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(54) Title: BOARD COMPRISING HYDROTALCITE

(57) Abstract: The invention relates to a process for producing board which comprises providing an aqueous suspension comprising cellulosic fibres; adding hydrotalcite to the suspension; dewatering the obtained suspension to provide a (i) single ply board; or (ii) a ply comprising cellulosic fibres and hydrotalcite, and attaching said ply to one or more plies comprising cellulosic fibres to provide a multi ply board comprising two or more plies. The invention further relates to board comprising one or more plies containing cellulosic fibres, wherein the board further comprises hydrotalcite distributed throughout at least one of said one or more plies. The invention also relates to a method for producing a packaging material, a packaging material per se and uses of the packaging material comprising board comprising one or more plies containing cellulosic fibres and hydrotalcite. The invention also relates to a procedure of making a package and the package per se which package comprises board comprising one or more plies containing cellulosic fibres and hydrotalcite.

BOARD COMPRISING HYDROTALCITE

Field of the Invention

The present invention generally relates to board containing cellulosic fibres and hydrotalcite as well as the production thereof; packaging materials and packages comprising the board and the production thereof as well as uses of the packaging materials for packaging of foodstuff, beverages, pharmaceuticals, cosmetics and tobacco.

Background of the Invention

Packages are widely used throughout the world, for example to transport goods and protect the contents of the packages. It has proven especially difficult to design packages for maintaining the original properties of contents, such as foodstuff, beverages, pharmaceuticals and cigarettes. The quality of the content may be reduced either by the content itself changing over time, or by quality-reducing substances being supplied from or through the package. The content can be treated, e.g. pasteurised, as with milk, or dried, as with flour. Usually, the packages are designed with several plies or layers which often are made of different materials. Thus, each ply and each material has a specific quality and purpose in the package, such as preventing the transfer of oxygen, water or water vapour to the content of the package.

Packaging materials are frequently used for packaging solid and liquid foodstuffs and beverages, e.g. cereals, milk, juice, wine and water. Such packaging materials are usually made of board comprising several layers or plies of cellulosic fibres, combined with one or more layers of plastic material in direct contact with the foodstuff or beverage. Despite the use of packages containing a combination of several materials, the content may acquire an undesirable smell and/or taste after some time. The substances causing undesirable smell and taste are usually oxidation products formed during production and storage of the board. Since the packaging blanks usually are shipped flat and opened when ready to be filled, the oxidation products may be transferred to the plastic-coated inside of the packaging material.

It would be desirable to be able to provide board and board-containing packaging materials and packages having less undesirable or unpleasant smell and/or taste. It would also be desirable to be able to provide improved processes for the production of such products.

Summary of the Invention

The present invention is generally directed to a process for producing board comprising

(i) providing an aqueous suspension comprising cellulosic fibres;

(ii) adding hydrotalcite to the suspension;

(iii) dewatering the obtained suspension to provide a single ply board.

The present invention is further generally directed to a process for producing board which comprises

(i) providing an aqueous suspension comprising cellulosic fibres;

(ii) adding hydrotalcite to the suspension;

(iii) dewatering the obtained suspension to provide a ply comprising cellulosic fibres and hydrotalcite; and

(iv) attaching said ply to one or more plies comprising cellulosic fibres to provide a multi ply board comprising two or more plies.

The present invention is also generally directed to board comprising one or more plies containing cellulosic fibres, wherein the board further comprises hydrotalcite distributed throughout at least one of said one or more plies.

The present invention is further generally directed to a method for producing a packaging material which comprises

(i) providing board comprising one or more plies containing cellulosic fibres and hydrotalcite; and

(ii) subjecting the board to one or more converting operations selected from printing, varnishing, coating, laminating, metallizing, die cutting, scoring, creasing, foil blocking, embossing and folding.

The present invention is also generally directed to a packaging material comprising board which comprises one or more plies containing cellulosic fibres and hydrotalcite, wherein it further comprises one or more grooves, creases or scores.

The invention is further generally directed to a procedure of making a package comprising:

(i) providing a blank of packaging material comprising board comprising one or more plies containing cellulosic fibres and hydrotalcite;

(ii) filling the packaging blank with a solid or liquid content to form an unsealed package; and

(iii) sealing the obtained package.

The present invention is also generally directed to a package comprising board containing cellulosic fibres and hydrotalcite, wherein it further comprises a solid or liquid content.

The invention is further directed to uses of the packaging material comprising board, which comprises one or more plies containing cellulosic fibres and hydrotalcite, for packaging of solid or liquid foodstuffs, beverages, pharmaceuticals, cosmetics, chocolates, cigarettes or tobacco.

