



(51) International Patent Classification:

D21H 21/52 (2006.01) *D21H* 27/18 (2006.01)
D21H 27/00 (2006.01) *D21H* 15/02 (2006.01)

(21) International Application Number:

PCT/EP2012/069560

(22) International Filing Date:

4 October 2012 (04.10.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

11184355.3 7 October 2011 (07.10.2011) EP
61/544,424 7 October 2011 (07.10.2011) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: PAPER AND BOARD PRODUCTION

(57) Abstract: The invention relates to the use of a composition comprising cellulosic fibres having a length weighted mean fibre length of from 100 to 800 μ m as a creep inhibitor in paper and board and/or in the production of paper and board. The invention further relates to the use of a composition comprising cellulosic fibres having a length weighted mean fibre length / width ratio offrom 5 to 35 as a creep inhibitor in paper and board and/or in the production of paper and board.



WO 2013/050436 A1

PAPER AND BOARD PRODUCTION**Field of the Invention**

- 5 The present invention relates to the use of a composition comprising cellulosic fibres as a creep inhibitor in paper and board and/or in the production of paper and board.

Background of the Invention

- 10 Paper and board products are made from cellulosic fibres and used in numerous applications. These fibres tend to absorb moisture and swell in environments of high humidity and they tend to shrink in low humidity conditions, thereby causing deformation of paper and board products. This dimensional instability of paper and board may lead to problems such as curl, bulge, cockle, warp and creep. Creep is defined as the time-
15 dependent strain occurring when solids are subjected to an applied stress. Creep is thus a property that all material exhibit. Mechanosorptive creep is the deformation that can occur under the combined action of load and varied humidity.

- Caulfield, Tappi J., 77(3)(1994)205 discloses the use of cross-linking chemicals to
20 decrease mechanosorptive creep in paper. However, there are problems associated with the use of large amounts of cross-linking chemicals.

- WO 2009/008822 discloses a composite material having reduced mechanosorptive creep comprising a fibre material and a thermoplastic material in fibre form. The use of
25 thermoplastic material may cause problems when manufacturing the composite material.

- Accordingly, there is still a need of paper and board having reduced creep, in particular reduced mechanosorptive creep. There is also still a need of additives that can be used to produce paper and board having reduced creep, in particular reduced mechanosorptive
30 creep.

Summary of the Invention

- It is an object of the present invention to provide paper and board in which the creep and
35 mechanosorptive creep are reduced. It is another object of the present invention to provide a composition comprising cellulosic fibres which impart reduced creep and mechanosorptive creep to paper and board, and which accordingly can be used as a creep

inhibitor, or a creep reducing agent, in paper and board, and in the production of paper and board.

5 By using the composition as an additive in the production of paper and board, it is possible to provide paper and board as well as products made thereof which have improved dimensional stability such as reduced creep, in particular in cyclical humidity conditions, thus reduced mechanosorptive creep. Hereby it is also possible to reduce or eliminate product performance problems such as curl and misregistration in printing processes, which problems often result in costly project rejects.

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The present invention also makes it possible to provide cellulosic products such as paper and board which show dimensional stability and reduced creep even though they do not contain a substantial amount of thermoplastic materials or cross-linking chemicals. By using the present invention it is possible to produce cellulosic products with better dimensional stability and creep resistance which are free or essentially free from thermoplastic materials or cross-linking chemicals.

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Accordingly, in one aspect, the present invention relates to the use of a composition comprising cellulosic fibres having a length weighted mean fibre length of from 100 to 800 μm as a creep inhibitor in paper and board and/or in the production of paper and board.

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In another aspect, the present invention relates to the use of a composition comprising cellulosic fibres having a length weighted mean fibre length / width ratio of from 5 to 35 as a creep inhibitor in paper and board and/or in the production of paper and board.

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This and other objects and aspects of the invention will be described in further detail hereinafter.

Detailed Description of the Invention

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The composition comprising cellulosic fibres, herein also referred to as "the cellulosic fibre composition" or "the composition", to be used according to the invention contains cellulosic fibres which can be derived from a wide variety of sources including wood fibres, non-wood fibres and mixtures thereof.

