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

(11) EP 3 184 694 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.06.2017 Bulletin 2017/26

(21) Application number: **15201668.9**

(22) Date of filing: **21.12.2015**

(51) Int Cl.:
D21H 25/00 *(2006.01)* ***D21H 27/10*** *(2006.01)*
D21H 27/30 *(2006.01)* ***D21H 19/44*** *(2006.01)*
D21H 19/82 *(2006.01)* ***D21H 19/84*** *(2006.01)*

(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
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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(54) RAINPROOF PAPER SACK

(57) The present disclosure provides a multi-ply sack comprising an inner paper ply and an outer paper ply, wherein:
the outer paper ply comprises a paper layer that is sized with at least one hydrophobic size;
the outside of the sized paper layer is provided with a pre-coating layer and a barrier coating layer;
the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 10:100 and 50:100;
the Gurley porosity according to ISO 5636-5 of the inner paper ply is less than 10 s; and
the sack is configured to allow air to escape from an inter-space between the inner paper ply and the outer paper ply during filling of the sack.

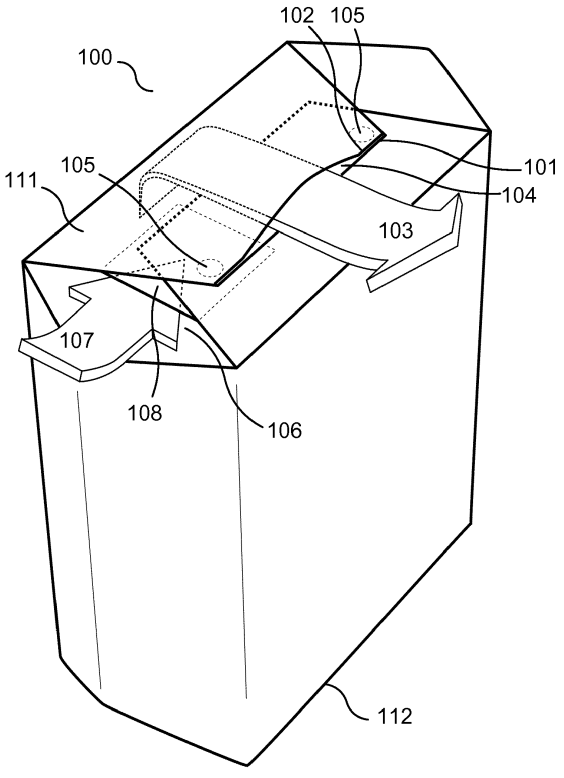

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a rainproof paper sack suitable for a hydraulic binder, such as cement, as well as a sack paper for use as the outer ply of such a rainproof sack.

BACKGROUND

[0002] During filling and storage of powdery material, such as cement, paper sacks are required to meet high standards.

[0003] Firstly, the paper sacks need to hold a considerable material weight, i.e. have high tensile strength. For this purpose, Kraft paper is a suitable sack wall material. The sacks typically have two or more walls, i.e. layers of paper material, to further strengthen the sack construction. A wall layer of a sack is often referred to as a ply. Production of ply material (i.e. sack paper) is for example disclosed in WO 99/02772.

[0004] Secondly, a material such as cement is sensitive to moisture contamination during storage. Hence, cement sacks often require a protection against atmospheric water vapor penetration through the sack plies. Such protection is often achieved by a moisture barrier incorporated as an intermediate layer in the sack, i.e. between two plies of the paper material. The moisture barrier is typically a plastic film ("free film"), e.g. of polyethylene (PE), that is impermeable to water. The free film may also improve resistance to grease and prevent contamination by microorganisms.

[0005] Thirdly, the paper sack should vent air during filling. In detail, the air that accompanies the powdered material shall efficiently vent from the sack as the filling machines that delivers the material run at high throughput rates. Often, the venting capability of the sack is the actual limiting factor for the filling rate. Efficient venting also prevents air from being trapped in the sack. Such trapped air may otherwise cause under-weight packs, sack rupture and problems when sacks are stacked for transportation. The "venting" is also referred to as "deaeration".

[0006] During the filling process, the only way for air to escape from the interior of the sack has, in many sack constructions, been through the walls of the sack. Kraft paper of high porosity is often used in the walls to achieve air permeability. However, an increased porosity of the paper normally results in a decrease in the overall strength. In particular, the strength may be significantly reduced if holes must be made in the paper material to achieve sufficient air permeability. Furthermore, the use of a free film may reduce deaeration during filling, since most such films are impermeable to air. Therefore, the free film layer has been provided with slits or perforations to facilitate deaeration.

SUMMARY

[0007] An object of the present discloure is to provide a sack that is rainproof and still meet other requirements of the sack industry. Examples of such other requirements are strength (to prevent rupture during handling), deaeration during filling (to allow high filling rates) and cost efficiency.

[0008] Another object of the present disclosure is to provide a sack paper for use as the outermost ply of the rainproof sack.

[0009] The following itemized listing presents various embodiments of the present disclosure.

1. A multi-ply sack comprising an inner paper ply and an outer paper ply, wherein:

   the outer paper ply comprises a paper layer that is sized with at least one hydrophobic size;
   the outside of the sized paper layer is provided with a pre-coating layer and a barrier coating layer;
   the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 10:100 and 50:100;
   the Gurley porosity according to ISO 5636-5 of the inner paper ply is less than 10 s; and
   the sack is configured to allow air to escape from an interspace between the inner paper ply and the outer paper ply during filling of the sack.

2. The multi-ply sack according to item 1, wherein the paper layer is creped.

3. The multi-ply sack according to item 1 or 2, wherein no plastic film ("free film") is provided between the inner paper ply and the outer paper ply.

4. The multi-ply sack according to any one of the preceding items, wherein the inside of the sized paper layer is provided with a backside coating, wherein the coat weight of the backside coating may be 1-5 g/m^2, such as 2-4 g/m^2.

5. The multi-ply sack according to item 4, wherein the backside coating comprises starch and/or rubber, wherein

the rubber may be synthetic rubber.

6. The multi-ply sack according to any one of the preceding items, wherein the inorganic filler comprises or consist of $CaCO_3$ pigment.

7. The multi-ply sack according to any one of the preceding items, wherein the binder of the pre-coating is selected from a starch and a rubber, such as a synthetic rubber.

8. The multi-ply sack according to any one of the preceding items, wherein the sack is configured to allow air to escape from the interspace between the inner paper ply and the outer paper ply through a top end of the sack during filling of the sack.

9. The multi-ply sack according to any one of the preceding items, wherein pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 15:100 and 40:100, such as between 20:100 and 35:100.

10. The multi-ply sack according to any one of the preceding items, wherein the inorganic filler accounts for at least 70 % of the dry weight of the pre-coating layer.

11. The multi-ply sack according to any one of the preceding items, wherein the particle size (% < 2 μm) of the inorganic filler is 80 or less, such as between 50 and 80, such as between 50 and 75, such as between 55 and 75.

12. The multi-ply sack according to any one of the preceding items, wherein the pre-coating layer comprises a thickening agent, such as CMC.

13. The multi-ply sack according to any one of the preceding items, wherein the coat weight of the pre-coating layer is 5-12 g/m^2, such as 6-10 g/m^2.

14. The multi-ply sack according to any one of the preceding items, wherein the coat weight of the barrier coating layer is 5-15 g/m^2, such as 6-12 g/m^2, such as 7-10 g/m^2.

15. The multi-ply sack according to any one of the preceding items, wherein the barrier coating layer comprises a synthetic rubber, such as styrene-butadiene rubber.

