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(54) Title: FLUFF PULP

(57) Abstract: The present invention is directed to fluff pulp having a Kappa number in the range of from 5 to 18 and having, when in the form of a dry sheet, ISO brightness in the range of from 30 to 60% and having a specific volume in the dry defibrated state of at least 19 dm³/kg and having absorption time in the range of from 2 to 4 seconds.



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FLUFF PULP

Field of the invention

5 The present invention is directed to a fluff pulp having a Kappa number in the range of from 5 to 18 and having, when in the form of a dry sheet, ISO brightness in the range of from 30 to 60% and having a specific volume in the dry defibrated state of at least 19 dm³/kg and having absorption time in the range of from 2 to 4 seconds. The invention is also directed to a process for producing such fluff pulp and to the use thereof.

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Background

Fluff pulp is commonly made from softwood pulp from sulphate pulping.
15 Depending on the pulping method, the properties of fluff pulp differs. Raw materials for softwood pulp may be various softwood species, such as Scandinavian pine, spruce, Southern pine, Loblolly pine, slash pine, Radiata pine, Douglas fir, Hemlock Cedar, White spruce, Lodgepole pine, Alpine fir or mixtures thereof.

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Bleaching is a common method for removing lignin and colored compounds left after the pulp cooking and thereby increasing the brightness of pulp, including fluff pulp. Industry practice for improving appearance of fluff pulp is to bleach the pulp to desired of brightness (the Technical Association of the
25 Pulp & Paper Industry ("TAPPI") or the International Organization for Standardization ("ISO")). The final ISO brightness of bleached pulps is between 85-94%. However, bleaching is expensive, represents a significant load on the environment and is often a source of manufacturing bottleneck.

Pulp is bleached or delignified in sequences and several bleaching steps and several bleaching chemicals need to be used to reach the desired brightness level. Examples of bleaching chemicals are oxygen, hydrogen peroxide, ozone, peracetic acid and chlorine dioxide.

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In view of the production cost, resource requirement and environmental impact of bleaching, it would be desirable to be able to achieve adequate fluff pulp properties, in particular sufficient absorption, but use less resources.

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Summary of the invention

The present invention is directed to fluff pulp having a Kappa number in the range of from 5 to 18 and having, when in the form of a dry sheet, ISO
15 brightness in the range of from 30 to 60% and having a specific volume in the dry defibrated state of at least 19 dm³/kg and having absorption time in the range of from 2 to 4 seconds.

It has surprisingly been found that fluff pulp with adequate properties can be
20 produced with significantly less use of resources, in particular less use of chemicals and energy.

The present invention is also directed to a method to produce said fluff pulp.

25 The present invention is also directed to the use of said fluff pulp. The fluff pulp is produced and delivered to customers in the form of rolls. The fluff pulp is first defibrated. The defibrated pulp is then used in the manufacture of for example absorption cores for hygiene products and in airlaid-nonwoven for various applications such as diapers, incontinence products, feminine hygiene
30 products etc.

Detailed description

As used herein, the term, "fluff" means defibrated, i.e. fiberized or shredded fluff pulp.

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As used herein, the term "Kappa number" refers to measurement of Kappa number according to the standard ISO 302:2015.

10 The Kappa number of the fluff pulp according to the present invention is in the range of from 5 to 18, preferably in the range of 5 to 15, such as in the range of 6 to 15, more preferably in the range of from 5 to 12 or from 9 to 13.

As used herein, the term "ISO Brightness" refers to measurement of brightness according to the ISO standard 2470.

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The ISO Brightness of the fluff pulp according to the present invention, when in the form of a dry sheet (i.e. before defibration), is in the range of from 30 to 60%, preferably in the range of from 35 to 55% or from 30 to 40%, more preferably in the range of from 36 to 50% or from 34 to 39%.

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As used herein, the specific volume of the fluff (i.e. after defibration of the fluff pulp, i.e. in the defibrated state) in the dry state, refers to the specific volume determined according to the standard SCAN-C 33:80, which involves the determination of the volume of a test specimen in dry state per mass unit (weight) of fluff. A 3g fluff sample, 50 mm in diameter, is formed in a forming unit. The sample is placed in the sample holder and a load of 2.8 kPa is applied. The specific dry volume is measured after 30 seconds (average of 5 replicates).

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30 The specific volume in the dry state of the fluff (conditioned according to ISO187) according to the present invention is at least 19 dm³/kg, preferably in the range of from 19 to 23 dm³/kg, such as from 19 to 22 dm³/kg.