Detailed Description of the Invention

According to the present invention it has been found that the problems caused by undesirable and unpleasant smell and/or taste of board and packaging materials and packages comprising board can be reduced by using hydrotalcite in the production thereof as an additive to aqueous cellulosic suspensions. It has also been found that the present invention reduces the negative impact on board making processes by the presence of disturbing and detrimental substances present in aqueous cellulosic suspensions, specifically problems caused by pitch, stickies and anionic low molecular weight organics. It has further been found that the addition of hydrotalcite in conjunction with additives used for making board also improves the performance of such additives as compared to when hydrotalcite is not added. Examples of such additives for which improved performance can be observed include drainage and retention aids, sizing agents, etc. Preferably, the hydrotalcite is used together with one or more drainage and retention aids comprising at least one cationic polymer. Thus, the present invention makes it possible to obtain a reduction of undesirable or unpleasant smell and/or taste of board and packaging materials comprising board, improved drainage (dewatering) and retention as well as improved sizing in board making processes, while simultaneously reducing the content of disturbing and detrimental substances in the cellulosic suspension.

Hydrotalcite belongs to the group of materials referred to as clays. The term "hydrotalcite", as used herein, refers to hydrotalcite and hydrotalcite-like clays including layered double hydroxide compounds, e.g. manasseite, pyroaurite, sjögrenite, stichtite, barbertonite, takovite, reevesite, desautelsite, motukoreaite, wermlandite, meixnerite, coalingite, chloro-magalumite, carrboydite, honessite, woodwardite, iowaite, hydrohonessite, mountkeithite, etc. The hydrotalcite according to the invention can be derived from naturally occurring hydrotalcites, synthetic hydrotalcites and chemically and/or physically modified naturally

occurring and synthetic hydrotalcites. Naturally occurring hydrotalcites normally have an essentially crystalline structure.

However, synthetically obtained hydrotalcites may also contain amorphous material having essentially the same chemical composition as the crystalline structures. The amount of amorphous material present in synthetic hydrotalcite clays depends mainly on the reaction parameters used. The term "clay", as used herein, refers to clays having essentially crystalline structure and also to clays both containing crystalline and amorphous structures.

Clays are characterised by a layered structure wherein atoms within the layers (lamellae) are cross-linked by chemical bonds, while the atoms of adjacent layers interact mainly by physical forces. The layers of the clay may be non-charged or charged depending on the type of atoms present in the layers. If the layers are charged, then the space between these layers, also designated as the interlayer space, contains ions which have the opposite charge with respect to the charge of the layers. The term "cationic clay", as used herein, refers to clays having positively charged layers and anions present in the interlayer space. The term "anionic clay", as used herein, refers to clays having negatively charged layers and cations present in the interlayer space. Usually the ions in the interlayer space are exchangeable. Preferably, the hydrotalcite of the invention is cationic, i.e. a cationic clay.

The hydrotalcite of the invention can virtually have any anion, optionally also water molecules, present in the interlayer space. Examples of common anions that can be present in the interlayer space include NO_3^-, OH^-, Cl^-, Br^-, I^-, CO_3^{2-}, SO_4^{2-}, SiO_3^{2-}, CrO_4^{2-}, BO_3^{2-}, MnO_4^-, $HGaO_3^{2-}$, HVO_4^-, and ClO_4^-, as well as pillaring or intercalating anions such as $V_{10}O_{28}^{6-}$ and $MO_7O_{24}^{6-}$, mono-carboxylates like acetate, dicarboxylates such as oxalate, and alkyl sulphonates such as lauryl sulphonate; usually hydroxide and carbonate. Naturally occurring hydrotalcites of the invention commonly have carbonate anions in the interlayer space.

The layer or lamella of the hydrotalcite suitably comprises at least two different metal atoms having different valences. Suitably, one metal atom is divalent and the other metal atom is suitably trivalent. However, the layer may also comprise more than two metal atoms. The charge of the layer is governed by the ratio of metal atoms having different valences. For instance, a higher amount of trivalent metals will render a layer having an increased density of the positive charge. Suitably, the hydrotalcite of the invention comprises layers containing divalent and trivalent metals in a ratio so that the overall charge of the layers is cationic, and the interlayers comprise anions. Preferably, the layers

essentially consist of divalent and trivalent metals in such a ratio that the overall charge of the layers is cationic.

