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(71) Applicant: **STORA ENSO OYJ** [FI/FI]; P.O. Box 309, 00101 Helsinki (FI).

(72) Inventors: **HEISKANEN, Isto**; Kanava-aukio 10 as 13-14, 55100 Imatra (FI). **BACKFOLK, Kaj**; Imatrantie 13 A6, 53100 Lappeenranta (FI). **KANKKUNEN, Jukka**; Vuoksenniskantie 103 b 7, 55800 Imatra (FI). **SIPPUS, Tuomo**; Tinaajankatu 4 as 3, 15610 Lahti (FI).

(74) Agent: **LINNÉ, Nina**; STORA ENSO AB, Group IP, Box 9090, 65009 Karlstad (SE).

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(54) Title: FLUTING OR LINER COMPRISING NSSC PULP

(57) Abstract: The present invention relates to a fluting or liner for corrugated board comprising a neutral sulfite semi chemical (NSSC) pulp, wherein said NSSC pulp has an ash content of less than 1.8 wt%, as determined according to standard ISO 1762:2019. The invention further relates to a a corrugated board comprising the fluting and/or liner.

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FLUTING OR LINER COMPRISING NSSC PULP

Technical field

The present invention relates to a fluting or liner comprising neutral sulfite semi chemical (NSSC) pulp.

Background

Corrugated board (sometimes referred to as corrugated cardboard or corrugated fiberboard) is a packaging material which can be converted to different types of packaging solutions. Corrugated board is a fiber based material made from cellulose fibers, virgin or recycled from used corrugated cardboard or other materials.

The corrugated board comprises a corrugated medium (fluting) and at least non-corrugated medium (liner or linerboard) glued onto a surface of the corrugated medium. For example, the corrugated board may consist of a layer of fluting glued between two layers of liner to form a sandwich structure. The sandwich structure can be formed in different ways such as in single, double, and triple walls as described, e.g., in Kirwan M., J., Paper and Paperboard. Packaging Technology, Blackwell Publishing 2005.

One difficulty when producing corrugated board is the adhesion of the liner to the fluting. Too low adhesion causes delamination and addition of too much adhesive to ensure that the adhesion is sufficient can cause washboarding and curl of the corrugated board. It is important that the adsorption of the added glue into the liner and/or corrugated medium is optimal. If the adhesive is not adsorbed by the fluting/liner delamination will occur and the same will happen if it is adsorbed too much into the fluting/liner.

Examples of different types of liners are kraftliner and testliner. Kraftliner is typically produced from kraft pulp that can be bleached or unbleached and may comprise one or more layers/plies wherein the top layer/ply is often optimized to provide a good printing surface and good moisture resistance. Testliner is mainly

produced from recycled corrugated board and is commonly manufactured in two layers/plies. Due to the presence of recycled fibers, testliner may typically have lower mechanical strength, particularly lower burst strength, than kraftliner. Kraftliner is frequently used in packaging boxes with higher demands on strength properties.

Fluting is formed from paper or paperboard which has been corrugated using heat, moisture and pressure using a corrugator.

Fluting is often prepared from neutral sulfite semi chemical (NSSC) pulp. NSSC pulp, which is normally made from hardwood species, is noted for exceptional stiffness and high rigidity making it suitable for use in fluting. Neutral Sulfite Semi-Chemical (NSSC) pulping is an old process that it is well known in the field of paper pulping. One of the reasons for using NSSC pulping is the high yield, typically above 60 %. In NSSC pulping, the cooking liquor comprises sulfite, such as Na_2SO_3 or $(NH_4)_2SO_3$ and a base, such as NaOH or Na_2CO_3. "Neutral" means that the pH of the NSSC cooking liquor is generally between 6 and 10. The pulp can be cooked in a batch or continuous cooker. Normally, the cooking time is between 5 minutes and 3 hours and the cooking temperature is 160-200 °C. The NSSC pulp comprises comparatively high amounts of residual lignin, such as 15-20 %, which makes the NSSC pulp stiff. The Kappa number of the NSSC pulp is typically above 70. The NSSC pulping is "semi-chemical" in the sense that it also comprises mechanical refining of the pulp. Refining may for example be done using a disc refiner at digester pressure or at atmospheric pressure.

