fluorochemical-free grease barrier paper comprising a base paper, wherein:

a first side of the base paper is impregnated with a first composition comprising oxidized starch, dextrin, a

crosslinker and a wax, such as alkyl ketene dimer (AKD); and

a second side of the base paper is impregnated with a second composition comprising oxidized starch, dextrin and a crosslinker.

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Description**TECHNICAL FIELD**

5 **[0001]** The present disclosure relates to the field of grease barrier paper, in particular grease-barrier paper to be used in the fast food industry.

BACKGROUND

10 **[0002]** In the fast-food industry, paper bags are used for serving hot foods such as French fries and hash browns. This type of food is greasy and the paper should therefore provide a grease barrier. Traditionally, the paper has provided with a fluorochemical-based coating for this purpose. The use of fluorochemicals is however questioned by many consumers and brand owners.

SUMMARY

[0003] There is an objective of the present disclosure to provide a fluorochemical-free grease-barrier paper that can be used in e.g. the fast-food industry.

20 **[0004]** Accordingly, the present disclosure provides a fluorochemical-free grease barrier paper comprising a base paper, wherein:

a first side of the base paper is impregnated with a first composition comprising oxidized starch, dextrin, a crosslinker and a wax, such as alkyl ketene dimer (AKD); and

25 a second side of the base paper is impregnated with a second composition comprising oxidized starch, dextrin and a crosslinker.

DETAILED DESCRIPTION

30 **[0005]** The present disclosure provides a fluorochemical-free grease barrier paper. This paper comprises a base paper, which preferably is a machine glazed paper (often referred to as an "MG paper"). Preferably, at least 75% (by dry weight) of the pulp used to form the base paper is virgin kraft pulp. In one embodiment, at least 90% (by dry weight) of the pulp used to form the base paper is virgin kraft pulp.

35 **[0006]** The kraft pulp may be a mixture of hardwood kraft pulp and softwood kraft pulp. Such a mixture is preferred since the inclusion of hardwood fibres reduces porosity (and thereby improves grease resistance) whereas the inclusion of softwood fibres increases strength, which improves runnability (since the paper is of low grammage and hence susceptible to breakage, e.g. during wind-up, if the strength is too low).

[0007] As an example, the dry weight ratio of softwood fibers to hardwood fibers may be between 3:1 and 1:1. In a preferred embodiment, the dry weight ratio is between 2:1 and 1.2:1. In a more preferred embodiment, it is between 1.8:1 and 1.3:1.

40 **[0008]** A balanced ratio of softwood fibres to hardwood fibres is particularly beneficial when the ash content of the paper is high. The reason for this is that high ash content reduces strength. Ash content and strength values are further discussed below.

45 **[0009]** In the barrier paper, a first side of the base paper is impregnated with a first composition comprising oxidized starch, dextrin, a crosslinker and a wax, such as alkyl ketene dimer (AKD). Further, a second side of the base paper is impregnated with a second composition comprising oxidized starch, dextrin and a crosslinker.

[0010] When the paper is impregnated with the oxidized starch and the dextrin, oil breakthrough is delayed or prevented. Further, the barrier paper become less brittle when it is impregnated rather than only coated with the oxidized starch/dextrin mixture. The preferred type of dextrin is maltodextrin.

50 **[0011]** The reason for including a crosslinker is to reduce the moist sensitivity, which is important given that the food to be contacted by the paper is often moist. A preferred type of crosslinker is a polyamide-epichlorohydrin (PAE) resin.

[0012] The amount of the crosslinker in the first composition maybe 1-9 %, such as 3-7 %, based on the dry weight of starch. Here, the amount of starch is the combined amounts of oxidized starch and dextrin in the first composition.

55 **[0013]** Likewise, the amount of the crosslinker in the second composition may be 1-9 %, such as 3-7 %, based on the dry weight of starch. Here, the amount of starch is the combined amounts of oxidized starch and dextrin in the second composition.