As used herein, the term "absorption time" refers to the absorption properties of fluff pulp according to the standard SCAN-C 33:80, which involves the determination of the time consumed to completely saturate a standardized test specimen with absorbed liquid. A 3g fluff sample, 50 mm in diameter, is

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formed in a forming unit. The sample is placed in a sample holder and a load of 2.8 kPa is applied. Tap water (23°C) is applied underneath and the time required for the water to reach the top of the sample is recorded (average of 5 replicates).

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As used herein, the term "absorption capacity" refers to the absorption capacity properties of fluff pulp according to the standard SCAN-C 33:80. A 3g fluff sample, 50 mm in diameter, is formed in a forming unit. The sample is placed in the sample holder and a load of 2.8 kPa is applied. Tap water (23°C) is applied underneath and the time required for the water to reach the top of the sample is recorded. After 30 seconds the addition of water stops. After additional 30 seconds the absorption capacity is recorded by measuring the weight of the test piece (average of 5 replicates).

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As used herein, the "knot content" of the fluff pulp refers to the knot content measured by using Alpine Air Jet with screen DIN ISO 3310 1.4 mm. A sample of fluff is agitated for 10 minutes above a wire using 4000 kPa negative pressure. The knots remaining on the wire are weighed and reported as a percentage of the total sample weight (average of two replicates).

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The knot content of the fluff pulp according to the present invention is preferably less than 13%.

The fluff pulp according to the present invention can be produced by the steps of

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- a) preparing sulphate pulp;
- b) washing, screening and cleaning the pulp;
- c) subjecting the pulp to oxygen delignification;
- d) washing the pulp that has been subjected to oxygen delignification and optionally adjusting the pH of the pulp;
- e) drying the pulp to obtain fluff pulp, having a moisture content of less than 10 weight-%, in the form of a roll.

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The pulp is sulphate pulp (Kraft pulp). The fibers of the fluff pulp according to the present invention preferably originate from softwood such as spruce and/or pine. Preferably, the sulphate pulp originates to at least 90% from softwood, less than 10% hardwood has been used in the preparation of the

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5 sulphate pulp. Thus, the sulphate pulp mainly originates from softwood but may contain traces of hardwood. The length-weighted average fiber length (measured on Metso Pulp Expert) is preferably in the range of from 1.8 to 2.5 mm, such as 1.9 to 2.2 mm. The pulp is washed, screened and cleaned before being subjected to the oxygen delignification step.

10 The oxygen delignification step is carried out using methods known in the art and can be carried in one or multiple steps. The pulp of is subjected to the oxygen delignification step in a wet state. Preferably the oxygen delignification is carried out until the pulp subjected to oxygen delignification has reached a Kappa number in the range of from 5 to 18.

15 The pulp that has been subjected to oxygen delignification is washed. The washing is typically carried out using water and may be carried out in one or more steps and may involve filtration. As part of the washing or immediately after the washing step, the pH may be adjusted. Preferably, the pH of the washed pulp should in the range of from 5 to 8, such as from 5 to 7. The washed pulp preferably contains less than 0.5 weight-% (based on the solids) extractives, more preferably less than 0.2 weight-% extractives, even more preferably less than 0.1 weight-% extractives and most preferably less than 20 0.05 weight-% extractives. In this context, extractives are for examples resins and fatty acids.

25 Optionally, hydrogen peroxide may be added to the washed pulp prior to the drying step.

The washed pulp is dried on a drying machine using methods known in the art. The dry pulp is formed into rolls after drying. The dried material has a moisture content of less than 10 weight-% (ISO 287), preferably less than 9%, 30 such as in the range of from 6 to 9 weight-%.

Preferably, the fluff pulp according to the present invention has not been subjected to bleaching. More preferably, the fluff pulp according to the present invention has not been subjected to ECF (elemental chlorine free) or 35 TCF (totally chlorine free) bleaching.

The fluff pulp may be treated with aluminum sulphate solution and pH adjusted to 5.5 to 6.5 in the stock preparation of the drying machine to decrease the defibration energy and knot content. The treatment has minor effect on absorption properties.

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The fluff (i.e. the defibrated form of the fluff pulp) according to the present invention can be used in articles and products wherein fluff is typically used. Thus, the fluff can be used in absorption cores in baby diapers, incontinence products and feminine hygiene products. The fluff is also the main component in airlaid nonwoven.