Synthetically produced and naturally occurring hydrotalcites according to the invention can be characterised by the general formula:

$$[M_m^{2+} M_n^{3+} (OH)_{2m+2n}] X_{n/z}^{Z-} \cdot bH_2O,$$

wherein m and n , independently of each other, are integers having a value such that m/n is in the range of from 1 to 10, preferably 1 to 6, more preferably 2 to 4 and most preferably values around 3; *b* is an integer having a value in the range of from 0 to 10, suitably a value from 2 to 6, and often a value about 4; $X_{n/z}^{Z-}$ is an anion where *z* is an integer from 1 to 10, preferably from 1 to 6, suitable $X_{n/z}^{Z-}$ including NO_3^-, OH^-, Cl^-, Br^-, I^-, CO_3^{2-}, SO_4^{2-}, SiO_3^{2-}, CrO_4^{2-}, BO_3^{2-}, MnO_4^-, $HGaO_3^{2-}$, HVO_4^-, ClO_4^-, pillaring and intercalating anions such as $V_{10}O_{28}^{6-}$ and $MO_7O_{24}^{6-}$, mono-carboxylates like acetate, dicarboxylates such as oxalate, and alkyl sulphonates such as lauryl sulphonate; M^{2+} is a divalent metal atom, suitable divalent metal atoms including Be, Mg, Cu, Ni, Co, Zn, Fe, Mn, Cd, and Ca, preferably Mg; M^{3+} is a trivalent metal atom, suitable trivalent metal atoms including Al, Ga, Ni, Co, Fe, Mn, Cr, V, Ti and In, preferably Al.

Preferably, the divalent metal is magnesium and the trivalent metal is aluminium, rendering the general formula:

$$[Mg_m^{2+} Al_n^{3+} (OH)_{2m+2n}] X_{n/z}^{Z-} \cdot bH_2O.$$

Hydrotalcites according to the invention can be prepared by hydrothermal treatment (solvo thermal) of a slurry containing an aluminium source and a magnesium source. Examples of suitable hydrotalcites of the invention and methods for their preparation include those disclosed in International Patent Application Publication No. WO 01/12550, the disclosure of which is hereby incorporated herein by reference.

In a preferred embodiment of the invention, the hydrotalcite has a $3R_2$ stacking. In another preferred embodiment of the invention, the hydrotalcite has a stacking other than the $3R_2$ stacking, for example a $3R_1$ stacking. Differences between the hydrotalcite $3R_1$ and $3R_2$ stackings are disclosed in International Patent Application Publication No. WO 01/12550, the disclosure of which is incorporated herein by reference.

Preferably, the hydrotalcite is used according to the invention either as a slurry (suspension) or powder, which can be easily dispersed in water. The suspension or powder of hydrotalcite may further also contain other components such as, for example, dispersing and/or protecting agents, which can contribute to the overall effect of the hydrotalcite. Such agents can have non-ionic, anionic or cationic character. Examples of suitable protective agents or colloids include water-soluble cellulose derivatives, e.g. hydroxyethyl- and hydroxypropyl-, methylhydroxypropyl- and ethylhydroxyethyl-cellulose, methyl- and carboxymethylcellulose, gelatine, starch, guar gum, xanthan gum, polyvinyl alcohol, etc. Examples of suitable dispersing agents include non-ionic agents, e.g. ethoxylated fatty acids, fatty acids, alkyl phenols or fatty acid amides, ethoxylated and non-ethoxylated glycerol esters, sorbitan esters of fatty acids, non-ionic surfactants, polyols and/or their derivatives; anionic agents, e.g. as alkyl or alkylaryl sulphates, sulphonates, ethersulphonates, polyacrylic acid; and cationic agent, e.g. esterquats obtained by reacting alkanolamines with mixtures of fatty acids and dicarboxylic acids, optionally alkoxylating the resulting esters and quaternising the products, quaternised fatty acid amides, betaines, dimethyl dialkyl or dialkylaryl ammonium salts, and cationic gemini dispersing agents.

According to the present invention, board is produced by a process which comprises adding hydrotalcite to an aqueous cellulosic suspension and then dewatering the obtained suspension to form the board. In a preferred embodiment of the invention, the process produces a single ply board comprising hydrotalcite which preferably is distributed throughout the board, more preferably substantially uniformly distributed throughout the board. Single ply board contains just one ply or layer comprising cellulosic fibres.

In another preferred embodiment of the invention, the process produces a multi ply board comprising two or more plies or layers containing cellulosic fibres wherein at least one of said two or more plies or layers comprises hydrotalcite. Preferably, the hydrotalcite is distributed throughout at least one of said two or more plies, more preferably substantially uniformly distributed throughout at least one of said two or more plies, most preferably in at least one of the outer plies. Multi ply board according to the invention can be produced by forming at least one ply comprising cellulosic fibres and hydrotalcite and attaching said at least one ply to one or more plies comprising cellulosic fibres to form the multi ply board. For example, multi ply board can be produced by 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 board of the invention include those comprising from three to seven plies or layers comprising cellulosic fibres and at least one of said plies or layers comprising hydrotalcite.

In the process of the invention, the board, e.g. single and multi ply board grades, can be subjected to further process steps. Examples of suitable process steps include coating, e.g. starch coating and pigment coating, printing and cutting. Accordingly, examples of suitable boards of the invention include coated board, e.g. starch and/or pigment coated, and printed board.