16. The multi-ply sack according to item 15, wherein the synthetic rubber is provided in the form of latex.

17. The multi-ply sack according to any one of the preceding items, wherein the barrier coating layer comprises a clay, such as a platy clay, such as platy kaolin.

18. The multi-ply sack according to any one of the preceding items, wherein the at least one hydrophobic size comprises rosin size.

19. The multi-ply sack according to any one of the preceding items, wherein the at least one hydrophobic size comprises AKD or ASA.

20. The multi-ply sack according to item 19, wherein the at least one hydrophobic size comprises AKD and rosin size.

21. The multi-ply sack according to item 20, wherein the sized paper layer has been sized with AKD and rosin size in a weight ratio between 1:6 and 1:1.5, such as between 1:5 and 1:2.

22. The multi-ply sack according to any one of the preceding items, wherein the Cobb 1800 s value measured according to ISO 535 of the sized paper layer is less than 60 g/m^2, such as less than 50 g/m^2, such as less than 45 g/m^2.

23. The multi-ply sack according to any one of the preceding items, wherein the Cobb 60 s value measured according to ISO 535 of the sized paper layer is less than 30 g/m^2, such as less than 25 g/m^2.

24. The multi-ply sack according to any one of the preceding items, wherein the sized paper layer is a bleached paper layer.

25. The multi-ply sack according to item 24, wherein brightness of the sized paper layer is at least 78 %, such as at least 83 %, according to ISO 2470-1.

26. The multi-ply sack according to any one of the preceding items, wherein the sized paper layer is a Kraft paper.

27. The multi-ply sack according to any one of the preceding items, wherein the sized paper layer is formed from a paper pulp comprising at least 50 dry weight % softwood pulp, such as at least 75 dry weight % softwood pulp, such as at least 90 dry weight % softwood pulp.

28. The multi-ply sack according to any one of the preceding items, wherein the grammage according to ISO 536 of the sized paper layer is 50-140 g/m^2, such as 55-100 g/m^2, such as 60-90 g/m^2.

29. The multi-ply sack according to any one of the preceding items, wherein the grammage according to ISO 536 of the outer paper ply is 60-150 g/m^2, such as 75-140 g/m^2, such as 80-115 g/m^2.

30. The multi-ply sack according to any one of the preceding items, wherein the tear strength according to ISO 1974 of the outer paper ply is at least 840 mN, such as at least 950 mN in the machine direction and in the cross direction.

31. The multi-ply sack according to any one of the preceding items, wherein the Gurley porosity according to ISO 5636-5 of the inner paper ply is less than 8 s, such as less than 7 s, such as less than 6 s.

32. The multi-ply sack according to any one of the preceding items, wherein the inner paper ply is unbleached.

33. The multi-ply sack according to any one of the preceding items, wherein the inner paper ply is a Kraft paper ply.

34. The multi-ply sack according to any one of the preceding items, wherein the inner paper ply is formed from a paper pulp comprising at least 50 dry weight % softwood pulp, such as at least 75 dry weight % softwood pulp, such as at least 90 dry weight % softwood pulp.

35. The multi-ply sack according to any one of the preceding items, wherein the grammage according to ISO 536 of the inner paper ply is 50-140 g/m^2, such as 55-100 g/m^2, such as 60-90 g/m^2.

36. The multi-ply sack according to any one of the preceding items, wherein the tensile energy absorption according to ISO 1924-3 of the inner paper ply is at least 175 J/m^2 in the machine direction and at least 182 J/m^2 in the cross direction.

37. The multi-ply sack according to any one of the preceding items, wherein the tensile energy absorption according to ISO 1924-3 of the inner paper ply is at least 196 J/m^2 in the machine direction and at least 203 J/m^2 in the cross direction.

38. The multi-ply sack according to any one of the preceding items, wherein the tensile energy absorption index according to ISO 1924-3 of the inner paper ply is at least 2.5 J/g in the machine direction and at least 2.6 J/g in the cross direction.

39. The multi-ply sack according to any one of the preceding items, wherein the sack is filled with contents and has a volume 8-45 liters, such as 12-45 liters.

40. The multi-ply sack according to any one of the preceding items, wherein the sack is filled with a hydraulic binder.

41. The multi-ply sack according to item 40, wherein the amount of hydraulic binder is 17-60 kg.

42. The multi-ply sack according to any one of the preceding items, wherein the sack is a valve sack.

43. A coated paper for use in a sack, wherein:

the coated paper comprises a paper layer sized with at least one hydrophobic size;
the sized paper layer is creped;
the sized paper layer is provided on a first side with a pre-coating layer and a barrier coating layer;

the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 10:100 and 50:100;
the sized paper is provided on a second side with a backside coating layer; and
the grammage according to ISO 536 of said coated paper is 75-140 g/m^2, such as 80-115 g/m^2.

44. The coated paper according to item 43, wherein the coat weight of the backside coating is 1-5 g/m^2, such as 2-4 g/m^2.

45. The coated paper according to item 43 or 44, wherein the backside coating comprises starch and/or rubber.

46. The coated paper according to item 45, wherein the rubber is synthetic rubber, such as styrene-butadiene rubber.

47. The coated paper according to any one of items 43-46, wherein the inorganic filler of the pre-coating layer comprises or consist of $CaCO_3$ pigment.

48. The coated paper according to any one of items 43-47, wherein the binder of the pre-coating is selected from a starch and a rubber, such as a synthetic rubber.

49. The coated paper according to any one of items 43-48, wherein pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 15:100 and 40:100, such as between 20:100 and 35:100.

50. The coated paper according to any one of items 43-49, wherein the inorganic filler accounts for at least 70 % of the dry weight of the pre-coating layer.

51. The coated paper according to any one of items 43-50, wherein the particle size (% < 2 μm) of the inorganic filler is 80 or less, such as between 50 and 80, such as between 50 and 75, such as between 55 and 75.

52. The coated paper according to any one of items 43-51, wherein the pre-coating layer comprises a thickening agent, such as CMC.

53. The coated paper according to any one of items 43-52, wherein the coat weight of the pre-coating layer is 5-12 g/ m^2, such as 6-10 g/m^2.

54. The coated paper according to any one of items 43-53, wherein the coat weight of the barrier coating layer is 5-15 g/m^2, such as 6-12 g/m^2, such as 7-10 g/m^2.

55. The coated paper according to any one of items 43-54, wherein the barrier coating layer comprises a synthetic rubber, such as styrene-butadiene rubber.

56. The coated paper according to item 55, wherein the synthetic rubber is provided in the form of latex.

57. The coated paper according to any one of items 43-56, wherein the barrier coating layer comprises a clay, such as a platy clay, such as platy kaolin.

58. The coated paper according to any one of items 43-57, wherein the at least one hydrophobic size comprises rosin size.

59. The coated paper according to any one of items 43-58, wherein the at least one hydrophobic size comprises AKD or ASA.

60. The coated paper according to any one of items 43-59, wherein the at least one hydrophobic size comprises AKD and rosin size.

61. The coated paper according to item 60, wherein the sized paper layer has been sized with AKD and rosin size in a weight ratio between 1:6 and 1:1.5, such as between 1:5 and 1:2.

62. The coated paper according to any one of items 43-61, wherein the Cobb 1800 s value measured according to ISO 535 of the sized paper layer is less than 60 g/m^2, such as less than 50 g/m^2, such as less than 45 g/m^2, such as less than 40 g/m^2.

63. The coated paper according to any one of items 43-62, wherein the Cobb 60 s value measured according to ISO 535 of the sized paper layer is less than 30 g/m^2, such as less than 25 g/m^2.

