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(54) **HEAT-SEALABLE WRAPPING PAPER**

(57) The present invention relates to a, preferably heat-sealable, coated paper comprising a cellulose layer and at least a coating on at least one side of the cellulose layer, wherein the coating comprises a styrene-butadiene copolymer and a packaging comprising the coated paper, as well as a method of manufacturing coated paper.

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Description**Technical field of the invention**

5 **[0001]** The present invention relates to a coated paper, and method for the manufacture thereof.

Prior art

10 **[0002]** In the last ten decades, plastics became the dominant material for the production of a multitude of products due to their low costs and durability. On the other hand, the chemical structure of plastics renders them resistant to many natural processes of degradation and as a result, they are slow to degrade. The high level of plastic production together with the extremely slow degradation of this material have led to a high prominence of plastic pollution in the environment, especially in the oceans. In order to reduce the amount of plastic produced, it has been proposed a total single use plastic ban. Single use plastics, or disposable plastics, are used only once before they are thrown away. These items

15 include, among others, most packaging materials.
[0003] The use of plastic films as packaging materials was considered advantageous in that the material can be folded according to the outer shape of the object and this can then be heat-sealed.

[0004] There is a need for a heat-sealable wrapping paper that does not contain plastic.

20 **Summary of the invention**

[0005] It is an object of the present invention to provide a coated paper that can be used for single use packaging (such as toilet, kitchen paper rolls etc.). The coated paper of the present invention, has good workability (i.e. can be easily folded) and can be produced on standard paper machine. The coated paper is preferably heat-sealable and more

25 preferably a heat-sealable wrapping paper. The heat-sealability of the paper renders the same suitable to be utilized on the same machine used for plastic packaging. This is a big advantage for companies manufacturing packaging of different products in that the change of raw material for the packaging will not require additional investment.
[0006] A further advantage of the coated paper of the present invention, compared to standard paper, is that the application of additional adhesive material on the sealing lines of the packaging is not necessary. This leads to a reduction

30 of the costs for the production (i.e. simpler devices).
[0007] The coated paper according to the present invention has a coating as described in the appending claims and can be used as packaging of different products such as toilet and kitchen paper rolls.

Detailed Description of the Invention

35 **[0008]** The present invention provides a coated, preferably heat-sealable, paper comprising (or consisting of) a cellulose layer and a coating on at least one side of the cellulose layer, wherein the coating comprises styrene-butadiene copolymer.

[0009] The coated paper according to the invention is particularly suitable for packaging, in particular by utilizing the heat-sealability of the coated paper, and offers an environmentally friendly alternative to plastic packaging. The heat-sealing functionality is achieved during the paper production process using standard paper machines. In addition, the

40 paper performs well on existing form-, fill- and seal packing lines. Accordingly, the present invention is also concerned with a packaging comprising the coated paper according to the present invention and with a packaging prepared using the coated paper according to the present invention, namely heat-sealing the coated paper.
[0010] The coating comprising styrene-butadiene copolymer (also "SBR" hereinafter) shows many advantages over other coatings and these will be apparent from the description below. In the present invention, the coating preferably comprises at least 50 wt.-%, more preferably at least 80 wt.-%, still more preferably at least 90 wt.-%, and most preferably at least 95 wt.-% of SBR in terms of the weight of the coating, with the remainder preferably being other polymers. The other polymers are preferably selected from the group consisting of polyvinyl alcohol, polyvinyl acetate, polyvinyl chloride, acrylates, polyurethanes and combinations, in particular blends thereof.

50 **[0011]** Any styrene-butadiene copolymer can be used in the present invention provided that said copolymer can be dispersed in water. Styrene butadiene latex is preferably used for forming the coating. Examples thereof include LITEX SX 9130 sold by Synthomer.

[0012] In the present invention, the coating can be present on one side only of the cellulose layer or on both sides.