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Thus, the fluff pulp according to the present invention can, following defibration, for example be used in absorption cores and in airlaid nonwovens. It can be used as or in a liquid absorption material such as in
15 absorbents in diapers, such as baby diapers as well as incontinence products. It can also be used for example in napkins and tissues. Such products can be produced using methods known in the art. The products typically comprise one or more further components, such as superabsorbents, polymers, wetting agents, viscose/rayon/lyocell fibers, bicomponent fibre,
20 cotton fiber, other fibers, standard latex binder, specialty latex binder etc.

Examples

25 Example 1

Kraft pulp samples were collected from immediately after a production-scale pulp digester ("unbleached"), after a subsequent step of oxygen delignification ("oxygen delignified") and after a bleaching step ("bleached"). Thus, the
30 "bleached" sample had been subjected to both oxygen delignification and bleaching.

Each pulp sample was rinsed thoroughly with water, centrifuged, granulated and stored in a fridge prior to analysis.

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Laboratory sheets were formed from each type of pulp. The laboratory sheets were defibrated using a laboratory hammer mill (Kamas H01).

Chemical and fluff properties were tested according to the standard test methods. The results obtained are illustrated in table 1. The Kappa number was measured on the dry sheet formed. The ISO Brightness was measured on the dry sheet formed. The specific volume, absorption time and absorption capacity were measured on the fluffed material, i.e. after defibration. The sheet and pulp properties were evaluated in conditioned climate according to ISO 187.

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Table 1. Chemical and fluff properties

Sample	Kappa number	ISO Brightness, %	Specific volume, dry state, dm³/kg	Absorption time, s	Absorption capacity, g/g
Unbleached	25	24	22	10.5	10.0
Oxygen delignified	11	36	20.5	3	9.2
Bleached	1	87	21	2.5	9.5

It can be seen from the results reported in table 1 that the absorption properties as well as fluff properties (specific volume) are almost identical for the bleached fluff pulp as compared to the oxygen delignified fluff pulp.

Example 2

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Kraft pulp samples were collected from immediately after a production-scale subsequent step of oxygen delignification ("oxygen delignified") and after a bleaching step ("bleached"). Thus, the "bleached" sample had been subjected to both oxygen delignification and bleaching.

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Then the pulp was centrifuged, granulated and stored in dark plastic bags in refrigerator at 25 to 30% dry content. Pulp for one sheet was soaked and wet disintegrated. The pulp suspension was pH adjusted to 5.8, agitated for 10

minutes and then dewatered in a sheet former. Some of the samples were treated with $\text{Al}_2(\text{SO}_4)_3$ solution and then pH-adjusted with NaOH to 5.8.

The wet sheets were pressed and dried to a moisture content of <7%.

Chemical and fluff properties were tested according to the standard test methods. The results obtained are illustrated in table 1. The Kappa number was measured on the dry sheet formed. The ISO Brightness was measured on the dry sheet formed. The specific volume, absorption time and absorption capacity were measured on the fluffed material, i.e. after defibration. The sheet and pulp properties were evaluated in controlled climate conditions according to ISO 187.

Table 2. Chemical and fluff properties

Sample	$\text{Al}_2(\text{SO}_4)_3$ solution, l/BDt	Kappa number	ISO Bright- ness, %	Specific volume, dry state, dm^3/kg	Ab- sorption time, s	Ab- sorption capacity, g/g
Oxygen delignified	0	9	39	22	3.2	9.4
Oxygen delignified	30	9	41	22	3.1	9.8
Oxygen delignified	45	9	40	22	3.1	9.8
Oxygen delignified	80	9	40	22	2.6	9.2
Bleached	30	1	86	21	2.3	9.7
Bleached	80	1	86	22	2.6	9.9

It can be seen from the results reported in table 2 that the absorption properties as well as fluff properties (specific volume) are almost identical for the bleached fluff pulp as compared to the oxygen delignified fluff pulp. The treatment with aluminum sulphate solution has minor effect on the absorption properties.

Example 3

5 A production trial was performed on a sulphate pulp fiber line with a drying machine for fluff pulp. The sulphate pulp was oxygen delignified and either bleached or unbleached. The kappa number of the pulp measured on-line after the oxygen delignification was between 8 and 11. The bleached reference fluff pulp was produced at the same fiber line, but this pulp was bleached in the bleaching plant to a kappa number of 1.