64. The coated paper according to any one of items 43-63, wherein the sized paper layer is a bleached paper layer.

65. The coated paper according to any one of items 43-64, wherein brightness of the sized paper layer is at least 78 %, such as at least 83 %, according to ISO 2470-1.

66. The coated paper according to any one of items 43-65, wherein the sized paper layer is a Kraft paper ply.

67. The coated paper according to any one of items 43-66, wherein the sized paper layer is formed from a paper pulp comprising at least 50 dry weight % softwood pulp, such as at least 75 dry weight % softwood pulp, such as at least 90 dry weight % softwood pulp.

68. The coated paper according to any one of items 43-67, wherein the grammage according to ISO 536 of the sized paper layer is 50-140 g/m^2, such as 55-100 g/m^2, such as 60-90 g/m^2.

69. A sack for a hydraulic binder comprising an outer ply composed of the coated sack paper according to any one of items 43-69.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig 1 shows a sack according to the present disclosure configured to allow "top deaeration".

Fig 2 shows the sack of Fig 1 provided with a top patch for reinforcement.

DETAILED DESCRIPTION

[0011] As a first aspect of the present disclosure, there is thus provided a multi-ply sack comprising an inner paper ply and an outer paper ply, wherein the outer paper ply comprises a paper layer that is sized with at least one hydrophobic size. Further and the outside of the sized paper layer is provided with a pre-coating layer and a barrier coating layer.

[0012] The outside of the outer paper ply is exposed to the surroundings, which means that the outside of the outer paper ply can be exposed to rain. Bleached paper is generally significantly less hydrophobic than unbleached paper. Accordingly, bleached/white sack paper has higher water absorptiveness and is more sensitive to rain. Therefore, it is more challenging to develop a rainproof sack having a bleached outer paper ply than a rainproof sack having an unbleached outer paper ply. Still, sacks having white outer plies are demanded on the marked, also for sacks that may be exposed to rain. The concept of the present disclosure is thus particularly beneficial when the sized paper layer of the outer paper ply is bleached. The brightness of the sized paper layer may for example be at least 78 % or at least 80 % according to ISO 2470-1. Preferably, it is at least 83 %.

[0013] The total amount of hydrophobic size used for sizing the sized paper layer may for example be 1.5-4.0 kg/ton paper, such as 2.0-3.5 kg/ton paper. The sizing technique may be internal sizing, which means that the size is added in the wet end of the paper machine, or surface sizing, which means that the size is applied to the paper surface after initial drying. Examples of hydrophobic sizes are alkylketene dimer (AKD), alkenylsuccinic anhydride (ASA) and rosin size, which are all commercially available papermaking chemicals. The inventor has found that AKD and ASA reduce the water absorptiveness more efficiently than rosin size. However, the inventor has also noted that the hydrophobicity of a paper sized with ASA may deteriorate after longer storage times due to sensitivity to oxygen and sunlight. The inventor concludes that sizing with a combination of AKD and rosin size may be preferred. The added amount of AKD may be 0.4-1.4 kg/ton paper and preferably 0.5-1 kg/ton paper. The added amount of rosin size may be 1.2-4.2 kg/ton paper and preferably 1.5-3 kg/ton paper. The weight ratio of AKD to rosin size may be between 1:6 and 1:1.5. Preferably, the weight ratio is between 1:5 and 1:2 and more preferably between 1:4 and 1:2.5.

[0014] In the context of the present disclosure, "kg/ton paper" refers to kg per ton of dried paper from the paper making process. Such dried paper normally has a dry matter content (w/w) of 90-95 %.

[0015] Alum may also be added to the pulp, e.g. in an amount of 0.5-5 kg/ton paper. The addition of alum is particularly beneficial when the hydrophobic size comprises rosin size. Alum refers to hydrated potassium aluminium sulphate (potassium alum).

[0016] The Cobb value represents the amount of water absorbed by a paper surface in a given time. Consequently,

the hydrophobic sizing reduces the Cobb value of the sized paper layer. Two examples of Cobb values are Cobb 60 s and Cobb 1800 s, wherein the absorption of water is measured after 60 seconds and 1800 seconds (30 minutes), respectively.

[0017] Rain typically means long-term exposure to rain and therefore, the Cobb 1800 s for the outside of the sized paper layer is considered to be particularly relevant.

[0018] The Cobb 1800 s value measured according to ISO 535 of the outside of the sized paper layer may for example be less than 60 g/m^2. Preferably it is less than 50 g/m^2 and more preferably less than 45 g/m^2 or less than 40 g/m^2. A typical lower limit for the Cobb 60 s value may be 25 or 30 g/m^2. A preferred range for the Cobb 1800 s value is thus 25-50 g/m^2.

[0019] The Cobb 60 s value measured according to ISO 535 of the outside of the sized paper layer may for example be less than 30 g/m^2. Preferably it is less than 25 g/m^2. A typical lower limit for the Cobb 60 s value may be 10 or 15 g/m^2. A preferred range for the Cobb 60 s value is thus 15-25 g/m^2.

[0020] It is to be understood that the Cobb values are measured on the surface of sized paper layer before it is coated.

[0021] The sizing merely reduces water absorption. It does not completely prevent it. Therefore, the sized paper layer is provided the barrier coating layer (further discussed below).

[0022] As the outer paper ply is coated with a barrier coating layer, the sack of the first aspect may lack a plastic film arranged between the outer paper ply and the inner paper ply. Such a plastic film, which is also referred to as a "free film", is often used in prior art sacks to provide a barrier for moisture and liquid water.

[0023] Between the sized paper layer and the barrier coating layer, the pre-coating layer is provided. A purpose of the pre-coating layer is to even the surface of the sized paper layer and thus reduce the amount of barrier material needed to form an efficient barrier coating layer. This is particularly beneficial when the sized paper layer is creped.

[0024] However, the reduction in the amount of barrier material is only a cost reduction if the pre-coating material is cheaper than a typical barrier material. Therefore, the pre-coating layer comprises a high amount of (relatively cheap) inorganic filler. In addition, the pre-coating layer comprises a binder to hold the pre-coating layer together and bind it to the sized paper layer.

[0025] The binder and the inorganic filler are provided in a dry weight ratio of between 10:100 and 50:100 (sometimes referred to as between 10 and 50 parts). Preferably, the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 15:100 and 40:100. The most preferred dry weight ratio is between 20:100 and 35:100. A benefit of a relatively high proportion of binder (i.e. $\geq$ 20 parts) is that the pre-coating better contributes to the overall barrier properties of the outer paper ply.

[0026] The filler and the binder are preferably the main components of the pre-coating layer. The inorganic filler normally accounts for at least 70 % of the dry weight of the pre-coating layer.

[0027] Preferably, the particles of the inorganic filler are relatively large. Coarser particles means lower specific surface area, which in turn means that the binder in the pre-coating can form a more robust film. At the same time, the coarser particles do not negatively affect the printing properties as a barrier coating covers the pre-coating. Further, filler products with coarser particles are generally cheaper. Yet other benefits of coarser particles is that they result in a pre-coating layer that better cover the surface and better prevents formation of blade scratches during blade coating of a barrier layer comprising platy clay than a pre-coating layer with finer particles.

[0028] The particle size of filler and pigment is often expressed as the weight proportion of particles having a particle size below 2 μm. The value (% < 2 μm) is often measured using the particle size analyzer SediGraph 5100 (micromeritics®).