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Wood fibres may be derived from hardwood and softwood, e.g. from chemical pulps, mechanical pulps, thermo-mechanical pulps, chemical thermo-mechanical pulps, recycled fibres and newsprint. Examples of suitable wood fibres include birch, beech, aspen, e.g.

European aspen, alder, eucalyptus, maple, acacia, mixed tropical hardwood, pine, e.g. loblolly pine, fir, hemlock, larch, spruce, e.g. Black spruce or Norway spruce, and mixtures thereof.

- 5 Non-wood fibres may be derived from seed fibres, e.g. cotton linters, seed hull fibres, e.g. soybean hulls, pea hulls and corn hulls, bast fibres, e.g. flax, hemp, jute, ramie and kenaf, leaf fibres, e.g. manila hemp and sisal hemp, stalk and straw fibres, e.g. bagasse, corn and wheat, grass fibres, e.g. bamboo and reed canary grass, cellulosic fibres from algae, e.g. velonia, bacteria and fungi, and parenchymal cells, e.g. vegetables such as sugar
10 beets, and fruits, e.g. citrus fruits such as lemons, limes, oranges and grapefruits.

The cellulosic fibres of the composition may have a length weighted mean fibre length of from about 100, or from about 200, usually from about 250 μm , and the length weighted mean fibre length may be up to about 1,100, or up to about 1,000, usually up to about 800,
15 or up to about 750, or up to 700 μm . The cellulosic fibres of the composition may have a length weighted mean fibre width of from about 10, usually from about 15 μm , and the length weighted mean fibre width may be up to about 60, usually up to about 50, or up to about 45, usually up to about 30 μm . The cellulosic fibres of the composition of the invention may have a length weighted mean fibre length / width ratio of at least about 5, or at
20 least about 10, usually at least about 12 and the length weighted mean fibre length / width ratio may be up to about 35, or up to about 30, usually up to about 25. The length weighted mean fibre length and length weighted mean fibre width, as referred to herein, are measured by means a Fiber Tester of Lorenzen & Wettre, Sweden, which operates according to ISO 16065-2:2007, and the length weighted mean length / width ratio is calculated from such
25 data.

The cellulosic fibres of the composition may or may not contain ionic groups. According to one preferred embodiment, the cellulosic fibres of the composition are free or essentially free from anionic groups, e.g. the cellulosic fibres of the composition have an average
30 degree of substitution of anionic groups of below 0.001. According to another preferred embodiment, the cellulosic fibres of the composition have an average degree of substitution of anionic groups of from 0.001, usually from about 0.01, or from about 0.02, up to 0.25, or up to about 0.20, usually up to about 0.15, or up to 0.10, or up to about 0.05. At these low degrees of substitution, the cellulosic fibres are preferably dispersible in water,
35 but not water-soluble. The term "average degree of substitution", or "DS" as used herein, means the average number of anionic groups, or substituent groups, per anhydroglucose unit of cellulose. The degree of substitution of anionic groups can be determined by the

methods of ASTM D1439-03 and conductometric titration as described by S. Katz, R.P. Beatson and A.M. Scallan in Svensk Papperstidning No. 6/1984, pp. 48-53.

5 Examples of suitable anionic groups include carboxyl groups and substituted carboxyl groups, e.g. carboxyalkyl groups such as carboxymethyl groups. The counter-ion of the anionic group is usually an alkali metal or alkaline earth metal, e.g. sodium or potassium, suitably sodium. The carboxyl group can be illustrated by the formula $\text{--COO}^- \text{Na}^+$, and the carboxymethyl group by the formula $\text{--CH}_2\text{COO}^- \text{Na}^+$. Examples of suitable cellulosic fibres of the composition of the invention include carboxylated cellulosic fibres and
10 carboxyalkylated cellulosic fibres, e.g. carboxymethylated cellulosic fibres, having a degree of substitution as defined above.