The hydrotalcite can be added at any point in the board production process starting from the point where wood chips are disintegrated up to the point in the process where dewatering of the cellulosic suspension takes place.

According to a preferred embodiment of the invention, the hydrotalcite is added to a cellulosic suspension of a pulp making process. The hydrotalcite can be added prior to or after the pulping process which can be kraft, mechanical, thermo-mechanical, chemomechanical, chemo-thermo-mechanical pulping processes. The hydrotalcite can be added just before the pulping process or directly to the pulping process, such as to the digester. However, it is preferred that the hydrotalcite is added to the cellulosic suspension subsequent to chemical digestion such as after the brown stock washer, or after refining of (chemo-)mechanical pulp. Usually, the cellulosic pulp is bleached in a multi stage bleaching process comprising different bleaching stages and the hydrotalcite can be added to any bleaching sequence. Examples of suitable bleaching stages include chlorine bleaching stages, e.g. elementary chlorine and chlorine dioxide bleaching stages, non-chlorine bleaching stages, e.g. peroxide stages like ozone, hydrogen peroxide and peracetic acid, and combinations of chlorine and non-chlorine bleaching and oxidizing stages, optionally in combination with reducing stages like treatment with dithionite. The hydrotalcite can be added to the cellulosic suspension directly to a bleaching stage, preferably to the mixer prior to the bleaching tower, at any point between the bleaching and washing stages, and also to a washing stage where the hydrotalcite may be partly removed, e.g. in the displacement section. Preferably, when adding the hydrotalcite to a cellulosic suspension of a pulp making process, the pulp obtained is subsequently used in a board making process.

According to another preferred embodiment of the invention, the hydrotalcite is added to a cellulosic suspension of a board making process. The hydrotalcite can be added to the cellulosic suspension at any point of the board making process such as to the thick stock, thin stock, or to the white water before it is recycled, e.g. prior to the thin stock feed box. Preferably, the hydrotalcite is added to the thick stock. The hydrotalcite can also be added at more than one point of the pulp and/or board making processes. For instance, in integrated pulp and board mills, the hydrotalcite can be added in the process for pulp production, and optionally also in the process for board production, and one or more drainage and retention

aids can be added in the process for board production. Such processes can include dewatering the cellulosic suspension containing hydrotalcite, diluting the suspension obtained, adding to the diluted suspension one or more drainage and retention aids and dewatering the suspension containing the drainage and retention aids.

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 gable-top, aseptic, brick and non-aseptic 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; fluting and corrugated fluting. Preferably, the board has a grammage of at least 130 g/m^2, more preferably in the range of from 140 to 600 g/m^2 and most preferably from 150 to 450 g/m^2. Preferably, the board has a bulk density of 120 to 1200 kg/m^3, more preferably from 150 to 800 kg/m^3 and most preferably from 200 to 600 kg/m^3. The process can be used in the production of board from different types of aqueous suspensions comprising cellulosic fibres, or aqueous cellulosic suspensions. Preferably, the suspension contains at least 25% by weight and more preferably at least 50% by weight of such fibres, based on a dry substance. The cellulosic fibres can be based on bleached and unbleached pulps, they can be based on virgin and/or recycled fibres, and the suspension can be based on fibres from chemical pulp such as sulphate, sulphite and organosolve pulps, mechanical pulp such as thermo-mechanical pulp (TMP), chemo-thermo-mechanical pulp (CTMP), refiner pulp and ground wood pulp, from both hardwood and softwood, and can also be based on recycled fibres, optionally from de-inked pulps (DIP), and mixtures thereof. In multi ply board grades the plies can be made of different types of pulp. Examples of suitable multi ply combinations with bleached cellulosic fibre include bleached chemical pulp top / DIP, CTMP or mechanical pulp middle / bleached chemical pulp back; and bleached chemical pulp top / DIP, CTMP or mechanical pulp middle / mechanical pulp back; the top side optionally being coated and the back side optionally being coated.

The cellulosic suspension can also contain mineral fillers of conventional types such as, for example, kaolin, china clay, titanium dioxide, gypsum, talc and natural and synthetic calcium carbonates such as chalk, ground marble and precipitated calcium carbonate.

Preferably, the hydrotalcite is added to the cellulosic suspension in an amount of from about 0.01% by weight to about 10% by weight, more preferably from about 0.05% by weight up to about 5% by weight, calculated as dry hydrotalcite on a dry cellulosic suspension.

In the process of the invention the hydrotalcite is preferably used in conjunction with one or more additional additives by addition to the aqueous cellulosic suspension prior to dewatering. Examples of suitable additional additives include drainage and retention aids, cationic coagulants, sizing agents like rosin-based sizing agents and cellulose-reactive sizing agents, e.g. ketene dimers and succinic anhydrides, dry strength agents, wet strength agents like polymers formed by reaction of polyamines or polyamideamine with epichlorohydrin, optical brightening agents, dyes, etc.