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At the drying machine the pulp for trial point 2 and trial point 3 was treated with $\text{Al}_2(\text{SO}_4)_3$ and pH-adjusted with NaOH.

15 Fluff properties were tested according to the standard test methods. The results obtained are illustrated in table 1. The ISO Brightness was measured on the fluff pulp. The knot content, the specific volume, absorption time and absorption capacity were measured on the fluffed material, i.e. after defibration. The sheet and pulp properties were evaluated in controlled climate conditions according to ISO 187.

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Table 3. Chemical and fluff properties

Sample	Kappa number , wet pulp	Al ₂ (SO ₄) ₃ solution, l/BDt	ISO Brightness, %	Knot content, %	Specific volume, dry state, dm ³ /kg	Ab-sorption time, s	Ab-sorption capacity, g/g
Trial point 1 Oxygen delignified	8-11	0	45-46	17-18*	22	3.3-3.4	9.8
Trial point 2 Oxygen delignified	8-11	30	46-50	6-8*	22-23	3.3-3.4	9.9-10.0
Trial point 3 Oxygen delignified	8-11	80	47-48	6-8**	21	2.6-2.8	9.0-9.3
Reference Bleached	1	20	89-90	12*	21	2.4	9.8

* Fluff defibretad in Kamas H01 hammer mill att 3600 rpm

** Fluff defibretad in Kamas H01 hammer mill att 2500 rpm

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It can be seen from the results reported in table 3 that the absorption properties as well as fluff properties (specific volume) are almost identical for the bleached fluff pulp as compared to the oxygen delignified fluff pulp.

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In view of the above detailed description of the present invention, other modifications and variations will become apparent to those skilled in the art. However, it should be apparent that such other modifications and variations may be affected without departing from the spirit and scope of the invention.

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Claims

1. Fluff pulp having a Kappa number in the range of from 5 to 18 and having, when in the form of a dry sheet, ISO brightness in the range of from 30 to 60% and having a specific volume in the dry defibrated state of at least 19 dm³/kg and having absorption time in the range of from 2 to 4 seconds according to the standard SCAN-C 33:80.
2. Fluff pulp according to claim 1, wherein the ISO brightness is in the range of from 30 to 40%.
3. Fluff pulp according to claim 1, wherein the ISO brightness is in the range of from 35 to 50%.
4. Fluff pulp according to any one of claims 1-3, wherein the specific volume in the dry defibrated state is in the range of from 19 to 23 dm³/kg.
5. Fluff pulp according to any one of claims 1-4, wherein the Kappa number is in the range of from 5 to 12.
6. Fluff pulp according to any one of claims 1-4, wherein the ISO brightness is in the range of from 36 to 50%.
7. Fluff pulp according to any one of claims 1-6, in the form of a roll.
8. A process for preparing fluff pulp comprising the steps of
 - a) preparing sulphate pulp;
 - b) washing, screening and cleaning the pulp;
 - c) subjecting the pulp to oxygen delignification;
 - d) washing the pulp that has been subjected to oxygen delignification and optionally adjusting the pH of the pulp;
 - e) drying the pulp to obtain fluff pulp, having a moisture content of less than 10 weight-%, in the form of a roll.
9. A process according to claim 8 wherein the sulphate pulp is prepared from at least 90% softwood.

10. A process according to any one of claims 8 or 9, wherein the oxygen delignification is carried out until the pulp subjected to oxygen delignification has a Kappa number in the range of from 5 to 18.
- 5 11. A process according to any one of claims 8 to 10 that does not comprise any bleaching step.
12. Fluff pulp obtainable according to the process of any one of claims 8-11.
- 10 13. A product comprising or prepared from defibrated fluff pulp, wherein said fluff pulp is, prior to defibration, a fluff pulp according to any one of claims 1-7 or claim 12.
- 15 14. Airlaid nonwoven comprising or prepared from defibrated fluff wherein said fluff pulp is, prior to defibration, a fluff pulp according to any one of claims 1-7 or claim 12.
- 20 15. Absorption core comprising or prepared from defibrated fluff pulp, wherein said fluff pulp is, prior to defibration, a fluff pulp according to any one of claims 1-7 or claim 12.
16. Hygien product comprising absorption core according to claim 15.
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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, CHEM ABS Data, COMPENDEX, EMBASE, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"P" document published prior to the international filing date but later than the priority date claimed	

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Continuation of: second sheet

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Information on patent family members

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