Currently, strength and mechanical properties of fluting and corrugating medium are improved by adding small amounts of chemical pulp to mechanical pulps. Typically, 5-15% chemical pulp is added. This of course adds costs but also leads to reduced dewatering speed. One potential route is to mix semi-chemical pulp such as NSSC with unbleached kraft pulp, although this may lead to undesired optical mottle and variations in shade, as well as variations in organoleptic properties.

The fluting and liner(s) are attached to each other by arranging an adhesive between the corrugated medium and liner(s). The liner is attached to at least one surface of the corrugated medium by the adhesive. The adhesive is preferably applied on a least one surface of the fluted corrugated medium and the liner is thereafter attached to said surface. Any conventional adhesives in the area may be used. The adhesive may for example be a glue that is based on starch that can be extracted from a wide variety of plants. Some of the most common plants are maize, wheat, barley, rice, potato, tapioca and peas. The starch is preferably native, i.e. no modification of the starch has been done. The adhesive may also comprise water, sodium hydroxide and boric acid. Other additives, such as additives to improve the wet strength or adhesive bond strength may also be added. Also, other functional chemicals in order to improve e.g. moisture resistance or gelling behavior can be added, e.g. borax, glyoxal or mixtures thereof.

One important challenge when making corrugated medium and corrugated board is the resistance to humidity. When the corrugated board is exposed to humidity, water and water vapor may diffuse through the liners and soften the corrugating medium. A common solution to this problem is to increase grammage of the fluting and/or liner, but this is in conflict with environmental demands requiring lower grammage materials consuming less raw material.

Another solution is to provide a barrier layer on the liner to reduce the penetration of water and water vapor. However, this is only a partial solution since moisture diffusion may still occur on the opposite side or via the edges and consequently impact the mechanical stability of the corrugated board. Barrier layers also increase cost and typically reduce recyclability of the materials.

The fluting or corrugating medium may also be treated with hydrophobizing chemicals or coated, but this generally adds costs and may also impact the mechanical properties of the fluting negatively. High levels of hydrophobizing chemicals may also compromise the adhesion between the fluting and the liner(s). Particularly, NSSC pulps require high levels of hydrophobizing chemicals to obtain a required level of water resistance in the finished fluting.

New machine concepts and increased machine speeds, combined with increased demands for source reduction, has further increased the need for pulps with improved properties.

There remains a need for new and improved fluting and liner materials that combine strength, low grammage, water/moisture resistance, low chemical consumption, low cost, and/or high recyclability.

Description of the invention

It is an object of the present disclosure to provide a fluting or liner, which solves or ameliorates at least some of the above mentioned problems.

It is a further object of the present disclosure to provide a fluting or liner with improved water resistance properties which can reduce the amount of a hydrophobizing internal sizing agent required to obtain a required level of water resistance in the finished fluting or liner.

It is a further object of the present disclosure to provide a corrugated board comprising the improved fluting and/or liner.

The above-mentioned objects, as well as other objects as will be realized by the skilled person in the light of the present disclosure, are achieved by the various aspects of the present disclosure.

The present invention is based on the inventive realization that if the ash content of a NSSC pulp used in a fluting or liner is reduced, the amount of hydrophobizing internal sizing agent required to obtain a required level of water resistance in the finished fluting or liner can be significantly reduced. Reducing the ash content of the pulp has also been found to reduce the required amounts of other wet end chemicals, e.g. drainage/retention chemicals in the fluting or liner.

Reduction of the ash content can be achieved by washing of the pulp. The ash content can also be reduced by more efficient removal of bark prior to the pulping process.

According to a first aspect illustrated herein, there is provided a fluting or liner for corrugated board comprising a neutral sulfite semi chemical (NSSC) pulp, wherein said NSSC pulp has an ash content of less than 1.8 wt%, as determined according to standard ISO 1762:2019.