Examples of suitable drainage and retention aids include organic polymers, which can be selected from anionic, amphoteric, non-ionic and cationic polymers, siliceous materials, and mixtures thereof. The use of siliceous materials and organic polymers as drainage and retention aids, or as flocculating agents, is well known in the art. The term "drainage and retention aid", as used herein, refers to a component (agent, additive) which, when being added to an aqueous cellulosic suspension, give better drainage and/or retention than is obtained when not adding said component. Preferably, the hydrotalcite is used in conjunction with at least one cationic polymer. The term "cationic polymer", as used herein, refers to an organic polymer having one or more cationic groups, preferably an overall cationic charge. The cationic polymer may also contain anionic groups, and such polymers are commonly also referred to as amphoteric polymers.

Polymers suitable for use in the process can be derived from natural or synthetic sources, and they can be linear, branched or cross-linked. Examples of suitable polymers include anionic, amphoteric and cationic polysaccharides, preferably starches; anionic, amphoteric and chain-growth polymers, preferably cationic acrylamide-based polymers, including essentially linear, branched and cross-linked anionic and cationic acrylamide-based polymers; as well as cationic poly(diallyldimethyl ammonium chloride); cationic polyethylene imines; cationic polyamines; cationic polyamideamines and vinylamide-based polymers, anionic step-growth polymers, preferably anionic naphthalene-based condensation polymers. Cationic starch and cationic polyacrylamide are particularly preferred polymers and they can be used singly, together with each other or together with other polymers, e.g. other cationic and/or anionic polymers. The molecular weight of the polymer is suitably above 1,000,000 and preferably above 2,000,000. The upper limit is not critical; it can be about 50,000,000, usually 30,000,000 and suitably about 25,000,000. However, the molecular weight of polymers derived from natural sources may be higher.

Examples of suitable siliceous materials include anionic silica-based particles and anionic clays of the smectite type. 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 aqueous colloidal dispersions, so-called sols. Examples of suitable silica-based particles include colloidal silica and different types of polysilicic acid, either homopolymerised or co-polymerised. The silica-based sols can be modified and contain other elements, e.g. aluminium, boron, nitrogen, zirconium, gallium, titatnium and the like, which can be present in the aqueous phase and/or in the silica-based particles. Examples of suitable silica-based particles of this type include colloidal aluminium-modified silica and aluminium silicates. Mixtures of such suitable silica-based particles can also be used. Examples of suitable drainage and retention aids comprising anionic silica-based particles include those disclosed in U.S. Patent Nos. 4,388,150; 4,927,498; 4,954,220; 4,961,825; 4,980, 025; 5,127, 994; 5,176, 891; 5,368,833; 5,447,604; 5,470,435; 5,543,014; 5,571,494; 5,573,674; 5,584,966; 5,603,805; 5,688,482; and 5,707,493; which are hereby incorporated herein by reference.

Examples of suitable anionic silica-based particles include those having an average particle size below about 100 nm, preferably below about 20 nm and more preferably in the range of from about 1 to about 10 nm. As conventional in the silica chemistry, the particle size refers to the average size of the primary particles, which may be aggregated or non-aggregated. The specific surface area of the silica-based particles is suitably above 50 m^2/g and preferably above 100 m^2/g. Generally, the specific surface area can be up to about 1700 m^2/g and preferably up to 1000 m^2/g. The specific surface area is measured by means of titration with NaOH in a well known manner, e.g. as described by G.W. Sears in Analytical Chemistry 28(1956): 12, 1981-1983 and in the U.S. Patent No. 5,176,891. The given area thus represents the average specific surface area of the particles.

Preferably, the anionic silica-based particles have specific surface area within the range of from 50 to 1000 m^2/g, more preferably from 100 to 950 m^2/g. Sols of silica-based particles of these types also encompass modifications, for example with any of the elements mentioned above. Preferably, the silica-based particles are present in a sol having a S-value in the range of from 8 to 50 %, preferably from 10 to 40%, containing silica-based particles with a specific surface area in the range of from 300 to 1000 m^2/g, suitably from 500 to 950 m^2/g, and preferably from 750 to 950 m^2/g, which sols can be modified as mentioned above. The S-value can be measured and calculated as described by Iler & Dalton in J. Phys. Chem. 60(1956), 955-957. The S-value indicates the degree of aggregation or microgel formation and a lower S-value is indicative of a higher degree of aggregation.