The cellulosic fibre composition of the invention may contain both water-soluble cellulosic material and water-insoluble cellulosic material. In one embodiment, at least 50, or at least
15 70, preferably at least 80 or at least 85 % by weight of the cellulosic material present in the composition is insoluble in water, measured on an aqueous cellulosic composition containing 1 % by weight of cellulosic material at 20 °C. The water-insoluble material is usually swellable and dispersible in water.

20 The cellulosic fibres of the composition of the invention may have a specific surface area of at least 1.5, or at least about 2, usually at least about 3 m²/g, and the specific surface area may be up to about 150, usually up to about 50, up to about 15, or up to about 10 m²/g. The specific surface area is determined by adsorption of N₂ at 177 K according to the BET method (ISO 9277:1995).

25 The cellulosic fibre composition of the invention may be aqueous or non-aqueous, e.g. dry; it may have a dry solids content of at least about 0.1, or at least about 0.5, usually at least about 1 % by weight, and the dry solids content may be up to about 100, or up to about 90, usually up to about 70, or up to about 50 % by weight, based on the total weight of the
30 composition. As the dry solids of the composition usually consist or essentially consist of cellulosic fibres, the composition may have a cellulosic fibre content which is the same as the dry solids content stated above. The remainder of the cellulosic fibre composition may be water or an aqueous phase or solution.

35 Cellulosic fibre compositions suitable for use according to the invention are known in the art and can be produced by methods known in the art, including those disclosed by WO 2007/001229 and/or PCT/EP2011/061571, which are hereby incorporated herein by reference.

According to the invention, the cellulosic fibre composition is used as a creep inhibitor, or creep reducing agent, in paper and board, in the production of paper and board, or both in paper and board and in the production of said paper and board. Preferably, paper and board is produced from an aqueous suspension comprising the cellulosic fibre composition. The cellulosic fibre composition may be used as an additive to cellulosic pulp, preferably to an aqueous cellulosic pulp suspension to provide paper and board having improved or reduced creep, in particular in cyclical humidity conditions, and improved or reduced mechanosorptive creep. The cellulosic fibre composition may be mixed with or added to the cellulosic pulp in a substantially dry state or substantially wet state. Accordingly, the cellulosic fibre composition may be mixed with or added to the cellulosic pulp or to the aqueous cellulosic pulp suspension in an amount of from about 0.1 to about 25, suitably from about 0.5 to about 15, or from about 1 to 10, usually from about 2 to about 8 % by weight, calculated as dry cellulosic fibres of the composition on dry cellulosic pulp.

The cellulosic pulp can be derived from a wide variety of sources including wood fibres, non-wood fibres and mixtures thereof. Examples of suitable wood and non-wood fibres include those defined above in respect of the cellulosic fibre composition of the invention. Preferably, the cellulosic pulp is derived from wood fibres such as hardwood, softwood and mixtures thereof.

The cellulosic pulp may be derived from chemical pulp, e.g. sulfate and sulfite pulp, organosolv pulp, recycled fibers, and/or mechanical pulp including e.g. refiner mechanical pulp (RMP), pressurized refiner mechanical pulp (PRMP), pretreatment refiner chemical alkaline peroxide mechanical pulp (P-RC APMP), thermo-mechanical pulp (TMP), thermo-mechanical chemical pulp (TMCP), high-temperature TMP (HT-TMP) RTS-TMP, alkaline peroxide pulp (APP), alkaline peroxide mechanical pulp (APMP), alkaline peroxide thermo-mechanical pulp (APTMP), thermopulp, groundwood pulp (GW), stone groundwood pulp (SGW), pressure groundwood pulp (PGW), super pressure groundwood pulp (PGW-S), thermo groundwood pulp (TGW), thermo stone groundwood pulp (TSGW), chemi-mechanical pulp (CMP), chemirefinermechanical pulp (CRMP), chemithermo-mechanical pulp (CTMP), high-temperature CTMP (HT-CTMP), sulfite-modified thermo-mechanical pulp (SMTMP), reject CTMP (CTMP_R), groundwood CTMP (G-CTMP), semichemical pulp (SC), neutral sulfite semi chemical pulp (NSSC), high-yield sulfite pulp (HYS), biomechanical pulp (BRMP), pulps produced according to the OPCO process, explosion pulping process, Bi-Vis process, dilution water sulfonation process (DWS), sulfonated long fibers process (SLF), chemically treated long fibers process (CTLF), long fiber CMP

process (LFCMP), and modifications and combinations thereof. The pulp may be a bleached or non-bleached pulp.