"NSSC pulp" is obtained from "NSSC pulping", which in turn is defined in the background section. The NSSC pulp can be hardwood pulp or softwood pulp, or a mixture thereof. The NSSC pulp is preferably hardwood pulp or a hardwood/softwood pulp mixture with less than 15 wt% softwood, preferably less than 10 wt% softwood, and more preferably less than 5 wt% softwood. The hardwood may for example be aspen, alder, poplar, eucalyptus, birch, acacia, or beech. The NSSC pulp is preferably prepared cooked using a cooking liquor comprising sulfite, preferably Na_2SO_3 or $(NH_4)_2SO_3$ and a base, preferably NaOH or Na_2CO_3. In some embodiments the yield from the NSSC pulping is above 60 %, preferably above 65 %, preferably above 70 %, and more preferably above 75 %. The term "neutral" means that the pH of the NSSC cooking liquor is in the range of 6-10. The cooking time preferably in the range of 5 minutes to 3 hours. The cooking temperature is preferably in the range of 160-200 °C. The NSSC pulp may comprise comparatively high amounts of residual lignin, such as 15-20 %. The Kappa number of the NSSC pulp is typically above 70, preferably above 80, preferably above 95, and more preferably above 100, according to ISO 3260. The NSSC pulping is "semi-chemical" in the sense that it also comprises mechanical refining of the pulp. Refining may for example be done using a disc refiner at digester pressure or at atmospheric pressure. The refining can be done in one or more steps at the same or different pulp consistencies. A first refining step may preferably be done at higher consistency such as 5-35 %, and a second refining step may preferably be done at lower consistency <5 %.

In some embodiments, said NSSC pulp in the fluting or liner has been subjected to washing to reduce the ash content. The purpose of washing is to separate the pulp

from black liquor to wash out the residual substances such as alkali-lignin produced in the cooking process, and purify the pulp. Washing can be done using one or more conventional pulp washing methods and washing equipment, including, but not limited to a rotary vacuum washer, a rotary pressure washer, a pressure and atmospheric diffusion washer, a horizontal belt washer and/or dilution/extraction equipment. Washing involves diluting the NSSC pulp with water, and subsequently removing the water together with diluted colloidal substances, salts, impurities, and fines through a wire.

In some embodiments, the NSSC pulp has been prepared from wood comprising less than 3 wt%, less than 2.5 wt%, less than 2 wt%, or preferably less than 1 wt% or less than 0.8 wt% bark.

The reduction of the ash content can be measured by measuring the ash content according to standard ISO 1762:2019. In some embodiments, said NSSC pulp has an ash content of less than 1.6 wt%, preferably less than 1.4 wt%, and more preferably less than 1.2 wt% or less than 1.0 wt% or less than 0.9 wt%, as determined according to standard ISO 1762:2019. In some embodiments, said fluting or liner has an ash content of less than 1.6 wt%, preferably less than 1.4 wt%, and more preferably less than 1.2 wt% or less than 1.0 wt% or less than 0.9 wt%, as determined according to standard ISO 1762:2019.

The reduction of the ash content can also be measured by measuring the hot water extract conductivity of the NSSC pulp according to ISO 6587. In some embodiments, said NSSC pulp has a hot water extract conductivity of less than 15 mS/cm, preferably less than 10 mS/cm, and more preferably less than 8 mS/cm, as determined according to ISO 6587. In some embodiments, said fluting or liner has a hot water extract conductivity of less than 15 mS/cm, preferably less than 10 mS/cm, and more preferably less than 8 mS/cm, as determined according to ISO 6587.

In some embodiments, the conductivity of the NSSC pulp used in the fluting or liner is less than 1200, less than 1000, less than 800, or less than 600, and more

preferably less than 500, less than 450, less than 400, less than 350 or less than 300 mS/m, when disintegrated at 3.5 wt% in distilled water.

In some embodiments, the NSSC pulp comprises less than 2 %, preferably less than 1.8 %, more preferably less than 1.6 %, Pulmac shives (slot size 0.1 mm). It has been found advantageous to use a pulp with low amount of shives.