55 **[0013]** The SBR coating on at least one side of the cellulose layer has a basis weight of 1 to 10 g/m² and preferably from 2 to 7 g/m². When the SBR coating is applied on both sides of the cellulose layer the basis weight is 1 to 10 g/m² and, preferably, 2 to 7 g/m², per each side. More specifically, when the cellulose layer comprises an SBR coating on both sides the total basis weight of the SBR coating is 2 to 20 g/m² and preferably 4 to 14 g/m².

[0014] The SBR coating used in the present invention is not sticky at room temperature and will seal only at temperature

of 120-250 °C, preferably 150-200 °C. The SBR coating is particularly suitable for this application in that it shows excellent heat-sealability even for very little amount of SBR on the layer.

[0015] The cellulose layer used in the present invention preferably is a nonwoven comprising natural fibers or mixture thereof. A person skilled in the art knows, on account of his knowledge and experience, that the correct composition of natural fibers can be specifically selected depending on the desired properties. Examples of natural fibers are cellulose, cotton, wool, hemp, Eucalyptus, NSBK, regenerated celluloses and fibrillated celluloses. Preferably, the cellulose layer used in the invention consists of natural fibers. In other words, only natural fibers are present in the cellulose layer and no other types of fibers. However, the cellulose layer can comprise other substances such as additives and sizing agents.

[0016] Any additive commonly used in the field of paper making can be present in the cellulose layer.

[0017] The cellulose layer can comprise sizing agents in an amount of 0.1-5.0 wt.-% and preferably 1.5-2.5 wt.-% based on the total weight of the cellulose layer. If the cellulose layer is also saturated (as explained below), the amount of sizing agent is calculated based on the total weight of the cellulose layer before saturation (and, accordingly, before coating). Any known sizing agent as used in the paper industries can be used in the cellulose layer. The sizing agent is preferably added to the cellulose pulp (i.e. is an internal sizing agent). Examples thereon include alkyl ketene dimers and/or styrene-acrylate-copolymers. In accordance with the present invention, the sizing agent(s) will improve the deposition of the coating on the cellulose layer and enhance the effectiveness of the coating in the sense that less coating is needed to achieve the desired effect.

[0018] The cellulose layer has a basis weight of 20 to 50 g/m² and, preferably, 30 to 40 g/m². The cellulose layer has a thickness of 40-70 μm, preferably 50-60 μm.

[0019] The present invention also provides a method for preparing coated paper, in particular the coated paper as defined above, comprising the steps of providing a cellulose layer, applying an aqueous dispersion of a styrene-butadiene copolymer to at least one surface of the cellulose layer and drying the cellulose layer with the aqueous dispersion of a styrene-butadiene copolymer on its surface to form a coating, and optionally saturating the cellulose layer before forming the coating.

[0020] Preferably, in the step of forming the coating on the cellulose layer, the styrene-butadiene copolymer is applied to both sides of the cellulose layer.

[0021] In another preferred embodiment, the cellulose layer is saturated and the coating is formed on only one side of the cellulose layer.

[0022] The cellulose layer can optionally be saturated before application of the SBR coating. Any resin, commonly used to saturate paper, can be used in the present invention but the saturation is preferably performed with aqueous dispersion based on styrene butadiene latex. In the present invention, the resin used to saturate the cellulose layer comprises at least 50 wt.-%, more preferably at least 80 wt.-%, still more preferably at least 90 wt.-%, and most preferably at least 95 wt.-% of SBR copolymer in terms of the weight of the total polymer present in the saturation, with the remainder preferably being other polymers. The other polymers are preferably selected from the group consisting of polyvinyl alcohol, polyvinyl acetate, polyvinyl chloride, acrylates, polyurethanes and combinations, in particular blends thereof. In the present specification, the term "saturation" is understood as synonymous with "impregnation". The amount of saturation resin in the heat-sealable paper is 2-15 g/m², preferably 3 to 12 g/m², and even more preferably 4-10 g/m². It is preferable to saturate the cellulose layer when the coating is applied on only one side of the cellulose layer. By using a saturated cellulose layer, the cohesion between the uncoated side and the coated side of the cellulose layer can be improved. This is advantageous for the use as heat-sealable wrapping paper.