5 In one embodiment, the mixing is made in a substantially dry state. The mixing of the cellulosic fibre composition with the cellulosic pulp may be made to form a cellulosic pulp mixture, which may have a dry solids content of at least about 10, usually at least about 15, usually from about 20, up to about 90, or up to about 50 % by weight, based on the total weight of the cellulosic pulp mixture. The remainder of the cellulosic pulp mixture may be water or an aqueous solution. The cellulosic pulp mixture may be added to or mixed with
10 water to form an aqueous suspension comprising the cellulosic pulp mixture and then dewatering the obtained suspension. The aqueous suspension may have a dry solids content of up to about 10 % by weight, e.g. from about 0.1, or from about 0.2, usually from about 0.3, up to about 10, or up to about 8, up to about 6, usually up to about 5 % by weight, based on the total weight of the cellulosic pulp mixture.

15 In another embodiment, the mixing is made in a substantially wet state. The mixing of the cellulosic fibre composition with the cellulosic pulp may be made to form a cellulosic pulp mixture in the form of an aqueous suspension and then dewatering the obtained suspension. The process may comprise adding the cellulosic fibre composition to an aqueous cellulosic pulp suspension and dewatering the obtained suspension. The aqueous
20 suspension may have a dry solids content of up to about 10 % by weight, e.g. from about 0.1, or from about 0.2, usually from about 0.3, up to about 10, or up to about 8, up to about 6, usually up to about 5 % by weight, based on the total weight of the cellulosic pulp mixture.

25 The cellulosic pulp mixture may be used in the production of paper and board wherein the cellulosic pulp mixture constitutes at least part of the cellulosic pulp used in the production process, usually the total amount of cellulosic pulp used. Preferably, when producing paper and board, an aqueous suspension comprising the cellulosic pulp mixture is formed and
30 then dewatered.

Further additives may also be used in the production of paper and board according to the invention, and these additives may be added to the cellulosic fibre composition, to the aqueous suspension comprising the cellulosic fibre composition, to the aqueous
35 suspension comprising cellulosic pulp and/or to the aqueous suspension comprising the cellulosic pulp mixture, usually to the aqueous suspension comprising cellulosic fibre composition and/or cellulosic pulp and/or cellulosic pulp mixture. Examples of suitable further additives include one or more drainage and retention aids, cationic coagulants, dry

strength agents, wet strength agents, e.g. polyamine-epichlorohydrin and polyamidoamine-epichlorohydrin based resins, optical brightening agents, dyes, sizing agents, e.g. rosin-based sizing agents, styrene acrylates and cellulose-reactive sizing agents, e.g. alkyl and alkenyl ketene dimers and multimers, and alkenyl succinic anhydrides, etc.

5

The further additives preferably comprise one or more drainage and retention aids. The expression "drainage and retention aid", as used herein, refers to one or more additives which, when added to an aqueous cellulosic suspension, give better drainage and/or retention than is obtained when not using said one or more additives. The one or more

10 drainage and retention aids may comprise anionic polymers, cationic polymers, siliceous materials and combinations thereof, preferably at least one cationic polymer. Examples of suitable anionic polymers include anionic polyacrylamide and anionic naphthalene-formaldehyde condensation polymers, e.g. anionic naphthalene sulfonates. Examples of suitable cationic polymers include cationic polysaccharides, e.g. cationic starches, and

15 cationic synthetic polymers, e.g. cationic polyacrylamides, cationic poly(diallyldimethylammonium chlorides), cationic polyethylene imines, cationic polyamines and cationic polyamidoamines. The weight average molecular weight of the anionic and cationic polymers may be above about 5,000, or above about 10,000, usually above about 1,000,000 g/mole. The upper limit is not critical; it can be about 50,000,000, usually 30,000,000 g/mole.