In addition to reducing the ash content, the washing may also lead to a reduction of the content of cellulose fines in the NSSC pulp. The term cellulose fines as used herein generally refers to cellulosic particles significantly smaller in size than cellulose fibers. In some embodiments, the term fines as used herein refers to fine cellulosic particles, which are able to pass through a 200 mesh screen (equivalent hole diameter 76 µm) of a conventional laboratory fractionation device (SCAN-CM 66:05). The reduction of fines in the NSSC pulp may for example be in the range of 0.1-10 wt%, or in the range of 0.5-7 wt%.

The inventors have found that by reducing the ash content of the NSSC pulp, the amount of a hydrophobizing internal sizing agent required to obtain a required level of water resistance in the finished fluting or liner can be significantly reduced.

Accordingly, the NSSC pulp is employed in a pulp composition for use in fluting or liner for corrugated board, wherein the pulp composition further comprises at least one internal sizing agent. The term “pulp composition” refers to an aqueous dispersion of cellulose fibers and non-fibrous additives used as a furnish for making paper or paperboard in a paper machine.

The pulp of the pulp composition of the fluting or liner preferably mainly comprised of NSSC pulp. Preferably at least 50 wt% of the pulp of the pulp composition is NSSC pulp, based on dry weight. In other examples, at least 55 wt%, 60 wt%, 65 wt%, 70 wt%, 75 wt%, 80 wt%, 85 wt%, 90 wt%, 95 wt% or 98 wt% of the pulp is NSSC pulp, based on dry weight.

The part of the pulp of the pulp composition not being NSSC pulp may comprise any kind of fibers, such as hardwood and/or softwood fibers and may include, e.g.,

chemical pulp, mechanical pulp, thermomechanical pulp or chemi-thermomechanical pulp (CTMP). The part of the pulp composition not being NSSC pulp may also for example comprise recycled fibers. For example, the pulp of the present disclosure may consist essentially of NSSC pulp or a mixture of NSSC pulp and recycled fibers. "Recycled fibers" refers to fiber material that has previously been incorporated in some paper or board product. Alternatively, or as a complement, the part of the pulp not being NSSC pulp may for example comprise reject pulp. For example, the pulp of the present disclosure may consist essentially of NSSC pulp and reject pulp. "Reject pulp" refers to pulp prepared by refining the screen reject from a pulping process.

In some embodiments, the pulp pf the pulp composition comprises less than 10 wt%, preferably less than 5 wt%, more preferably less than 2 wt% of recycled fibers. A low amount of recycled fibers is preferred, since high amounts of inorganic materials are typically added via recycled fiber. In some embodiments, said fluting comprises less than 10 wt%, preferably less than 5 wt%, more preferably less than 2 wt% of recycled fibers.

The fluting and/or liner may further comprise an internal sizing agent. The internal sizing agent is preferably a hydrophobizing sizing agent. In some embodiments, the internal sizing agent is selected from the group consisting of alkyl ketene dimer (AKD), alkenyl succinic anhydride (ASA), rosin sizes, and mixtures thereof. In a preferred embodiment, the internal sizing agent is alkyl ketene dimer (AKD).

In some embodiments, the amount of the internal sizing agent in the fluting or liner is in the range of 0.5-6 kg/tn, preferably in the range of 0.5-4 kg/tn, preferably in the range of 0.5-3 kg/tn and more preferably in the range of 1-2 kg/tn, based on dry weight. Consequently, the amount sizing agent in the fluting or liner is quite low.

At least one side of the fluting or liner preferably has a Cobb 30 s value below 30, preferably below 25, and more preferably below 22, as determined according to standard ISO 535. It may be preferred that both sides of the fluting or liner has a Cobb 30 s value below 30, preferably below 25, and more preferably below 22, as

determined according to standard ISO 535. It has surprisingly been found that the addition of clean NSSC pulp to the bottom or top ply of the liner or fluting will not affect the Cobb value negatively. Consequently, the side/s of the liner or fluting comprising clean NSSC pulp preferably has a Cobb 30 s value below 30, preferably below 25, and more preferably below 22, as determined according to standard ISO 535. NSSC pulp is often used in the back ply of a fluting or liner and it is then preferred that the back side of the fluting or liner has a Cobb 30 s value below 30, preferably below 25, and more preferably below 22, as determined according to standard ISO 535.