[0023] A "coating" within the meaning of the present invention is a film formed on the surface of the cellulose layer. The coating is preferably a polymer-based film on the surface of the cellulose layer, more preferably a polymer-based film, adherent film, and most preferably a continuous film covering the complete surface of at least one side of the cellulose layer. That is, preferably no fibers of the cellulose layer are exposed to the outside in the coated paper according to the present invention. The coating allows the provision of a paper having high gloss and high smoothness of the surface. Conventional saturated or impregnated paper exhibits much lower surface gloss and smoothness. The coating can bind through heat-sealing the coated paper to itself or to another material, in particular to another coated paper according to the present invention, thus avoiding the need of further adhesive.

[0024] The coating may be formed by applying a surface coating composition to the surface of the cellulose layer and subsequently curing and/or drying the surface coating composition. The surface coating composition may be applied to the surface of the cellulose layer by spraying, brushing, or rolling. Upon application to the surface, the surface coating composition undergoes film formation. Preferably, a liquid surface coating composition of relatively low viscosity is applied to the cellulose layer and is cured to form a solid, high-molecular-weight, polymer-based adherent film. The coating may also be formed by coalescence-based film formation. Coalescence-based film formation takes place with polymer particles dispersed in a liquid phase, preferably with latex polymers, and most preferably with water-dispersed styrene-butadiene copolymers.

[0025] An aqueous dispersion of a styrene-butadiene copolymer within the meaning of the present invention is an "SBR latex" or a "styrene-butadiene latex".

[0026] The surface coating composition may comprise a film-forming component and a solvent. The film-forming component is preferably a water-dispersible polymerizable material and more preferably water-dispersed styrene-butadiene copolymer. The surface coating composition may optionally comprise pigments and/or other additives.

[0027] Saturation can be distinguished from coating in that during saturation the resin penetrates into the cellulose layer. In contrast, the coating remains on the surface of the layer. Thus, saturation does not result in the formation of a continuous film on the surface of the cellulose layer.

[0028] The coated paper of the present invention can be produced using wet-laying processes known to the skilled person. When additives such as wet strength- and/or sizing agents are present in the cellulose layer, these are added to the pulp.

[0029] The saturation can be carried out according to any known method such as in a dip bath, which is then squeezed off with rollers.

[0030] The coating can be applied with an air brush, a "Mayer Bar", a "Speed Sizer", a roller blade, an anilox roller or a "Blade Coater". Another possibility to apply the coating on the cellulose layer is by means of air knife coating.

[0031] The SBR coating, as well as the saturation step, where applicable, can be performed online and since the solvent is water no emission problem will arise.

[0032] The coated paper according to the present invention preferably has a basis weight of 25-70 g/m², more preferably 30-60 g/m² and even more preferably 35-55 g/m². Such a low grammage product has the required flexibility and stiffness so that it can be used as packaging material. If the basis weight is lower than 25 g/m², the paper easily tears so as to be unsuitable to be used as packaging. In contrast, if the basis weight is higher than 70 g/m² than the paper is not flexible anymore.

[0033] The coated paper according to the present invention may have a thickness of 35 - 70 µm, preferably 40 - 60 µm.

[0034] The tensile strength of the coated paper according to the present invention in machine direction is preferably 40-90 N/15mm, more preferably 60-80 N/15mm. The tensile strength of the heat sealable paper in cross direction is 20-70 N/15mm, preferably 30-50 N/15mm.

[0035] The bending stiffness of the coated paper according to the present invention in machine direction is preferably 0.12-0.5 Nmm and, more preferably 0.19-0.35 Nmm. The bending stiffness in cross direction is preferably 0.01-0.1 Nmm and, more preferably, 0.01-0.05 Nmm.