20

Examples of suitable siliceous materials include anionic silica-based particles and anionic clays of the smectite type, e.g. bentonite. Preferably, the siliceous material has particles in the colloidal range of particle size. Anionic silica-based particles, i.e. particles based on SiO_2 or silicic acid, are preferably used and such particles are usually supplied in the form of

25 aqueous colloidal dispersions, so-called sols. Examples of suitable silica-based particles include colloidal silica and different types of polysilicic acid, either homopolymerised or copolymerised, for example polymeric silicic acid, polysilicic acid microgel, polysilicate and polysilicate microgel. The silica-based sols can be modified and contain other elements, e.g. aluminum, boron, magnesium, nitrogen, zirconium, gallium, titanium and the like, which can

30 be present in the aqueous phase and/or in the silica-based particles.

Examples of preferred drainage and retention aids for use in the process include cationic starches, cationic polyacrylamides, anionic polyacrylamides, anionic siliceous materials and combinations thereof. Examples of suitable combinations of drainage and retention

35 aids comprise (i) cationic starch and anionic siliceous material, preferably silica-based particles, (ii) cationic polyacrylamide and anionic siliceous material, preferably silica-based particles, (iii) cationic starch, cationic polyacrylamide and anionic siliceous material, preferably silica-based particles, (iv) cationic polyacrylamide, anionic polyacrylamide and

anionic siliceous material, preferably silica-based particles, and (v) cationic starch, anionic polyacrylamide and anionic siliceous material, preferably silica-based particles.

5 The one or more drainage and retention aids can be added to the suspension in amounts which can vary within wide limits depending on, inter alia, type and number of additives, type of suspension, point of addition, etc. When used, the anionic polymers are usually added in an amount of at least 0.001, often at least 0.005 % by weight, based on dry weight of the suspension, and the upper limit is usually 3 and suitably 1.5 % by weight. When used, the cationic polymers are usually added in an amount of at least about 0.001, often at least about
10 0.005 % by weight, based on dry weight of the suspension, and the upper limit is usually about 3 and suitably about 1.5 % by weight. When used, the siliceous materials are usually added in an amount of at least about 0.001, often at least about 0.005 % by weight, based on dry weight of the suspension, and the upper limit is usually about 1.0 and suitably about 0.6 % by weight.

15 The drainage and retention aids can be added in conventional manner and in any order. When using a siliceous material, it is common to add a cationic polymer before adding the siliceous material, even if the opposite order of addition may also be used. It is further common to add a cationic polymer before a shear stage, which can be selected from pumping, mixing, cleaning, etc., and to add the siliceous material after that shear stage.
20

Examples of suitable coagulants include organic and inorganic coagulants. Examples of suitable organic coagulants include low molecular weight cationic polymers, e.g. homo and copolymers of diallyl dimethyl ammonium chloride (DADMAC), polyamines,
25 polyamideamines, polyethylene imines, and dicyandiamide condensation polymers having a molecular weight in the range of from 1,000 to 700,000, suitably from 10,000 to 500,000. Examples of suitable inorganic coagulants include aluminium compounds, e.g. alum and polyaluminium compounds, e.g. polyaluminium chlorides, polyaluminium sulphates, polyaluminium silicate sulphates and mixtures thereof.

30 When used, the coagulant is preferably added prior to adding the one or more drainage and retention aids. The cationic coagulant can be added in an amount of at least about 0.001, or from about 0.05, usually from about 0.1, up to about 3.0, usually up to about 2.0 % by weight, calculated as dry coagulant on dry suspension,

35 When used, each of the dry strength agent, wet strength agent and sizing agent as defined above can be added to the suspension in an amount of from about 0.01 to about 1, usually from about 0.1 to about 0.5 % by weight, calculated as dry agent on dry suspension.

In the production of paper and board of the invention, it is possible to use mineral fillers of conventional types, e.g. kaolin, china clay, titanium dioxide, gypsum, talc and natural and synthetic calcium carbonates, e.g. chalk, ground marble and precipitated calcium carbonate. If present, the paper and board may have a content of mineral filler up to 50, or up to 35, usually up to about 30 or up to 20 % by weight, based on the dry weight of the paper or board. It is also possible that no filler is used in the production of paper and board of the invention.