[0029] When filler/pigment is used in coatings to improve printing properties, the particle size value (% < 2 μm) is generally above 80. In contrast, the particle size value (% < 2 μm) of the inorganic filler of the present disclosure is preferably 80 or lower, such as between 50 and 80. In some embodiments, the particle size value (% < 2 μm) is between 50 and 75, such as between 55 and 75.

[0030] The inorganic filler may for example comprise or consist of $CaCO_3$ pigment. Other types of filler are generally more expensive.

[0031] The binder of the pre-coating can for example be starch or rubber, such as a synthetic rubber. Rubber is preferred as it makes a contribution to the water barrier properties of the outer paper ply. The rubber may for example be a synthetic rubber, preferably styrene-butadiene rubber.

[0032] When preparing a composition form forming the pre-coating layer, the synthetic rubber is normally provided in the form of a water dispersion, normally referred to as latex.

[0033] Examples of other (optional) components of the pre-coating layer are thickening agents, coloring agents, optical brightening agents and antifoaming agents. One embodiment of the pre-coating layer comprises carboxymethyl cellulose (CMC), which is a thickening agent. A synthetic thickener, such as an acrylic copolymer, can also be used. An example of synthetic thickener is Rheocoat 35 from Coatex.

[0034] The coat weight of the pre-coating layer may for example be 5-12 g/m^2, such as 6-10 g/m^2. If the coat weight of the pre-coating is too low, higher amounts of barrier material, which is expensive, are needed in the next coating layer

to obtain an effective barrier layer. If the coat weight of the pre-coating is too high, the cost of the product will be unnecessarily high.

[0035] In embodiments of the present disclosure, the barrier coating layer comprises a synthetic rubber, such as styrene-butadiene rubber. When preparing the barrier coating composition, the synthetic rubber is normally provided in the form of latex.

[0036] In alternative or complementary embodiments of the present disclosure, the barrier coating layer comprises a clay, preferably a platy clay, such as platy kaolin. The most preferred type of clay is hyper-platy kaolin.

[0037] Clay (and in particular hyper-platy clay) creates a tortous path for moisture transmission and therefore suitable for creating barrier functions.

[0038] A specific example of hyper-platy kaolin is the product Barrisurf™ (Imerys).

[0039] A barrier coating layer consisting of synthetic rubber is sometimes difficult to print. In a preferred embodiment, the barrier coating layer thus comprises both the synthetic rubber and the clay. For example, the synthetic rubber and the platy clay may account for at least 50 %, such as at least 75 or 85 %, of the dry weight of the barrier coating layer. The dry weight ratio of clay to synthetic rubber may for example be between 1:1 and 2.4:1, such as between 1.3:1 and 2.1:1.

[0040] The barrier coating layer may comprise a thickening agent, such as CMC or a synthetic thickener, such as an acrylic copolymer. As mentioned above, an example of a synthetic thickener is Rheocoat 35 from Coatex.

[0041] The coat weight of the barrier coating layer may for example be 5-15 g/m^2, such as 6-12 g/m^2, such as 7-10 g/m^2. If the coat weight is too low, the barrier coating layer may fail to provide an efficient barrier. If the coat weight is too high, the cost of the product will be unnecessarily high. It is notable that the barrier chemicals are generally relatively expensive.

[0042] In embodiments of the first aspect, the inside of the sized paper layer is provided with a backside coating. A purpose of such a backside coating is to prevent curling that can otherwise occur when paper coated on one side only is dried. To contribute to the overall water resistance of the outer paper ply, the backside coating may comprise a barrier chemical, such as rubber. Again, synthetic rubber, such as styrene-butadiene rubber, is preferred. As a complement or an alternative to the barrier chemical, the backside coating may comprise starch.

[0043] The coat weight of the backside coating is preferably 1-5 g/m^2, such as 2-4 g/m^2.

[0044] To provide strength, the sized paper layer of the outer paper ply is preferably a Kraft paper, which means that is formed from a pulp prepared according to the Kraft process. For the same reason, the starting material used for preparing the pulp that is used for forming the sized paper layer of the outer paper ply can comprise softwood (which has long fibers and thus forms a strong paper). Accordingly, the sized paper layer is preferably formed from a paper pulp comprising at least 50 % softwood pulp, preferably at least 75 % softwood pulp and more preferably at least 90 % softwood pulp. The percentages are based of the dry weight of the pulp.

[0045] A sack paper normally has a grammage according to ISO 536 of 50-140 g/m^2. A sack paper of a higher grammage is stronger, but also more expensive. For the sized paper layer of the outer paper ply of the present disclosure, the grammage is preferably 60-125 g/m^2 and more preferably 65-100 g/m^2. For the outer paper ply (including the coating layers), the grammage according to ISO 536 is preferably 65-150 g/m^2, such as 75-140 g/m^2, such as 80-115 g/m^2.

[0046] The tensile strength is the maximum force that a paper will withstand before breaking. In the standard test ISO 1924-3, a stripe having a width of 15 mm and a length of 100 mm is used with a constant rate of elongation. The tensile strength is one parameter in the measurement of the tensile energy absorption (TEA). In the same test, the tensile strength, the stretchability and the TEA value are obtained.

[0047] TEA is sometimes considered to be the paper property that best represents the relevant strength of the paper sack wall. This is supported by the correlation between TEA and drop tests. When a sack is dropped, the filling goods move inside the sack when it hits the floor. This movement means a strain on the sack wall. To withstand the strain, the TEA should be high, which means that a combination of high tensile strength and good stretch in the paper will then absorb the energy.

[0048] The stretchability according to ISO 1924-3 of the sized paper layer or the outer paper ply may for example be at least 4.5 % in the machine direction (MD) and at least 5.5 % in the cross direction. To obtain high stretchability in the MD, the sized paper layer may be creped.

[0049] For example, the sized paper layer may be creped by a Clupak or Expanda unit. The skilled person knows how to adjust such a unit to obtain a desired stretchability in the MD.

[0050] The TEA index is the TEA value divided by the grammage. The TEA according to ISO 1924-3 of the outer paper ply may for example be 150-300 J/m^2 in both MD and CD. The TEA index according to ISO 1924-3 of the outer paper ply may for example be 2.2-3.5 J/g in the MD and 2.8-4.2 J/g in the CD.

[0051] The tear strength according to ISO 1974 of the sized paper layer or the outer paper ply may for example be at least 840 mN, such as at least 950 mN in both the machine direction (MD) and in the cross direction (CD). In one embodiment, the tear strength is at least 860 mN in MD and at least 1000 mN in CD.

[0052] To obtain satisfactory strength, the sized paper layer may comprise starch. For example, the added amount of starch may be 1-15 kg/ton paper, such as 2-12 kg/ton paper, such as 4-11 kg/ton paper. The starch may for example

be a cationic starch or a mixture of cationic and anionic starch.

[0053] To allow for sufficient deaeration, the Gurley porosity according to ISO 5636-5 of the inner paper ply is less than 10 s. Preferably, it is less than 8 s and more preferably less than 6 s. Brown QuickFill Plus and Brown QuickFill SE, which are marketed by BillerudKorsnäs and have Gurley porosities of 3 s and 5 s, respectively, are examples of sack papers that can be used for the inner paper ply. Normally, it is pointless to reduce the Gurley value below 2.5 s. Further, it is generally difficult to produce a sack paper of such a low Gurley value and sufficient strength. Ranges for the Gurley porosity of the inner paper ply are thus 2.5-10 s, 2.5-8 s and 2.5-6 s.