[0036] The Cobb value of the coated paper as measured on a side comprising the SBR coating is preferably 1-20 g/m² and, more preferably 2-12 g/m² and even more preferably 3-8 g/m².

[0037] The minimum folding endurance in machine direction is preferably 500-5000 number of double folds, more preferably 1500-4000 and even more preferably 1800-3500.

[0038] The minimum folding endurance in cross direction is preferably 300-4000 number of double folds, more preferably 1300-3500 and even more preferably 1800-3000.

[0039] The coated paper according to the present invention preferably has a tear resistance in machine direction of 80-400 mN, more preferably 100-320 mN and even more preferably 150-250 mN. The tear resistance in cross direction is preferably 80-450 mN, more preferably 120-350 mN and even more preferably 200-300 mN.

[0040] The coated paper according to the present invention preferably has an elongation at break in machine direction 1.5-4.5%, more preferably 1.8-4.0% and even more preferably 2.0-3.0%. The elongation at break in cross direction is preferably 6-20%, more preferably 8-15% and even more preferably 10-13%.

[0041] The coated paper according to the present invention has a Gurley smoothness (as measured on the side with the coating) equal to or higher than 200 Gurley seconds. The standard Gurley smoothness (as measured on the side with the coating) is preferably 200-850 Gurley seconds, more preferably 300-700 Gurley seconds and even more preferably 350-600 Gurley seconds.

[0042] The coated paper according to the present invention preferably has a gloss (as measured on the side with the coating), measured at 60°, of 8-40 GU (GU=gloss unit), preferably 9-30 GU and even more preferably 10-25 GU.

[0043] In a preferred embodiment, the coated paper according to the present invention has a basis weight of 30-60 g/m², a thickness of 35-70 µm, a tensile strength of the paper in machine direction of 40-90 N/15mm, and a tensile strength in cross direction of 20-70 N/15mm.

[0044] In a more preferred embodiment, the coated paper according to the present invention has a basis weight of 35-55 g/m², a thickness of 40-60 µm, a tensile strength of the paper in machine direction of 60-80 N/15mm, and a tensile strength in cross direction of 30-50 N/15mm.

[0045] In another preferred embodiment, the coated paper according to the present invention has a basis weight of 30-60 g/m², a thickness of 35-70 µm, a tensile strength of the paper in machine direction of 40-90 N/15mm, a tensile strength in cross direction of 20-70 N/15mm, a tear resistance in machine direction of 100-320 mN, a tear resistance in cross direction of 120-350 mN, an elongation at break in machine direction of 1.8-4.0%, and an elongation at break in cross direction of 8-15%.

[0046] In a more preferred embodiment, the coated paper according to the present invention has a basis weight of 35-55 g/m², a thickness of 40-60 µm, a tensile strength of the paper in machine direction of 60-80 N/15mm, a tensile

strength in cross direction of 30-50 N/15mm, a tear resistance in machine direction of 150-250 mN, a tear resistance in cross direction of 200-300 mN, an elongation at break in machine direction of 2.0-3.0%, and an elongation at break in cross direction of 10-13%.

[0047] In another more preferred embodiment, the coated paper according to the present invention has a basis weight of 30-60 g/m², a thickness of 35-70 μm, a tensile strength of the paper in machine direction of 40-90 N/15mm, a tensile strength in cross direction of 20-70 N/15mm, a bending stiffness in machine direction of 0.12-0.5 Nmm, a bending stiffness in cross direction of 0.01-0.1 Nmm, a Cobb value measured on a side comprising the coating of 2-12 g/m², a minimum folding endurance in machine direction of 1500-4000 double folds, a minimum folding endurance in cross direction of 1300-3500 double folds, a tear resistance in machine direction of 100-320 mN, a tear resistance in cross direction of 120-350 mN, an elongation at break in machine direction of 1.8-4.0%, an elongation at break in cross direction of 8-15%, Gurley smoothness of 300-700 Gurley, and seconds, a gloss of 9-30 GU (GU=gloss unit).