10 The paper and board produced according to the invention may have a content of cellulosic material of at least about 50, or at least about 65, usually at least about 70 or at least 80, frequently at least about 90 or at least 95 % by weight, based on the dry weight of the paper or board. The cellulosic material of the paper and board comprises the composition comprising cellulosic fibres and optionally cellulosic pulp, preferably both the composition
15 comprising cellulosic fibres and cellulosic pulp as defined above. Preferably, the paper and board are essentially free from polymeric thermoplastic material, meaning that the paper and board may have a content of polymeric thermoplastic material less than 5, or less than 2, usually less than 1 % by weight, based on the dry weight of the paper or board. Most preferably, the paper and board are free from polymeric thermoplastic material.

20 The invention may be used to produce single ply paper or board in which the cellulosic fibre composition, as defined herein, is distributed throughout the paper or board, preferably substantially uniformly distributed throughout the paper and board. Single ply paper and paper board contain just one ply or layer containing cellulosic fibres.

25 The invention may also be used to produce multi ply paper and board comprising two or more plies or layers containing cellulosic fibres wherein at least one of said two or more plies or layers comprises the cellulosic fibre composition, as defined herein. Preferably, the cellulosic fibre composition is distributed throughout at least one of said two or more plies,
30 more preferably substantially uniformly distributed throughout at least one of said two or more plies. Multi ply paper and board according to the invention can be produced by forming at least one ply comprising the cellulosic fibres composition, as defined herein, and attaching said at least one ply to one or more plies containing cellulosic fibres to form the multi ply paper or board. For example, multi ply paper and board can be produced by
35 forming the individual plies or layers separately in one or several web-forming units and then couching them together in the wet state. Examples of suitable grades of multi ply paper and board of the invention include those comprising from two to seven plies or layers comprising cellulosic fibres and wherein at least one of said plies or layers comprises the

cellulosic fibre composition, as defined herein, preferably one or more of the middle (internal) plies or layers.

The term "board, as used herein, refers to board comprising cellulosic fibres including solid board, e.g. solid bleached sulphate board (SBS) and solid unbleached sulphate board (SUS), paper board, carton board, e.g. folding boxboard (FBB), folding carton board, liquid packaging board (LPB), including all types of aseptic, non-aseptic autoclavable packaging boards, white lined chipboard (WLC), unbleached kraftboard, grey chipboard and recycled board, liner board and container board, including white sulphate kraftliner, fully bleached kraftliner, testliner, white sulphate testliner, unbleached kraftliner, unbleached testliner and recycled liner, corrugated board, fluting and corrugated fluting. The board may have a grammage of at least about 130, usually at least about 140 or at least about 150 g/m², and it may be up to about 1,400, or up to about 1,300 g/m². The board may have a bulk density of at least about 120, usually at least about 150, or at least about 200 kg/m³, and it may be up to about 1,400, usually up to about 800, or up to about 600 kg/m³.

Example

The invention is further illustrated in the following Example which, however, is not intended to limit the same. Parts and % relate to parts by weight and % by weight, respectively, and all suspensions are aqueous, unless otherwise stated.

Two different cellulosic fibre compositions were used as additives in a paper and board making process in which paper or board sheets with a grammage of approximately 150 g/m² were made from Timsfors test liner using a dynamic sheet former (ADF, supplied by Techpap, France). Cellulosic pulp suspensions at a consistency of 0.5 % and conductivity 2.0 mS/cm at pH 7 were formed in a mixing chest and the following additions were made:

- (i) cellulosic fibre composition, if any, was added to the suspension in an amount of 5 % by weight, calculated as dry cellulosic fibres of the composition on dry cellulosic pulp suspension, whereupon the obtained suspension was mixed for 30 seconds,
- (ii) alkyl ketene dimer (Eka DR28HF, Eka Chemicals AB) was added to the suspension in an amount of 2 kg/t, based on dry suspension, whereupon the suspension was mixed for 15 seconds, and
- (iii) cationic potato starch (Perlbon 970, Lyckeby) was added to the suspension in an amount of 10 kg/t, based on dry suspension, whereupon the suspension was mixed for 15 seconds, and