[0054] To provide strength, the inner paper ply is preferably a Kraft paper ply. For the same reason, the starting material used for preparing the pulp that is used for forming the paper of the inner paper ply can comprise softwood. Accordingly, the inner paper ply is preferably formed from a paper pulp comprising at least 50 % softwood pulp, preferably at least 75 % softwood pulp and more preferably at least 90 % softwood pulp. The percentages are based of the dry weight of the pulp.

[0055] As explained above, sack paper normally has a grammage according to ISO 536 of 50-140 g/m^2 and a sack paper of a higher grammage is stronger, but also more expensive. For the inner paper ply of the present disclosure, the grammage is preferably 55-100 g/m^2 and more preferably 60-90 g/m^2.

[0056] The inner paper ply preferably provides substantial dry strength to the sack. Accordingly, the tensile energy absorption (TEA) according to ISO 1924-3 of the inner paper ply is preferably at least 175 J/m^2 in the machine direction (MD). In the cross direction (CD), the TEA according to ISO 1924-3 is preferably at least 182 J/m^2.

[0057] More preferably, the TEA according to ISO 1924-3 is at least 196 J/m^2 in the MD and/or at least 203 J/m^2 in the CD.

[0058] A typical upper limit for the TEA may be 260 J/m^2 in MD and 270 J/m^2 in CD.

[0059] To take the TEA in both MD and CD into account, a geometric TEA may be calculated as the square root of the product of TEA in MD and TEA in CD (TEA (geometric) = V(TEA (MD)* TEA (CD))).

[0060] Accordingly, the geometric TEA according to ISO 1924-3 of the inner paper ply is preferably at least 178 J/m^2, such as 178-265 J/m^2, and more preferably 199-265 J/m^2.

[0061] To reduce the fibre consumption, the inner paper ply is advantageously strong already at a relatively low grammage. Therefore, the TEA index according to ISO 1924-3 of the inner paper ply may be at least 2.5 J/g in the MD and at least 2.6 J/g in the CD. Preferably, the TEA index according to ISO 1924-3 of the inner paper ply is at least 2.8 J/g, such as 2.8-3.5 J/g in the MD and at least 2.9 J/g, such as 2.9-3.9 J/g in the CD.

[0062] The porosity of the inner paper ply of the sack of the present disclosure allows air to pass from the inside of the sack to an interspace between the inner paper ply and the outer paper ply. Further, the sack of the present disclosure is configured to allow air to escape from the interspace between the inner paper ply and the outer paper ply (to the ambient air) during filling of the sack.

[0063] Preferably, the sack design is such that air can escape from the interspace between the inner paper ply and the outer paper ply through a top end of the sack during filling of the sack.

[0064] For example, a top end of the sack may be formed by folding and gluing the plies such that a portion of the top end is not sealed and air can escape from the interspace through the non-sealed portion during filling of the sack. Such an embodiment is further discussed below with reference to figures 1 and 2.

[0065] The sack of the present disclosure is preferably a valve sack. Valve sacks are well known to the skilled person. A valve sack is provided with a valve through which it may be filled. Such a valve is normally provided at a folded top end of the sack. A typical valve is further discussed below with reference to figures 1 and 2.

[0066] Figure 1 illustrates a multi-ply sack 100 according to an embodiment of the present disclosure having a top end 111 and a bottom end 112. The sack comprises an inner paper ply 101 and an outer paper ply 102. To improve rain resistance, the paper layer of the outer paper ply 102 is sized with at least one hydrophobic size. Further, the paper layer is coated with a pre-coating and a barrier coating. To facilitate deaeration, the Gurley porosity according to ISO 5636-5 of the inner paper ply 101 is less than 10 s.

[0067] The sack 100 is configured to allow air to escape (the air escape is illustrated by the arrow 103) from an interspace between the inner paper ply 101 and the outer paper ply 102 through the top end 111 of the sack 100 during filling of the sack 100. Such a deaeration is achieved by a non-sealed portion 104 forming an opening between the inner paper ply 101 and the outer paper ply 102 at the top end 111. The non-sealed portion 104 may be flanked by sealed portions 105, i.e. portions in which the outer paper ply 102 is sealed (preferably glued) to the inner paper ply 101. For a 25 kg sack 100 having a width of 400-420 mm, the width of the non-sealed portion may for example be 150-160 mm and for a 35 kg having a width of 440-460 mm, the width of the non-sealed portion may be 190-200 mm.

[0068] The top end 111 of the sack 100 of figure 1 further has a filling valve 106 into which a filling spout may be inserted. The arrow 107 illustrates how the filling spout is inserted into the valve 106. A ceiling of the valve 106 is reinforced by a valve reinforcement 108, which preferably is composed of paper. Because of the reinforcement provided by the valve reinforcement 108, the sack 100 can hang on the filling spout during filling without breaking. When fully opened, the opening of the valve 106 may be approximatively diamond-shaped.

[0069] Figure 2 illustrates the sack 100 of figure 1 onto which a top patch 201 has been applied. The top patch reinforces

top end 111 of the sack 100. A slit 202 in the top patch 201 ensures that the air still can escape through the non-sealed portion 104 during filling. The slit 202 is thus substantially aligned with the non-sealed portion 104. Further, the width of the slit 202 is preferably approximately the same as the width of the non-sealed portion 104. Again, the escape of air from the interspace between the inner paper ply 101 and the outer paper ply 102 through the top end 111 of the sack 100 is illustrated by the arrow 103.

[0070] To best protect the contents against rain, the sack 100 is oriented such that the opening formed by the non-sealed portion 104 is facing down.

[0071] The dimensions of the sack of the present disclosure may for example be such that it has a volume of 8-45 liters, preferably 12-45 liters in a filled configuration.

[0072] The sack of the present disclosure may for example contain a hydraulic binder, such as cement. The amount of the hydraulic binder may for example be 17-60 kg. 25 kg sacks, 35 kg sacks and 50 kg sacks are demanded on the market and may thus be prepared according to the present disclosure. The dimensions of a filled 25 kg sack may for example be 400x450x110 mm. A "25 kg sack" typically can be filled with about 17.4 liters of material, while a "50 kg sack" is typically can be filled with about 35 liters of material.

[0073] As a second aspect of the present disclosure, there is provided a coated paper for use in a sack, wherein
the coated paper comprises a paper layer sized with at least one hydrophobic size;
the sized paper layer is creped;
the sized paper layer is provided on a first side with a pre-coating layer and a barrier coating layer;
the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 10:100 and 50:100;
the sized paper is provided on a second side with a backside coating layer,
the grammage according to ISO 536 of said coated paper is 75-140 g/m^2, such as 80-115 g/m^2.

[0074] The second aspect is a preferred embodiment of the outer paper ply of the first aspect. The embodiments of the outer paper ply of the first aspect discussed above apply *mutatis mutandis* to the coated paper of the second aspect.

EXAMPLES

Preparation of a sized paper layer, trial 1

[0075] Bleached kraft papers having a grammage of 70 or 80 g/m^2 for use as a sized paper layer according to the present disclosure were prepared as follows.

Type of pulp: Bleached sulphate pulp from softwood
HC refining: 180 kWh/ton paper
LC refining: 100 kWh/ton paper
Pulp additive: 2.5 kg/ton paper of Fennosize G516/9M (a mixture of AKD and rosin size in a weight ratio of 1:3)
Pulp additive: 1.0 kg/ton paper of Raisamyl 50021, 1.0 kg/t (cationic starch)
Pulp additive: 15.0 kg/ton paper of Fennostrength UF 3467 (ureaformaldehyde wet strength agent)
Pulp additive: 0.42 kg/ton paper of Eka NP 247 (retention nano particle)
Pulp additive: 0.07 kg/ton paper of Eka PL 1510U (retention polymer)
Pulp additive: 0.5-2.5 kg/ton paper of Kemira ALG (alum) to obtain a headbox pH of 4.8-4.9

[0076] As specified above, a wet strength agent was added. This is however not necessary when preparing a sized paper layer according to the present disclosure because the sized paper layer is coated to prevent soaking.