[0048] In a most preferred embodiment, the coated paper according to the present invention has a basis weight of 35-55 g/m², a thickness of 40-60 μm, a tensile strength of the paper in machine direction of 60-80 N/15mm, a tensile strength in cross direction of 30-50 N/15mm, a bending stiffness in machine direction of 0.19-0.35 Nmm, a bending stiffness in cross direction of 0.01-0.05 Nmm, a Cobb value measured on a side comprising the coating of 3-8 g/m², a minimum folding endurance in machine direction of 1800-3500 double folds, a minimum folding endurance in cross direction of 1800-3000 double folds, a tear resistance in machine direction of 150-250 mN, a tear resistance in cross direction of 200-300 mN, an elongation at break in machine direction of 2.0-3.0%, an elongation at break in cross direction of 10-13%, Gurley smoothness of 350-650 Gurley, and seconds, a gloss of 10-25 GU (GU=gloss unit).

Example 1

[0049] A heat sealable paper has been produced on a paper machine. Only cellulose fibers have been used for the cellulose layer (i.e. 100% cellulose fibers) in combination with other additives commonly used for paper production. Alkyl ketene dimers have been used as sizing agents. In this example the cellulose layer has been impregnated with 5 g/m² SBR latex and consequently coated on one side with 5 g/m² of SBR latex.

[0050] The features of the so obtained heat sealable paper are listed in Table 1. In table 1, the acronym MD means machine direction and CD means cross direction.

Table 2

	Heat sealable paper
Thickness (μm)	55
Basis weight (g/m ²)	46
Tensile strength MD (N/15 mm)	71.8
Tensile strength CD (N/15 mm)	40.8
Bending stiffness MD (Nmm)	0.24
Bending stiffness CD (Nmm)	0.02
Cobb Value (g/m ²)	4
Minimum Folding endurance MD (number of double folds)	3000
Minimum Folding endurance CD (number of double folds)	2000
Tear resistance MD (mN)	230
Tear resistance CD (mN)	250
Elongation at break MD (%)	2.5
Elongation at break CD (%)	12.5
Gurley smoothness ^A (Gurley seconds)	458
Gloss ^A (GU)	11,4
^A Measured on the coated side	

Tests Methods

[0051] Standard atmospheres for conditioning and testing: according to DIN EN 20187:1993. The sample were first conditioned and then tested to determine the features indicated below.

[0052] Basis weight: according to ISO 536:2012.

[0053] Thickness: according to EN ISO 534:2011 with a compressive load of 1.0 bar.

[0054] Tensile strength and elongation at break: according to DIN EN ISO 1924-2:2008 but sample width of 15 mm; test length 100 mm; and rate of elongation of 150 mm/min.

[0055] Bending stiffness: measured with CREUSOT-LOIRE Instrumentation (adamel-Ihomargy 15 Avenue Jean Jaures 94201 Ivry/Seine; licence Kodak Pathe). Sample are conditioned according to DIN EN 20187. From these samples, at least 8 measuring strips 15 mm wide and 150 mm long are cut longitudinally and transversely to the machine direction. The samples shall be free from wrinkles, creases, creases, holes, watermarks and other irregularities. The experiments are carried out in the same climate in which the sample pretreatment has taken place. Before starting the test, check that the free length of zero (that is, if the sample top is flush with the top edge of the swing clamp), the display on the scale is also zero. The resonance is achieved when the free length of the sample has a maximum deflection. When the resonance is reached, the free length, which is then equal to the resonance length, is read on the scale. After reading the resonance length, one will quickly come out of the resonance range by carefully pulling the sample further. (Can be repeated any number of times).

[0056] From the measured resonance lengths, the arithmetic mean value is calculated separately for samples along and transversely to the machine direction, and from this the specific bending stiffness is calculated.

$$S \text{ [N mm]} = 20 \times (l/100)^4 \times (m_A/100)$$

l= value read [mm] (Resonance length)

m_A= basis weight [g/m²]

S= bending stiffness

Biegesteifigkeit

[0057] Cobb Value: according to ISO 535:2014. The sample were measured after 10 minutes.