- (iv) cationic polyacrylamide (Eka PL1510, Eka Chemicals) was added to the suspension in an amount of 0.5 kg/t, based on dry suspension, whereupon the suspension was mixed for 15 seconds, and
- (v) a siliceous material in the form of an aqueous sol of anionic silica-bases particles (Eka NP 442, Eka Chemicals) was added to the suspension in an amount of 0.3 kg/t, calculated as SiO₂ and based on dry suspension, whereupon the suspension was mixed for 15 seconds,
- and then the obtained suspension was pumped from the mixing chest through a traversing nozzle on a wire positioned on a rotating drum of the dynamic sheet former where it was dewatered for sheet formation.

The obtained paper or board sheets were pressed in a plane press at 10 bar for 5 minutes and thereafter dried restrained in a plane drier at 115 °C for 10 minutes. The paper products were cured in oven at 105 °C for 10 minutes and thereafter conditioned in a climate room according to ISO 187:1990.

Creep measurement of the paper products were performed in cross direction and in tension using a Rheometrics RSA-II (Rheometrics Scientific, Piscataway, NJ, USA). Rectangular paper or board strip samples of 6 mm in width were prepared by cutting, using a sharp edged frame. The thickness of the sample was in the range of 240 to 257 µm. The static tension was chosen to correspond to 20 % of the stress at break in tensile tests performed at 50 % relative humidity (RH) according to the method of ISO 1924-3. The value was taken from the reference sample. The applied static load was adjusted according to the thickness of the current sample to result in a stress of approximately 3 MPa. The paper or board samples were stored in controlled climate before analysis at a temperature of 23 °C and 50 % RH. The samples were mounted in the RSA-II, the clamping length was 22.6 mm, and the force was applied in tension direction. The temperature was kept constant at 23 °C. The relative humidity was varied between two levels; 50 % RH and 90 % RH. An initial phase at 50 % RH was followed by two cycles starting at 90 % RH and ending at 50 % RH. Each level of relative humidity was kept for 30 minutes. The total time for the test was hence 150 minutes in the humidity sequence 50-90-50-90-50 % RH. The sample was enclosed in an air convection oven with circulating dry air. The instrument was also equipped with humidity control system consisting of a relative humidity sensor in the oven which sends a signal to a PID regulator. The regulator controls an electric valve which mixes a dry and a humid air stream to set the relative humidity. The strain of the samples was recorded continuously and reported as a percentage of the initial free length. The results of the creep measurements can be seen in Table 1.

Test No. 1 is a reference in which no cellulosic fibre composition was used as an additive to the cellulosic pulp suspension.

In Test No. 2, a cellulosic fibre composition was used for comparison. This composition had been prepared by enzymatic degradation and mechanical beating by means of a microfluidizer according to the general disclosure of Henriksson et al., An environmentally friendly method for enzyme-assisted preparation of microfibrillated cellulose (MFC) nanofibers, European Polymer Journal 2007, 43, pp. 3434-3441 and contained cellulosic fibres having a length weighted mean fibre length of 89 μm , length weighted mean fibre width of 25 μm and length weighted mean fibre length / width ratio of 3.6.

In Test No. 3, a cellulosic fibre composition was used according to this invention. The composition had been prepared according to the general disclosure of PCT/EP2011/061571 and contained cellulosic fibres having a length weighted mean fibre length of 290 μm , length weighted mean fibre width of 31 μm and length weighted mean fibre length / width ratio of 9.

Length weighted mean fibre length and length weighted mean fibre width of the cellulosic fibres of the composition of Test Nos. 2 and 3 were measured by means a Fiber Tester of Lorenzen & Wettre, Sweden, which operates according to ISO 16065-2:2007. The length weighted mean fibre length / width ratio was calculated from such data.