In yet another preferred embodiment of the invention, the silica-based particles are selected from polysilicic acid, either homopolymerised or co-polymerised, having a high specific

surface area, suitably above about 1000 m^2/g. The specific surface area can be within the range of from 1000 to 1700 m^2/g and preferably from 1050 to 1600 m^2/g. The sols of modified or co-polymerised polysilicic acid can contain other elements as mentioned above. In the art, polysilicic acid is also referred to as polymeric silicic acid, polysilicic acid microgel, polysilicate and polysilicate microgel, which all are encompassed by the term polysilicic acid used herein. Aluminium-containing compounds of this type are commonly also referred to as polyaluminosilicate and polyaluminosilicate microgel, which are both, encompassed by the terms colloidal aluminium-modified silica and aluminium silicate used herein.

Examples of suitable anionic clays of the smectite type include montmorillonite/bentonite, hectorite, beidelite, nontronite, saponite, laponite, preferably bentonite. Examples of suitable anionic bentonite clays include those disclosed in U.S. Patent Nos. 4,753,710; 5,071,512; and 5,607,552, which are hereby incorporated herein by reference.

Examples of suitable cationic coagulants (also referred to as trash catchers and fixatives) include water-soluble organic polymeric coagulants and inorganic coagulants. The cationic coagulants can be used singly or together, i.e. a polymeric coagulant can be used in combination with an inorganic coagulant. Examples of suitable water-soluble organic polymeric cationic coagulants include cationic polyamines, polyamideamines, polyethylene imines, dicyandiamide condensation polymers and polymers of water soluble ethylenically unsaturated monomer or monomer blend which is formed of 50 to 100 mole % cationic monomer and 0 to 50 mole % other monomer. The amount of cationic monomer is usually at least 80 mole %, suitably 100 %. Examples of suitable ethylenically unsaturated cationic monomers include dialkylaminoalkyl (meth)-acrylates and –acrylamides, preferably in quaternised form, and diallyl dialkyl ammonium chlorides, e.g. diallyl dimethyl ammonium chloride (DADMAC), preferably homopolymers and copolymers of DADMAC. The organic polymeric cationic coagulants usually have 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.

Examples of preferred drainage and retention systems according to the invention comprise:

(i) anionic silica-based particles in combination with cationic polysaccharides, preferably starch, or cationic chain-growth polymers, preferably cationic acrylamide-based polymer, optionally in combination with cationic coagulant;

(ii) anionic silica-based particles in combination with anionic acrylamide-based polymer, optionally in combination with cationic organic polymer and/or cationic coagulant;

(iii) bentonite in combination with cationic chain-growth polymers, preferably cationic acrylamide-based polymer, optionally in combination with cationic coagulant;

(iv) cationic polysaccharide, preferably cationic starch, in combination with anionic step-growth polymer, preferably anionic naphthalene-based condensation polymer; optionally in combination with cationic coagulant;

(v) cationic chain-growth polymer, preferably cationic acrylamide-based polymer, in combination with anionic step-growth polymer, preferably anionic naphthalene-based condensation polymer, optionally in combination with cationic coagulant;

(vi) cationic chain-growth polymer, preferably cationic acrylamide-based polymer, in combination with cationic coagulant; and

(vii) cationic chain-growth polymer, preferably cationic acrylamide-based polymer, in combination with cross-linked anionic and cationic acrylamide-based polymers.

The components of drainage and retention aids can be added to the cellulosic suspension in conventional manner and in any order. When using a siliceous material, it is preferred to add a cationic polymer to the suspension before adding the siliceous material, even if the opposite order of addition may also be used. It is further preferred 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. When using a cationic coagulant, it is preferably introduced into the suspension prior to introducing cationic polymer and siliceous material, if used. Alternatively, the cationic coagulant and cationic polymer can be introduced into the suspension essentially simultaneously, either separately or in admixture, e.g. as disclosed in U.S. Patent No. 5,858,174, which is hereby incorporated herein by reference.

If the hydrotalcite according to the invention is used together with a drainage and retention aid, the hydrotalcite can be added to the suspension prior to or after the addition of the drainage and retention aid. Preferably, the hydrotalcite is added prior to the addition of drainage and retention aid(s). Preferably, the hydrotalcite is added to the thick stock, or to the thin stock, and the drainage and retention aid is added to the thin stock. The hydrotalcite can also be added to the re-cycled white water. If two or more drainage and retention aids are used, i.e. a cationic polymer together with siliceous material, e.g. silica-based particles, and optionally anionic organic polymer, the hydrotalcite can be added to the cellulosic suspension (stock) prior to, after or in between the addition of the drainage and retention aids, or together with any of the drainage and retention aids. The hydrotalcite may also be added at several locations in the process, e.g. to the thick stock and again to the thin stock prior to the addition of drainage and retention aid.