To produce good quality paper, such as fluting or liner, with high amounts of NSSC pulp at high machine speeds it is important that mineral fillers and fiber fines are effectively retained while simultaneously achieving high dewatering rates. Microparticle retention aid systems, typically utilizing anionic colloidal silica and/or clay-based particles in combination with cationic polymers, have been developed to help deal with these challenges. Generally, microparticle retention aid systems have shown better retention and dewatering performance compared to the classical single or dual polymer retention aid systems. In some embodiments, the fluting or liner, further comprises a microparticle retention aid system, preferably a multi-component microparticle retention aid system.

In some embodiments, the microparticles of the microparticle retention aid system is selected from the group consisting of silica microparticles, bentonite microparticles and cellulose nanoparticles.

In some embodiments, the microparticle retention aid system comprises a water soluble polymer, preferably a cationic polymer.

In some embodiments, the amount of the microparticle retention aid system in the fluting or liner is in the range of 50 g/tn to 5 kg/tn, and more preferably in the range of 100 g/tn to 2 kg/tn, based on dry weight.

The fluting or liner may further include additional components commonly used in fluting or liner production, such as such as native starch or starch derivatives,

microfibrillated cellulose (MFC), cellulose derivatives such as sodium carboxymethyl cellulose, a filler, retention and/or drainage chemicals, flocculation additives, deflocculating additives, dry strength additives, softeners, cross-linking aids, sizing agents, dyes and colorants, wet strength resins, fixation agents, de-foaming aids, microbe and slime control aids, or mixtures thereof.

The fluting or liner is typically a single ply product, but it may also be a multiply product. The fluting or liner is typically formed in a gap former, but it may also be formed in a fourdrinier type former. The press section may be provided with a shoe press to maximize production.

The basis weight of the fluting or liner may preferably be in the range of 80-300 gsm.

In some embodiments, said fluting or liner has an equilibrium moisture content (EMC) of less than 10 wt%, preferably less than 8 wt% at 50% RH, as determined according to standard ISO 287.

In some embodiments, said fluting or liner has a cd/md stretch value greater than 1.8, preferably greater than 1.9, and more preferably greater than 2.0, as determined according to standard ISO 1924-3.

In some embodiments, said fluting or liner has a kinetic friction of less than 0.5, preferably less than 0.45, and more preferably less than 0.4, as determined according to standard ASTMD 1894-63

According to a second aspect illustrated herein, there is provided a corrugated board comprising a fluting and/or liner according to the first aspect. Corrugated board comprises at least one layer of liner, which is non-corrugated, and at least one layer of fluting. In normal production of corrugated board, fluting is corrugated and then glued to linerboard. For example, corrugated board may consist of a layer of fluting sandwiched between two layers of liner.

While the invention has been described with reference to various exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

Examples

The examples show that a washed NSSC pulp can be used in sheet making and provides improved mechanical properties and different response to liquid absorption.

Example 1 (comparative)

An NSSC beech pulp obtained in dry form and then disintegrated into furnish and made to 150 g/m^2 single ply web on a fourdrinier type pilot papermachine. The production speed was 45 m/min and temperature of the furnish was 45 °C.

Example 2 (comparative)

NSSC beech pulp as used in Example 1 was refined to a higher SR value and a web was prepared as in Example 1. The increased SR due to the refining increased especially tensile index (Geom).

Example 3

NSSC beech pulp as used in Example 1 was washed with water (40 m^3 fresh water per ton of pulp) using an Eimco belt washing unit. 2.7% of the fines were removed together with colloidal substances and impurities in the liquid phase, including electrolytes. As a consequence of the washing, the pH of the pulp suspension increased, confirming the removal of electrolytes and reduction of the ash content. A web was prepared as in Example 1. A small improvement in both tensile strength and stretch was noticed.