Table 1

Test No.	Initial Strain (%)	1 st Cycle Strain (%)		2 nd Cycle Strain (%)		Recovery (% of max)	
		90%RH	50%RH	90%RH	50%RH	1 st Cycle	2 nd Cycle
1	0.53	3.29	2.69	3.66	3.07	18.2	16.3
2	0.61	3.21	2.60	3.55	2.96	19.2	17.1
3	0.52	2.24	1.67	2.54	1.96	25.8	23.3

The results show that the use of the composition comprising cellulosic fibres according to the invention resulted in much lower strain of the paper or board, thus lower creep, at the first and second cycles at 50 and 90 % relative humidity as well as better recovery over the composition comprising cellulosic fibres used for comparison and the cellulosic pulp suspension used as a reference.

Claims

1. Use of a composition comprising cellulosic fibres having a length weighted mean fibre length of from 100 to 800 μm as a creep inhibitor in paper and board and/or in the production of paper and board.
2. Use of a composition comprising cellulosic fibres having a length weighted mean fibre length / width ratio of from 5 to 35 as a creep inhibitor in paper and board and/or in the production of paper and board.
3. Use according to claim 2, wherein the cellulosic fibres have a length weighted mean fibre length of from 100 to 1100 μm .
4. Use according to any one of claims 1 to 3, wherein the cellulosic fibres have a length weighted mean fibre length of from 200 to 800 μm .
5. Use according to any one of claims 1 to 4, wherein the cellulosic fibres have a length weighted mean fibre width of from 10 to 50 μm .
6. Use according to any one of claims 1 to 5, wherein the cellulosic fibres have a length weighted mean fibre length / width ratio of from 10 to 30.
7. Use according to any one of claims 1 to 6, wherein the cellulosic fibres contain carboxymethyl groups.
8. Use according to any one of claims 1 to 6, wherein the cellulosic fibres have an average degree of substitution of anionic groups of from 0.001 to 0.25, preferably an average degree of substitution of carboxymethyl groups from 0.01 to 0.15.
9. Use according to any one of claims 1 to 8, wherein the composition has a content of at least 85 % by weight of cellulosic material which is insoluble in water, measured on an aqueous cellulosic composition containing 1 % by weight of cellulosic material at 20 °C.
10. Use according to any one of claims 1 to 9, wherein the cellulosic fibres have a specific surface area of from 1.5 to 150 m^2/g , preferably from 3 to 150 m^2/g .

11. Use according to any one of claims 1 to 10, wherein the composition comprising cellulosic fibres is used as an additive to an aqueous cellulosic pulp suspension in the production of paper and board.

5 12. Use according to any one of claims 1 to 11, wherein the composition comprising cellulosic fibres is added to an aqueous cellulosic pulp suspension in an amount of from 0.1 to 10 % by weight, calculated as dry cellulosic composition on dry cellulosic pulp.

10 13. Use according to any one of claims 1 to 12, wherein the paper and board are free from polymeric thermoplastic material.

14. Use according to any one of claims 1 to 13, wherein the composition is aqueous.

15 15. Use according to any one of claims 1 to 13, wherein the composition is non-aqueous.

16. Use according to any one of claims 1 to 15, wherein the paper and board is liner.

20 17. Use according to any one of claims 1 to 15, wherein the paper and board is corrugated board.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/069560

A. CLASSIFICATION OF SUBJECT MATTER INV. D21H21/52 D21H27/00 D21H27/18 D21H15/02 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) D21H		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DATABASE WPI Week 199605 Thomson Scientific, London, GB; AN 1996-045724 XP002666939, & JP 7 310296 A (TOKUSHU SEISHI KK) 28 November 1995 (1995-11-28)	1,2,4-17
A	abstract -----	3
Y	WO 2009/008822 A1 (STFI PACKFORSK AB [SE]; VOMHOFF HANNES [SE]; BERTHOLD FREDRIK [SE]; MA) 15 January 2009 (2009-01-15) cited in the application	1,2,4-17
A	claims 1,3 -----	3
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"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 "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 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search 5 November 2012	Date of mailing of the international search report 13/11/2012	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Ponsaud, Philippe	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/069560

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