[0077] Wet creping was carried out to increase the stretchability in the MD.

[0078] The properties of the prepared bleached kraft papers (BKP_{70} and BKP80) and a reference paper are presented in table 1 below.

Table 1.

	BKP80 Bleached	BKP70 Bleached	SplashBag* Unbleached (as tested)	SplashBag* Unbleached (as specified)
Grammage (g/m^2)	80	70	70	70
TEA index MD/CD (J/g)	2.8/3.6	2.7/3.2	3.1/3.7	3.1/3.4
Stretchability MD/CD (%)	6.0/9.2	7/8.7	6.1/8.4	5.8/8.0

(continued)

	BKP80 Bleached	BKP70 Bleached	SplashBag* Unbleached (as tested)	SplashBag* Unbleached (as specified)
Tear strength MD/CD (mN)	1200/ 1120	1050/ 1092	700/700	749/798
Wet tensile strength MD (kN/m)	1.74	1.24	1.97	1.8
Cobb 60 s (g/m^2)	21	20	N/A	21
Cobb 1800 s (g/m^2)	39	38	40	N/A
Gurley (s)	22	22	N/A	N/A
*"SplashBag" refers to the outer ply of a SplashBag marketed by Mondi.				

[0079] In table 1, it is seen that the Cobb 1800 s values of BKP70 and BKP80 are lower than the Cobb 1800 s value of the outer layer of the Mondi SplashBag even though BKP70 and BKP80 are bleached and the outer layer of Mondi SplashBag is unbleached. This is of significance as the Cobb 1800 s value reflects the rain resistance of the paper.

Preparation of a sized paper layer, (prophetic) trial 2

[0080] Bleached kraft paper having a grammage of 80 g/m^2 for use as a sized paper layer according to the present disclosure is prepared as follows.

Type of pulp: Bleached sulphate pulp from softwood
HC refining: 180 Wh/ton paper
LC refining: 80 kWh/ton paper
Pulp additive: 2.5 kg/ton paper of Fennosize G517/9M (a mixture of AKD and rosin size in a weight ratio of 1:3)
Pulp additive: 7.0 kg/ton paper of Roquette Hi-Cat 5216 A (cationic starch)
Pulp additive: 3.0 kg/ton paper of Roquette Vector AS 104 (anionic starch)
Pulp additive: 0.5-2.5 kg/ton paper of Kemira ALG (alum) to obtain a headbox pH of 5.6-5.9

[0081] Wet creping was carried out to increase the stretchability in the MD.

Preparation of a coated sack paper for an outer paper ply

[0082] To prepare a coated sack paper for an outer paper ply according to the present disclosure, an aqueous pre-coating composition comprising styrene-butadiene latex and $CaCO_3$ pigment in a dry weight ratio of 30:100 is prepared. CMC (thickening agent) is added to the pre-coating composition such that a viscosity of about 700 cP (measured according to Scan-P 50:84, but with a sample temperature of 34-40 °C) is obtained. Further, the pH of the pre-coating composition is adjusted to 8.3 using NaOH.

[0083] The pre-coating composition is then applied to sized paper prepared according to trial 2 above using a blade coater. The pressure and angle of the coating blade is adjusted such that the coat weight of the pre-coating is 8 g/m^2.

[0084] Further, an aqueous backside coating composition comprising starch (4-6 %) and styrene-butadiene latex (2-5 %) is prepared. The backside coating composition is applied to the backside of the paper via a roll distributing system at the same position as the coater or the pre-coating, i.e. opposite of the blade, to obtain a backside coat weight of 2-4 g/m^2.

[0085] The pre-coating is dried with IR-heaters and drying cylinders to such an extent that the barrier coating composition (described below) can be applied without problems like scuffing of the pre-coating.

[0086] An aqueous barrier coating composition comprising styrene-butadiene latex and hyper-platy kaolin pigment (Barrisurf™ (Imerys)) in a dry weight ratio of 50:100 is prepared. An acrylic co-polymer (Rheocoat 35 from Coatex) is added as a thickening agent to obtain a viscosity of about 1200 cP (measured according to Scan-P 50:84, but with a sample temperature of 34-40 °C). Further, the pH of the barrier coating composition is adjusted to about 8 using NaOH.

[0087] The barrier coating composition is applied with a roll which is dipped in a chest with the barrier coating composition and the excess is removed with a coating blade. The pressure and angle of the coating blade is adjusted such that the coat weight of the barrier coating is 8 g/m^2. The barrier coating surface is dried with IR-dryers, which allowing a fast setting of the coating colour. The drying continues with cylinders and hot air until the desired moisture level is obtained. Normally the finished product has a dry content of 92-95%.

[0088] The coated paper is the calendared in order to compress the coating and the fibers to make the surface and the fiber network even more closed and therefore more resistant to penetration of water. For the same reason rain will easier leave the surface of the sack.

Sack preparation

[0089] Sacks (Sack 1 and Sack 2) are then prepared using the coated sack paper prepared according to the above as the outer paper ply and a commercial sack paper as the inner paper ply.

Sack 1

[0090]

Outer paper ply: Coated sack paper prepared according to the above
Inner paper ply: QuickFill® Brown Plus (unbleached), marketed by BillerudKorsnäs AB (Sweden), see table 2
Free film: none
Deaeration concept: top deaeration according to figure 2

Sack 2

[0091] Outer paper ply: Coated sack paper prepared according to the above Inner paper ply: QuickFill® Brown SE (unbleached), marketed by BillerudKorsnäs AB (Sweden), see table 2

Free film: none

Deaeration concept: top deaeration according to figure 2

[0092]

Table 2. Both papers of table 2 are formed from unbleached sulphate/kraft pulp from softwood

	QuickFill Plus Unbleached	QuickFill SE Unbleached
Grammage (g/m^2)	70	70
Gurley (s)	3	5
Tensile strength MD/CD (kN/m)	5.6/4.9	5.6/4.9
TEA MD/CD (J/m^2)	215/240	215/240
TEA index MD/CD (J/g)	3.1/3.4	3.1/3.4
Stretch MD/CD (%)	6.0/8.0	6.0/8.0

Deaeration test

[0093] The normalised MegaGurley flow according to Haver&Boecker (L/02) vs. pressure drop is tested for three different 25 kg sacks; Sack 1, Sack 2 and a commercially available reference sack. Sack 1 and Sack 2 are expected to show deaeration curves that are better than or comparable to the reference sack.

Drop test for dry sacks

[0094] 10 sacks according to Sack 1 or Sack 2 are filled with 24.9 kg cement each and tested in a drop test according to ISO 7965-1 (a constant drop height method, drop height = 1.2 m). The sacks are conditioned according to ISO 6599-1. The dimensions of each sack are 400 mm x 450 mm x 110 mm.

[0095] For each sack, the number of drops until failure is measured.

[0096] The result of the drop test is expected to be comparable to or better than the result obtained with a comparable "normal" sack with a slitted or perforated free film.

Rain test

[0097] Sacks according to Sack 1 or Sack 2 are filled with about 25 kg of cement.

[0098] The filled sacks are exposed to rain conditions according to ISO 2875 for 2, 4, 6 or 8 hours. During the exposures, the sacks are oriented with the deaeration opening facing down.