[0058] Folding endurance: This test is to find the number of double folds required to break a 15 mm wide strip of paper under a tension load of 1000 grams.

[0059] Instrument: A Massachusetts Institute of Technology Folding Endurance Tester made by Tinius Olsen Testing Machine Company (Phila. USA).

[0060] The test sample is a strip of 15 mm wide and at least 6"long.

[0061] Work instruction: i) ensure the switch is "off"; ii) turn the knob on the motor so that the jaws of the bottom clamp point upward; iii) place the strip in the top and bottom clamps so that it is straight and centered in the clamps; iv) tighten the top clamp; v) place 1 Kg weight onto the top platform, align the sample strip and tighten the bottom clamp; vi) remove weight from the platform and ensure the counter is set to zero; vii) turn the machine on; take the reading when the strip breaks. The test is repeated 5 times and the minimum folding endurance corresponds to the average value of the 5 tests.

[0062] Tear resistance: according to ISO 1974:2012 by using L & Tearing Tester from Lorentzen & Wettre (code 009, type 961701, number 5625) with pendulum: code A-pend, type 962035, number 1269. Two single layers have been used for the test.

[0063] Gloss: according to ISO 2813:2015-02. The measurement has been performed using BYK Gardner micro-Trio-gloss (CAT-No. 4520; Ser. No. 197383). The measuring angle depends on the gloss unit and corresponds to:

- 60° when the gloss is 10-70 GU;
- 85° when the gloss is <10 GU;
- 20° when the gloss is >70 GU.

[0064] Smoothness: measured using GENUINE GURLEY Automatic Densometer 4340 from Rycobel Group (Mod. 4340N; Ser. 1802947; Ref. 7216.9715). Setting: i) Test: Smoothness/Standard Gurley Smoothness; ii) Measuring surface: 1,0 square inch; iii) Air: 100 cc.

Claims

1. A coated paper comprising a cellulose layer and at least a coating on at least one side of the cellulose layer, wherein

the coating comprises styrene-butadiene copolymer.

2. The coated paper according to claim 1, wherein the basis weight of the coating on one side of the cellulose layer is 1 to 10 g/m².
3. The coated paper according to claim 1 or 2, wherein the coating is present only on one side of the cellulose layer.
4. The coated paper according to claim 3, wherein the cellulose layer is saturated at least on the side of the cellulose layer opposite to the coating.
5. The coated paper according to claim 1 or 2, wherein the coating is present on both sides of the cellulose layer.
6. The coated paper according to claim 4, wherein the basis weight of the coating on each side of the cellulose layer is 1 to 10 g/m².
7. The coated paper according to any one of claims 1 to 6, wherein the cellulose layer has a basis weight of 20 to 50 g/m².
8. The coated paper according to any one of claims 1 to 7, wherein the heat sealable paper has a basis weight of 25 to 70 g/m².
9. The coated paper according to any one of claims 1 to 8, wherein the cellulose layer comprises an internal sizing agent.
10. The coated paper according to any one of claims 1 to 9, which is heat sealable.
11. A packaging comprising the coated paper according to any one of claims 1 to 10.
12. A method of manufacturing coated paper comprising the steps of providing a cellulose layer, applying an aqueous dispersion of a styrene-butadiene copolymer to at least one surface of the cellulose layer and drying the cellulose layer with the aqueous dispersion of a styrene-butadiene copolymer on its surface to form a coating, and optionally saturating the cellulose layer before forming the coating.
13. The method according to claim 12, wherein in the step of forming the coating, the dispersion of styrene-butadiene copolymer is applied to both sides of the cellulose layer.
14. The method according to claim 12, wherein the step of saturating the cellulose layer is performed, and in the step of forming the coating, the dispersion of styrene-butadiene copolymer is applied to only one side of the cellulose layer.



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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 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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