[0014] The reason for including a wax, such as AKD, in the first composition is that it reduces tack when in contact with hot, greasy food, such a newly fried hashbrowns. The inventors have carried out trials showing unacceptable tack to hashbrowns when no wax is included. These trials also showed that the addition of a non-wax chemical, i.e. an EAA

polymer (Michem® Prime 4983), did not solve the tack problem. It was not until AKD was added the tack could be avoided. Further, the paper became soggy in contact with the hash browns when the EAA polymer was used than when AKD was used. The soggy problem was observed independent of the amount of EAA polymer in the composition (five different EAA polymer concentrations ranging from 5 pph to 25 pph were tested).

[0015] In one embodiment, no wax, such as no AKD, is included in the second composition. The reason for not including wax in this composition is that the second side is not contacting the food (it faces outwards when used in a bag) and that wax typically reduces friction, which is often undesired considering convertability and handleability of the barrier paper.

[0016] In one embodiment of the barrier paper, wherein the amount of wax, such as AKD, in the first composition is 1-9 %, such as 1-8 %, such as 2-7 %, based on the dry weight of starch. Here, the amount of starch is the combined amounts of oxidized starch and dextrin in the first composition.

[0017] Preferably, the wax is AKD in amount of 2-6 %, most preferably 2-4 %, based on the amount of starch. In the examples section below, the amount of AKD is 3 pph (i.e. about 3%). 5 pph (i.e. about 5%) has also been used in full-scale trials, but did not produce significantly better results than 3 pph.

[0018] Despite its strength reducing effect, it is often desired to have a relatively high ash content since addition of inorganic particles (typically clay) increases opacity.

[0019] In an embodiment, the ash content is 3-9 %, such as 5-9 %, such as 5-8 %. Typically, such a relatively high ash content is the consequence of addition of clay.

[0020] The reason for adding clay is to increase opacity, which is appreciated by consumers. However, clay reduces strength, which impairs runnability. Softwood pulp and cationic starch is typically included in the pulp to compensate for this strength reduction. In one embodiment of the barrier paper, the opacity is at least 47%, such as at least 53%. Here, opacity is measured according to ISO 2471:2008. Strength values are discussed below.

[0021] Starch (i.e. oxidized starch + dextrin) is typically the main component of the first composition. In a preferred embodiment, at least 75%, such as at least 80%, of the dry weight of the first composition is starch.

[0022] Likewise, starch (i.e. oxidized starch + dextrin) is typically the main component of the second composition. In a preferred embodiment, at least 80%, such as at least 85%, of the dry weight of the second composition is starch.

[0023] If too much of the starch-based compositions is applied, the barrier paper becomes brittle, which may result in breakage during winding or converting. If the applied amount is too low, the oil barrier properties may be insufficient. Preferably, the first composition is applied in an amount of 0.4-1.5 g/m², such as 0.6-1.4 g/m² (as dry). Likewise, the second composition is preferably applied in an amount of 0.4-1.5 g/m², such as 0.6-1.4 g/m² (as dry).

[0024] The basis weight of the barrier paper may be 30-65 g/m², such as 35-55 g/m², preferably 35-45 g/m². Higher basis weights are not needed (neither economically motivated) for the intended application. In the present application, basis weight is measured according to ISO 536:2019.

[0025] The impregnations typically result in a barrier paper of very high air resistance, which reflects high resistance to oil breakthrough. Hence, the barrier paper preferably has a Gurley value (measured according to ISO 5636-5:2013) of at least 400 s, such as at least 500 s. The Bendtsen porosity (measured according to ISO 5636-3:2013) of the barrier paper may for example be in the range of 10-50 ml/min.

[0026] In one embodiment of the barrier paper, the burst strength is at least 100 kPa and/or the burst strength index is at least 3.3 kN/g, such as 3.3-5.0 kN/g. Here, the burst strength is measured according to ISO 2758:2014.

[0027] In one embodiment of the barrier paper, the tear strength in the machine direction (MD) is at least 150 mN and/or the tear strength index in the MD is at least 4.0 mNm²/g, such as 4.0-6.5 mNm²/g.

[0028] In one embodiment of the barrier paper, the tear strength in the cross direction (CD) is at least 155 mN and/or the tear strength index in the CD is at least 4.3 mNm²/g, such as 4.3-6.8 mNm²/g.

[0029] Here, tear strength is measured according to ISO 1974:2012.