[0099] After the exposures, the sacks are cut open and the cement is visually inspected. The condition of the cement is expected to be acceptable, also after 8 hours of exposure.

Drop test after rain test

[0100] Sacks from the rain rest exposed to 2 hours of rain conditions are expected to survive several drops from a height of 80 cm without breaking. Sacks from the rain rest exposed to 8 hours of rain conditions are expected to survive several drops from a height of 40 cm without breaking.

Claims

1. A multi-ply sack comprising an inner paper ply and an outer paper ply, wherein:

   the outer paper ply comprises a paper layer that is sized with at least one hydrophobic size;
   the outside of the sized paper layer is provided with a pre-coating layer and a barrier coating layer;
   the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 10:100 and 50:100;
   the Gurley porosity according to ISO 5636-5 of the inner paper ply is less than 10 s; and
   the sack is configured to allow air to escape from an interspace between the inner paper ply and the outer paper ply during filling of the sack.

2. The multi-ply sack according to claim 1, wherein the paper layer is creped.

3. The multi-ply sack according to claim 1 or 2, wherein no plastic film ("free film") is provided between the inner paper ply and the outer paper ply.

4. The multi-ply sack according to any one of the preceding claims, wherein the sack is configured to allow air to escape from the interspace between the inner paper ply and the outer paper ply through a top end of the sack during filling of the sack.

5. The multi-ply sack according to any one of the preceding claims, wherein the Gurley porosity according to ISO 5636-5 of the inner paper ply is less than 8 s, such as less than 7 s, such as less than 6 s.

6. The multi-ply sack according to any one of the preceding claims, wherein the sack is filled with a hydraulic binder.

7. The multi-ply sack according to any one of the preceding claims, wherein the sack is a valve sack.

8. A coated paper for use in a sack, wherein:

   the coated paper comprises a paper layer sized with at least one hydrophobic size;
   the sized paper layer is creped;
   the sized paper layer is provided on a first side with a pre-coating layer and a barrier coating layer;
   the pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 10:100 and 50:100;
   the sized paper is provided on a second side with a backside coating layer, which backside coating may have a coat weight of 1-5 g/m^2, such as 2-4 g/m^2; and
   the grammage according to ISO 536 of said coated paper is 75-140 g/m^2, such as 80-115 g/m^2.

9. The coated paper according to claim 8, wherein the backside coating layer comprises rubber, such as synthetic rubber, such as styrene-butadiene rubber.

10. The coated paper according to claim 8 or 9, wherein pre-coating layer comprises binder and inorganic filler in a dry weight ratio of between 15:100 and 40:100, such as between 20:100 and 35:100.

11. The coated paper according to any one of claims 8-10, wherein the inorganic filler comprises or consist of $CaCO_3$ pigment.

12. The coated paper according to any one of claims 8-11, wherein the particle size (% < 2 μm) of the inorganic filler is 80 or less, such as between 50 and 80, such as between 50 and 75, such as between 55 and 75.

13. The coated paper according to any one of claims 8-12, wherein the at least one hydrophobic size comprises AKD.

14. The coated paper according to any one of claims 8-12, wherein the coat weight of the pre-coating layer is 5-12 g/m^2 and/or the coat weight of the barrier coating layer is 5-15 g/m^2.