Example 4

NSSC beech pulp as used in Example 1 was mixed with washed NSSC birch broke pulp (washed as described in Example 3). The pulps were mixed in a 50-50 ratio. A web was prepared as in Example 1. A significant improvement in both tensile strength and stretch was observed.

Example 5

In this example, washed NSSC birch broke pulp as used in Example 4 was used without any other fibers. A web was prepared as in Example 1. The tensile strength properties and stretch were further improved.

Table 1. Pulp compositions

		Ex 1	Ex 2	Ex 3	Ex 4	Ex 5
NSSC beech	%	100			50	
NSSC beech – refined	%		100			
NSSC beech – washed	%			100		
NSSC birch broke - washed	%				50	100
pH		6,7	6,7	6,9	6,8	7,3
°SR		26,0	32,0	21,5	24,0	31,0
Consistency in headbox	%	0,599	1,007	0,801	0,861	0,780

Table 2. Physical properties of formed sheets

		Ex 1	Ex 2	Ex 3	Ex 4	Ex 5
Density	kg/m^3	526	565	583	636	663
Permeability, Gurley Hill	s/100ml	3,6	6,1	4,8	15	55
Absorption, Klemm, md	mm	63	49	60	42	26
Absorption, Klemm, cd	mm	59	45	55	39	21
Tensile index, md	kNm/kg	41,34	46,24	39,38	60,17	88,88
Tensile index, cd	kNm/kg	25,65	29,31	28,21	40,62	48,70
Tensile index Geom		32,56	36,81	33,33	49,44	65,79
Stretch, md	%	1,08	1,10	1,19	1,33	1,49
Stretch, cd	%	1,57	2,06	1,67	2,48	3,02

Example 6

In this example washed NSSC pulp was added to a liner. The washed pulp has an ash content below 1.8 wt%.

Un-washed NSSC pulp was added to another liner as a comparison. The unwashed NSSC pulp has an ash content higher than 1.8 wt%.

All the liner produced comprised unbleached kraft pulp (100%) in the top ply and recycled fiber (RCF) pulp in the back ply with or without NSSC pulp addition.

Table 3. Results

		Ref	S1	S2	S3
Top ply (UBKP)	%	100	100	100	100
NSSC - back ply		No	Yes	Yes	Yes
Clean NSSC- back ply		No	No	No	Yes
Amount of NSSC in liner (based on total amount of fibers in the liner)	%	0	20	10	30
Grammage	g/m^2	135	135	135	135
Internal sizing (ASA)	kg/ton	1	1	1	1
COBB (60 s) – back side	g/m^2	30	131	77	33

It is clear from these tests that the use of clean NSSC pulp in the liner, as shown in Sample 3 (S3) in table 3, provides a liner with very good Cobb values even on the back side of the liner. The Cobb values are at the same level as for the reference sample. It is evident that the use of un-washed NSSC pulp, as can be seen in Samples 1 and Sample 2 (S1 and S2) will provide a liner with high Cobb value meaning that these samples has a much lower water resistance. Consequently, by the present invention it is possible to produce a liner with good (high) water resistance even with low amounts of internal sizing additions.

Unless otherwise stated, the physical properties discussed in the present disclosure are determined according to the following standards:

Brightness C/2° +UV	ISO 2470-1
L* C/2° +UV	ISO 5631-1
a* C/2° +UV	ISO 5631-1
b* C/2° +UV	ISO 5631-1
Grammage	ISO 536
Thickness, single sheet	ISO 534
Bulk, single sheet	ISO 534
Air permeability G-H	ISO 5636-5
Cobb 60 s	ISO 535
Moisture content 50 % rh	ISO 287
Scott-Bond	TAPPI T569
Tensile strength	ISO 1924-3
Tensile index	ISO 1924-3
Tensile strength md/cd	ISO 1924-3
Stretch	ISO 1924-3
Tensile stiffness	ISO 1924-3
Tensile stiffness index	ISO 1924-3
E-modulus	ISO 1924-3
TEA	ISO 1924-3
TEA index	ISO 1924-3
TEA index	ISO 1924-3
Fracture toughness	ISO/TS 17958
Fracture toughness index	ISO/TS 17958
Tearing resistance	ISO 1974
Tear index	ISO 1974
SCT	ISO 9895
SCT index	ISO 9895
RCT	ISO 12192
RCT index	ISO 12192
Burst index	ISO 2759
Bursting strength	ISO 2759