The drainage and retention aid(s) according to the invention can be added to the stock to be dewatered in amounts which can vary within wide limits depending on, inter alia, type and number of components, type of cellulosic suspension, salt content, type of salts, filler content, type of filler, point of addition, degree of white water closure, etc. Generally, the retention and drainage aid(s) are added in amounts that give better drainage and/or retention than is obtained when not adding the components. The cationic polymer is usually added in an amount of at least about 0.001% by weight, often at least about 0.005% by weight, based on dry cellulosic suspension, and the upper limit is usually about 3% and suitably about 1.5% by weight. Commonly applied addition amounts of cationic polymer are from about 0.01% up to about 0.5% by weight. Anionic materials, e.g. siliceous materials, i.e. anionic silica-based particles and anionic clays of the smectite type, and anionic organic polymers, are usually added in an amount of at least about 0.001% by weight, often at least about 0.005% by weight, based on dry cellulosic suspension, and the upper limit is usually about 1.0% and suitably about 0.6% by weight.

When using a cationic coagulant in the process, it can be added in an amount of at least about 0.001% by weight, calculated as dry coagulant on dry cellulosic suspension. Suitably, the amount is in the range of from about 0.05 up to about 3.0%, preferably in the range from about 0.1 up to about 2.0%.

Furthermore, the process can also be useful in the manufacture of board from cellulosic suspensions having high conductivity. In such cases, the conductivity of the suspension that is dewatered on the wire is usually at least 1.0 mS/cm, suitably at least 2.0 mS/cm, and preferably at least 3.5 mS/cm. Conductivity can be measured by standard equipment such as, for example, a WTW LF 539 instrument supplied by Christian Berner. The values referred to above are suitably determined by measuring the conductivity of the cellulosic suspension that is fed into or present in the head box of the board machine or, alternatively, by measuring the conductivity of white water obtained by dewatering the suspension.

The present invention further encompasses board making processes where white water is extensively recycled, or recirculated, i.e. with a high degree of white water closure, for example where from 0 to 30 tons of fresh water are used per ton of dry board produced, usually less than 20, suitably less than 15, preferably less than 10 and notably less than 5 tons of fresh water per ton of board.

The invention further relates to a method for producing a packaging material which comprises providing board comprising one or more plies containing cellulosic fibres and

hydrotalcite, as defined herein, and subjecting the board to one or more converting operations selected from printing, varnishing, coating, e.g. plastics coating, extrusion coating, barrier coating, laminating, e.g. plastic film laminating and metal foil laminating, e.g aluminium foil laminating, metallizing, die cutting, i.e. stamping out blanks, creasing, scoring, stripping, i.e. removal or debris, blanking, i.e. separation of blanks, foil blocking, embossing and folding. The term "creasing", as used herein, is also referred to as scoring and grooving. Preferably, the method includes one or more converting operations comprising scoring or creasing, more preferably two or more operations comprising scoring or creasing, for example cutting and scoring or creasing.

The invention also relates to a packaging material comprising board which comprises one or more plies containing cellulosic fibres and hydrotalcite, as defined herein, wherein it further comprises one or more creases. The creases, also referred to as scores, grooves or folding lines, make it easier to fold and erect the packaging material prior to filling. The packaging materials of the invention can have one or more layers of plastic film, metal foil, e.g. aluminium, and/or barrier coating.

The invention further relates to a procedure of making a package which comprises providing a blank of packaging material comprising board comprising one or more plies containing cellulosic fibres and hydrotalcite, as defined herein; filling the blank with a solid or liquid content to obtain an unsealed package; and then sealing the obtained package. Preferably the packaging material comprises one or more grooves, creases or scores. The term "blank", as used herein, means an unfilled package or packaging material. Preferably the blank is folded and erected prior to filling. Examples of suitable methods for sealing include gluing and heat sealing.

Examples of suitable solid and liquid contents include solid and liquid foodstuffs, e.g. tomato products, soup and cream; beverages, e.g. milk, fruit juice, wine and water; pharmaceuticals; cosmetics; chocolates; cigarettes and tobacco. In a preferred embodiment, the invention further comprises sterilizing the package and/or the content. The term "sterilizing", as used herein, means reducing the number of microorganisms. Examples of suitable methods and means for sterilization include heat, e.g. rapid heating and cooling, chemicals, e.g. hydrogen peroxide, irradiation, e.g. IR and UV irradiation. The filling can be made under sterile conditions.

The invention also relates to a package comprising board comprising one or more plies containing cellulosic fibres and hydrotalcite, as defined herein, wherein it further comprises a solid or liquid content. The invention further relates to uses of the packaging material

comprising board, which comprises one or more plies containing cellulosic fibres and hydrotalcite, as defined herein, for packaging of solid or liquid foodstuffs, beverages, pharmaceuticals, cosmetics, chocolates, cigarettes or tobacco.

Examples of suitable packaging of the invention include foodstuff packaging, beverage packaging, sterile packaging and aseptic packaging.

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, unless otherwise stated.