15. The coated paper according to any one of claims 8-14, wherein the sized paper layer is a bleached paper layer.

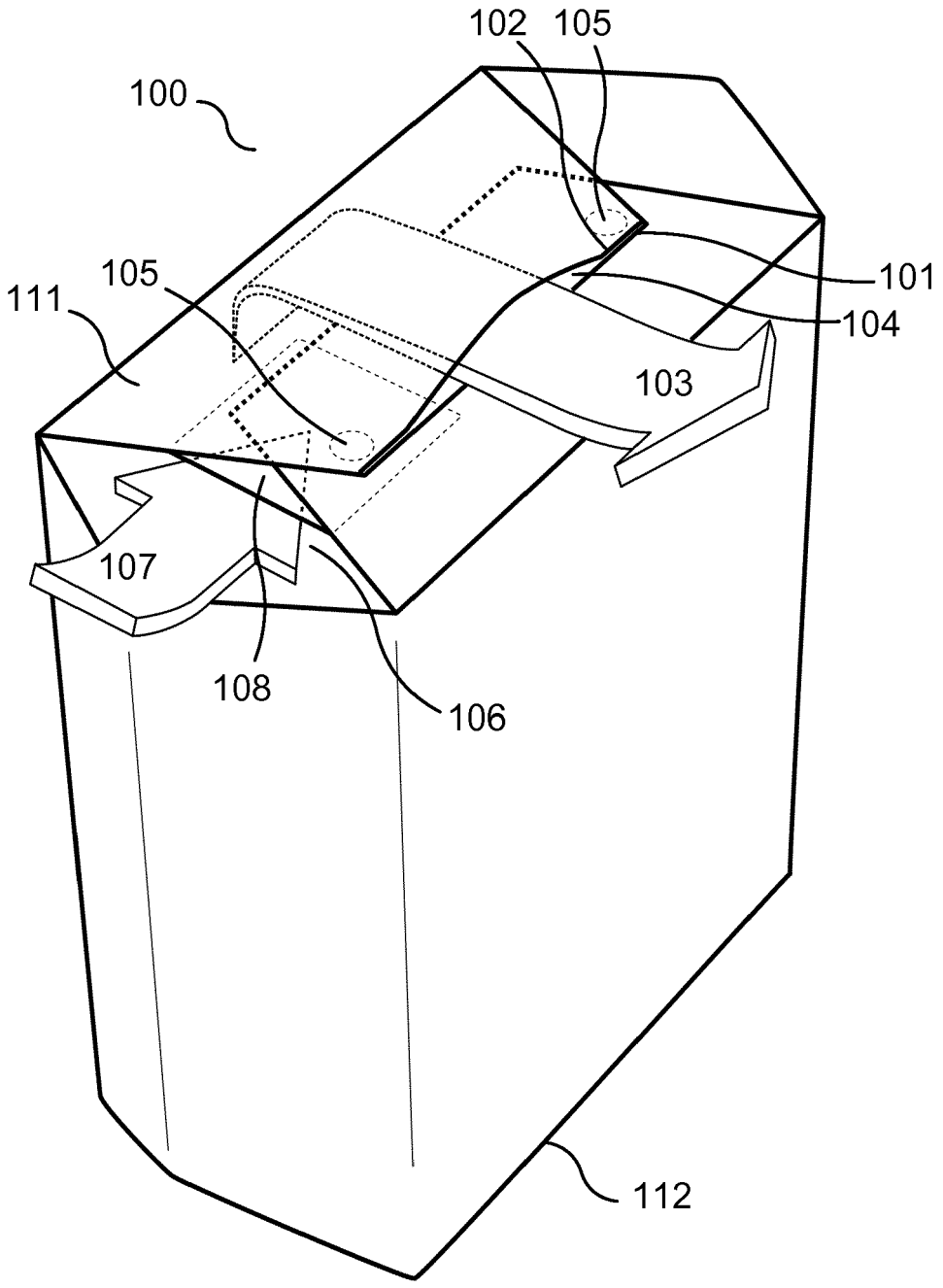

Fig. 1

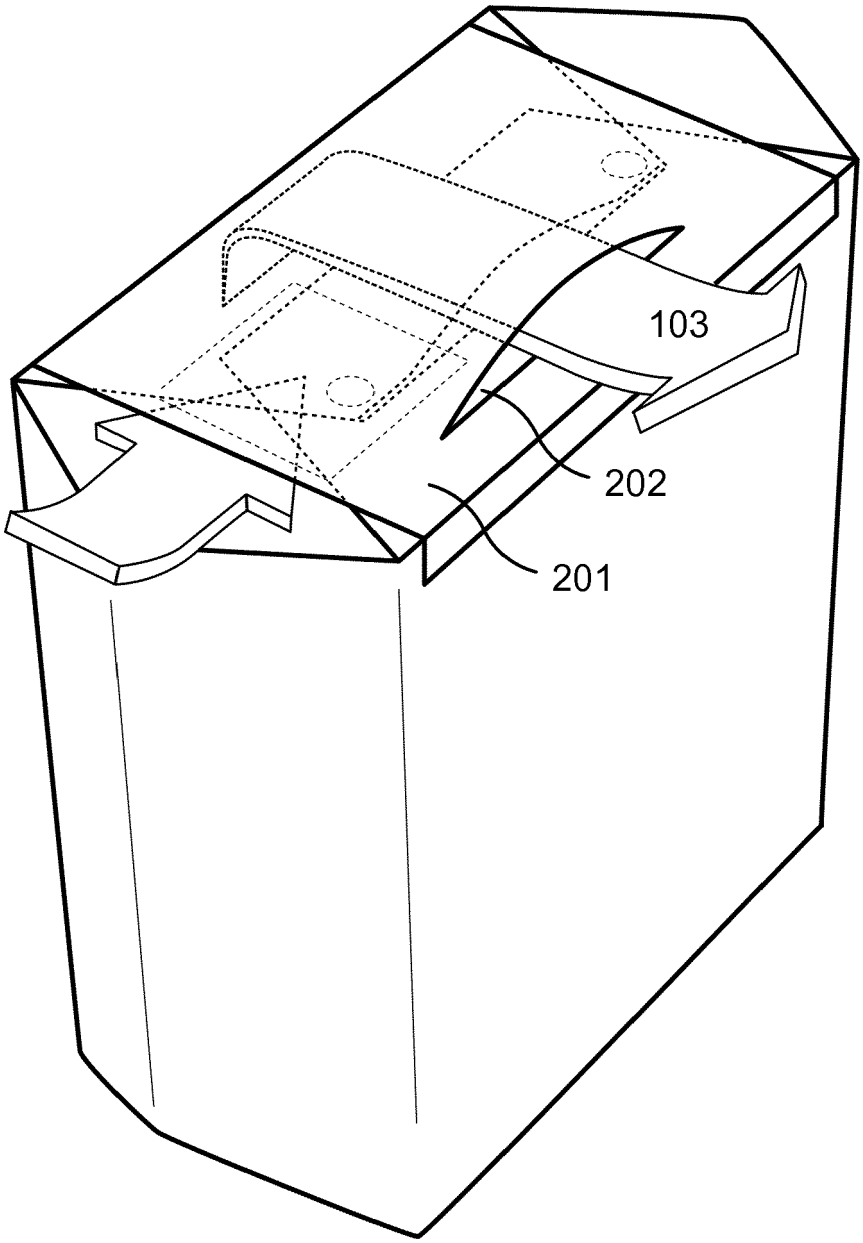

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 1668

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 Y	WO 2013/164646 A1 (IMERYS MINERALS LTD [GB]) 7 November 2013 (2013-11-07) * claims 1-42; examples 1,2 *	8,9,11, 13,15 8	INV. D21H25/00 D21H27/10 D21H27/30
Y	WO 2011/000942 A1 (BILLERUDS AB [SE]; AAVITSLAND GRETE [SE]; MAGNUSSON ANNA-KARIN [SE]; J) 6 January 2011 (2011-01-06) * claims 1-41 *	8	D21H19/44 D21H19/82 D21H19/84
A	DE 60 2005 003089 T2 (SMURFIT LEMBACEL [FR]) 21 August 2008 (2008-08-21) * claims 1-3; figures 1,2 *	1-15	
A	US 2003/226648 A1 (MCDONNELL WILLIAM T [US] ET AL) 11 December 2003 (2003-12-11) * the whole document *	1-15	
A	WO 2013/069788 A1 (JUJO PAPER CO LTD [JP]) 16 May 2013 (2013-05-16) * the whole document *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
A	EP 0 718 437 A1 (INT PAPER CO [US]) 26 June 1996 (1996-06-26) * the whole document *	1-15	D21H
A,D	WO 99/02772 A1 (ASSIDOMAEN KRAFT PRODUCTS AB [SE]; NILSSON BJOERN [SE]; HAAKANSSON STE) 21 January 1999 (1999-01-21) * the whole document *	1-15	
A	WO 03/010055 A1 (SHINDUCK IND CO LTD [KR]; CHOI KU-HWA [KR]; BANG BONG-JIN [KR]) 6 February 2003 (2003-02-06) * the whole document *	1-15	
A	WO 98/57861 A1 (BPB PLC [GB]) 23 December 1998 (1998-12-23) * the whole document *	1-15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 June 2016	Karlsson, Lennart

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 20 1668

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-06-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013164646 A1	07-11-2013	NONE	
WO 2011000942 A1	06-01-2011	EP 2449176 A1	09-05-2012
		US 2012134605 A1	31-05-2012
		WO 2011000942 A1	06-01-2011
DE 602005003089 T2	21-08-2008	AT 376966 T	15-11-2007
		DE 602005003089 T2	21-08-2008
		EP 1657180 A1	17-05-2006
		FR 2876670 A1	21-04-2006
US 2003226648 A1	11-12-2003	NONE	
WO 2013069788 A1	16-05-2013	CN 104080607 A	01-10-2014
		EP 2777934 A1	17-09-2014
		JP 5331265 B1	30-10-2013
		JP WO2013069788 A1	02-04-2015
		WO 2013069788 A1	16-05-2013
EP 0718437 A1	26-06-1996	DE 69531658 D1	09-10-2003
		DE 69531658 T2	24-06-2004
		EP 0718437 A1	26-06-1996
		US 5989724 A	23-11-1999
		US 6548120 B1	15-04-2003
WO 9902772 A1	21-01-1999	AT 219536 T	15-07-2002
		AU 8365898 A	08-02-1999
		BG 63849 B1	31-03-2003
		BG 104046 A	31-07-2000
		BR 9810569 A	19-09-2000
		CA 2295075 A1	21-01-1999
		CZ 9904763 A3	16-08-2000
		DE 1012377 T1	02-11-2000
		DE 69806168 D1	25-07-2002
		DE 69806168 T2	28-11-2002
		EE 200000009 A	15-08-2000
		EP 1012377 A1	28-06-2000
		ES 2147169 T1	01-09-2000
		HU 0003123 A2	28-02-2001
		PL 337972 A1	11-09-2000
		PT 1012377 E	31-10-2002
		RU 2208079 C2	10-07-2003
		WO 9902772 A1	21-01-1999
		ZA 9806082 A	26-01-1999
WO 03010055 A1	06-02-2003	CN 1535232 A	06-10-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 20 1668

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15-06-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		WO 03010055 A1	06-02-2003
WO 9857861 A1	23-12-1998	AU 8116298 A	04-01-1999
		DE 69808085 D1	24-10-2002
		DE 69808085 T2	28-05-2003
		EP 0989943 A1	05-04-2000
		ES 2184290 T3	01-04-2003
		US 5988881 A	23-11-1999
		WO 9857861 A1	23-12-1998

EPO FORM P0459

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 9902772 A **[0003]**