Unless otherwise stated, then the standard method can be applied for determining physical and mechanical properties in both cross direction (cd) and machine direction (md).

CLAIMS

1. A fluting or liner for corrugated board comprising a neutral sulfite semi chemical (NSSC) pulp, wherein said NSSC pulp has an ash content of less than 1.8 wt%, as determined according to standard ISO 1762:2019.

2. A fluting or liner according to claim 1, wherein said NSSC pulp has been subjected to washing to reduce the ash content.

3. A fluting or liner according to any one of the preceding claims, wherein said NSSC pulp has an ash content of less than 1.6 wt%, preferably less than 1.4 wt%, and more preferably less than 1.2 wt% or less than 1.0 wt% or less than 0.9 wt%, as determined according to standard ISO 1762:2019.

4. A fluting or liner according to any one of the preceding claims, wherein said NSSC pulp has a hot water extract conductivity of less than 5 mS/cm, preferably less than 10 mS/cm, and more preferably less than 8 mS/cm, as determined according to ISO 6587.

5. A fluting or liner according to any of the preceding claims, wherein the fluting or liner comprises at least one internal sizing agent.

6. A fluting or liner according to claim 5 wherein the internal sizing agent is selected form the group consisting of alkyl ketene dimer (AKD), alkenyl succinic anhydride (ASA), rosin sizes, and mixtures thereof, preferably the internal sizing agent is alkyl ketene dimer (AKD).

7. A fluting or liner according to any one of claims 5-6, wherein the amount of the internal sizing agent in the fluting or liner is in the range of 0.5-6 kg/tn, preferably in the range of 0.8-4 kg/tn, and more preferably in the range of 1-3 kg/tn, based on dry weight.

8. A fluting or liner according to any of the preceding claims, further comprising a microparticle retention aid system, preferably a multi-component microparticle retention aid system.

9. A fluting or liner according to claim 8, wherein the microparticles of the microparticle retention aid system is selected from the group consisting of silica microparticles, bentonite microparticles and cellulose nanoparticles.

10. A fluting or liner according to any one of claims 8-9, wherein the microparticle retention aid system comprises a water soluble polymer, preferably a cationic polymer.

11. A fluting or liner according to any of the preceding claims wherein at least one side of the fluting or liner has a Cobb (60s) value below 40 gsm, preferably below 35 gsm and even more preferably below 30 gsm, as determined according to standard ISO 535.

12. A fluting or liner according to any of the preceding claims, wherein said fluting or liner comprises less than 10 wt%, preferably less than 5 wt%, more preferably less than 2 wt% of recycled fibers.

13. A fluting or liner according to any of the preceding claims, wherein said fluting or liner has a hot water extract conductivity of less than 15 mS/cm, preferably less than 10 mS/cm, and more preferably less than 8 mS/cm, as determined according to ISO 6587.

14. A fluting or liner according to any of the preceding claims, wherein said fluting has an equilibrium moisture content (EMC) of less than 10 wt%, preferably less than 8 wt% at 50% RH, as determined according to standard ISO 287.

15. A fluting or liner according to any of the preceding claims, wherein said fluting or liner has a cd/md stretch value greater than 1.8, preferably greater than 1.9, and more preferably greater than 2.0, as determined according to standard ISO 1924-3.

16. A fluting or liner according to any of the preceding claims, wherein said fluting has a kinetic friction of less than 0.5, preferably less than 0.45, and more preferably less than 0.4, as determined according to standard ASTMD 1894-63

17. A corrugated board comprising a fluting and/or liner according to any of the preceding claims.