[0030] In one embodiment, at least one side (typically the first side) of the barrier paper has a Cobb 60 s value of less than 20 g/m², such as less than 19 g/m², such as less than 18.5 g/m². In one embodiment, both sides of the barrier paper have a Cobb 60 s value below 21 g/m², such as below 20 g/m². Here, the Cobb 60 s value is measured according to ISO 535:2014.

[0031] The second side of the barrier paper is intended to be facing outwards in a package. Hence, this side is often printed. Low surface roughness typically improves the quality of the print. Accordingly, the Bendtsen surface roughness (measured according to ISO 8791-2:2013) of the second side is preferably below 200 ml/min, such as below 150 ml/min, such as below 120 ml/min. The lower limit for the Bendtsen surface roughness (ISO 8791-2:2013) of the second side may for example be 50 ml/min.

[0032] The Bendtsen surface roughness (ISO 8791-2:2013) of the first side may for example be in the range of 200-500 ml/min.

[0033] In a preferred embodiment, the second side has a lower Bendtsen surface roughness value (ISO 8791-2:2013) than the first side. Such an embodiment may be obtained by selecting the wire side as the second side. In case of an MG paper, the second side is typically the glazed side.

[0034] The tensile strength in the MD of the barrier paper is preferably above 3.5 kN/m. Further, the tensile index in

the MD of the barrier paper is preferably in the range of 90-145 Nm/g.

[0035] The tensile strength in the CD of the barrier paper is preferably above 1.8 kN/m. Further, the tensile index in the CD of the barrier paper is preferably in the range of 50-100 Nm/g, such as 50-85 Nm/g.

[0036] Here, tensile strength is measured according to ISO 1924-3:2005.

[0037] The palm kernel oil breakthrough (measured according to ISO 16532-1) of the first side of the paper may be above 15 min, preferably above 18 min, such as above 20 min.

[0038] In one embodiment, the palm kernel oil breakthrough (measured according to ISO 16532-1) of both sides is above 15 min, preferably above 18 min, such as above 20 min.

[0039] The present invention further provides a package, such as a bag, for serving food, which package comprises at least one wall comprising the barrier paper discussed above. Said food may for example be fried or otherwise greasy food.

EXAMPLE

[0040] A furnish comprising softwood kraft fibres and hardwood kraft fibres in a 60:40 dry weight ratio was provided. The furnish contained clay in such an amount that the final ash content of the paper was 6.8%. Further, the furnish contained 3.7 kg/tonne dry fibre of cationic starch, 2.5 kg/tonne dry fibre of rosin size and retention polymer. In addition, NaOH and alum was added to adjust the pH to 5.6. The furnish was refined to such an extent that the paper (before impregnation) had a Gurley value of 87 s.

[0041] An MG paper was formed from the furnish on a full-scale paper machine equipped with a Yankee cylinder. The degree of drying was such that the paper web leaving the Yankee cylinder had a moisture content of 12%.

[0042] This paper web having a moisture content of 12% was impregnated on both sides in a (full-scale) film press.

[0043] In more detail, the upper side of the paper web was impregnated with a first water-based composition comprising:

13 wt.% of a starch mixture of oxidized starch and maltodextrin (Perfectafilm B4085 from Avebe);
5 pph (based on the amount of starch mixture) of PAE resin (Kymene GHP20 from Solenis, a crosslinker); and
3 pph of AKD (Solenis Aquapel F220).

[0044] The wire side (glazed side) of the paper web was impregnated with a second water-based composition comprising:

13 wt.% of a starch mixture of oxidized starch and maltodextrin (Perfectafilm B4085 from Avebe); and
5 pph (based on the amount of starch mixture) of PAE resin (Kymene GHP20 from Solenis, a crosslinker).

[0045] The applied dry amount of the first water-based composition was 0.96 g/m². The applied dry amount of the second water-based composition was 0.86 g/m².

[0046] The impregnated paper was then dried such that it had 6.2% moisture when rolled up. The basis weight at roll-up was 38 g/m². Further properties are provided in table 1 below.

Table 1. Properties of the impregnated paper. "MD" means machine direction. "CD" means cross direction. "US" means upper side. "WS" means wire side. Oil breakthrough was measured using palm kernel oil.

Burst strength (ISO 2758)	144 kPa
Burst strength index (ISO 2758)	3.8 kN/g
Tear strength, MD (ISO 1974)	186 mN
Tear strength index, MD (ISO 1974)	4.9 mNm ² /g
Tear strength, CD (ISO 1974)	197 mN
Tear strength index, CD (ISO 1974)	5.2 mNm ² /g
Cobb 60 s, US (ISO 535)	17.7 g/m ²
Cobb 60 s, WS (ISO 535)	19.0 g/m ²
Opacity (ISO 2471)	53%
Surface roughness, US (ISO 8791-2)	361 ml/min
Surface roughness, WS (ISO 8791-2)	91 ml/min

(continued)

	Porosity Bendtsen (ISO 5636-3)	23 ml/min
5	Air resistance (Gurley) (ISO 5636-5)	535 s
	Tensile strength, MD (ISO 1924-3)	4.5 kN/m
	Tensile index, MD (ISO 1924-3)	118 Nm/g
	Tensile strength, CD (ISO 1924-3)	2.3 kN/m
10	Tensile index, CD (ISO 1924-3)	61 Nm/g
	Oil breakthrough, US, left (ISO 16532-1)	21 min
	Oil breakthrough, US, middle (ISO 16532-1)	23 min
15	Oil breakthrough, US, right (ISO 16532-1)	21 min
	Oil breakthrough, WS, left (ISO 16532-1)	27 min
	Oil breakthrough, WS, middle (ISO 16532-1)	22 min
20	Oil breakthrough, WS, right (ISO 16532-1)	27 min

[0047] Bags was formed from the paper of table 1. In the bags, the upper side was facing inwards. Freshly fried hash browns were placed in the bags. After containing the hash browns, the paper of the bags was evaluated and found to have a satisfactory grease barrier, comparatively low sogginess and no tack issues.

Claims

1. A fluorochemical-free grease barrier paper comprising a base paper, wherein:

a first side of the base paper is impregnated with a first composition comprising oxidized starch, dextrin, a crosslinker and a wax, such as alkyl ketene dimer (AKD); and
a second side of the base paper is impregnated with a second composition comprising oxidized starch, dextrin and a crosslinker.

2. The barrier paper of claim 1, wherein the base paper comprises a mixture of hardwood fibers and softwood fibers.

3. The barrier paper of claim 2, wherein the dry weight ratio of hardwood fibers to softwood fibers is between 1:1 and 1:3.

4. The barrier paper of claim 3, wherein the dry weight ratio of hardwood fibers to softwood fibers is between 1:1.2 and 1:2.0, such as between 1:1.3 and 1:1.8.

5. The barrier paper of any one of the preceding claims, wherein the crosslinker is a PAE resin.

6. The barrier paper of any one of the preceding claims, wherein the amount of the crosslinker in the first composition is 1-9 %, such as 3-7 %, based on the dry weight of starch.

7. The barrier paper of any one of the preceding claims, wherein the amount of the crosslinker in the second composition is 1-9 %, such as 3-7 %, based on the dry weight of starch.

8. The barrier paper of any one of the preceding claims, wherein the amount of AKD in the first composition is 1-9 %, such as 1-8 %, such as 2-7 %, based on the dry weight of starch.

9. The barrier paper of any one of the preceding claims, wherein at least 75%, such as at least 80%, of the dry weight of the first composition is starch.

10. The barrier paper of any one of the preceding claims, wherein at least 80%, such as at least 85%, of the dry weight of the second composition is starch.

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11. The barrier paper of any one of the preceding claims, wherein the dry amount of the first composition is 0.4-1.5 g/m², such as 0.6-1.4 g/m².

5 12. The barrier paper of any one of the preceding claims, wherein the dry amount of the second composition is 0.4-1.5 g/m², such as 0.6-1.4 g/m².

13. The barrier paper of any one of the preceding claims, wherein the ash content is 3-9 %, such as 5-9 %, such as 5-8 %.

10 14. The barrier paper of any one of the preceding claims, wherein the basis weight measured according to ISO 536:2019 is 30-65 g/m², such as 35-55 g/m².

15 15. The barrier paper of any one of the preceding claims, wherein the Gurley value measured according to ISO 5636-5:2013 is at least 400 s, such as at least 500 s.

16. The barrier paper of any one of the preceding claims, wherein said dextrin is maltodextrin.

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