Example 1

In this example, the efficiency of the invention to reduce undesirable and/or unpleasant taste, smell and/or odour of board was evaluated.

A chemical substance which is present in board and causes undesirable taste, smell and/or odour, n-hexanal, was chosen as a smelling model substance, hereinafter "smelling substance". The content of the smelling substance was determined by the so-called hot method in which a sample consisting of 2.5 g of packaging material was placed in a vessel which then was sealed. After shaking for 5 min and subsequent thermostating at 100 °C for 40 min, an amount of gas above the sample was retrieved and immediately analysed in a gas chromatograph. The content of the smelling substance in the amount of gas was calculated from the top area of the chromatogram. The degree of undesirable taste, smell and/or odour was given as the smelling substance residue, which constitutes a percentage share of the content of smelling substance transferred from the cellulosic sheet or pulp containing hydrotalcite in relation to the corresponding content transferred from the sheet or pulp without additives. Thus, the content of smelling substance transferred from the sheet or pulp without any addition of hydrotalcite or paper chemicals was calculated.

Plies of board with and without hydrotalcite were produced on a pilot machine. A thick cellulosic suspension (thick stock) was used based on furnish from a liquid packaging board mill consisting of 30 % bleached softwood pulp and 70 % bleached hardwood pulp. The thick suspension was diluted with press water from bleached hardwood pulp to provide a consistency of 15 g/l. The obtained suspension had a pH of 7 and conductivity of 0.8 mS/cm. The suspension was stirred and heated to 50 °C. In one test, 50 kg/t hydrotalcite

(CC-22, Akzo Nobel Catalyst B.V.) was added to the suspension. The suspension was stirred for 30 minutes.

Prior to sheet formation, the following additives were added to the suspension in the following order: 8 % calcinated clay; 1 kg/t aluminium sulfate; 4 kg/t cationic starch (Perlbond 970); 1.6 kg/t rosin-based sizing agent (Eka Composize L44HT); 1.5 kg/t aluminium sulfate; 1.5 kg/t sizing agent based on alkenyl ketene dimer (Eka Keydime 28HF); 5 kg/t cationic starch (Perlbond 970); and 2.5 kg/t silica sol (Eka NP 442). The suspension was dewatered to form a sheet having a basis weight of approximately 90 g/m^2.

Directly after production, A4 sized sheets were wrapped in aluminium foil and sealed in air tight plastic bags. After two weeks, the sheet was analysed with gas chromatography for the smelling substance. Table 1 shows the amount of the smelling substance after storage for two weeks.

Table 1

Test No.	Hydrotalcite [kg/t]	Smelling Substance [ng/ml]
1	0	168
2	50	110

Example 1 shows that the invention resulted in a 35 % reduction of the content of the volatile smelling substance in the gas phase.

Example 2

Board was made as described in Example 1 except that the amount of hydrotalcite added was different. The board obtained was analysed for filler content, also referred to as ash retention. Table 2 shows the results.

Table 2

Test No.	Hydrotalcite [kg/t]	Filler [%]
1	0	7.6
2	10	8.2

Table 2 shows that the filler level was higher when adding hydrotalcite in the process.

Example 3

In this example, sizing performance was evaluated. A cellulosic suspension from a liquid packaging board mill was treated with hydrotalcite having the $3R_2$ stacking (CC-22, Akzo Nobel Catalyst B.V.) and with talc (Finntalc P05, Omya) respectively. Sizing, drainage and retention aids were added and hand sheets were made (SCAN-C 26:76). Sizing of the sheets was measured as Cobb 60 values (SCAN-P 12:64).

A thick cellulosic suspension (thick stock) was used based on furnish from a liquid packaging board (LPB) mill consisting of bleached softwood and hardwood pulp. The suspension was stirred and heated to 50 °C. Hydrotalcite or talc was added to the suspension which was stirred for 30 minutes. The thick suspension was then diluted with tap water to a consistency of 5 g/L. The obtained suspension had a pH of 8 and conductivity of 0.7 mS/cm. Before sheet making, 0.3 kg/ton of dry pulp of AKD (Keydime C223, Eka Chemicals), 8 kg/ton of dry pulp of cationic starch (Perlbond 970) and 0.5 kg/ton of dry pulp of silica-based particles (Eka NP 590, Eka Chemicals) were added. The sheets had a basis weight of approximately 73 g/m^2. Table 3 shows the sizing results obtained by addition of different amounts of talc and hydrotalcite to the liquid packaging board furnish.

Table 3

Test No.	Talc [kg/t]	CC-22 [kg/t]	Cobb 60
1	0	0	40
2	1		44
3	5		60
4		1	35
5		5	34

The sizing performance was improved when using hydrotalcite over talc. The cellulosic sheet containing bleached pulp and hydrotalcite can be used as a ply of single ply board and multi ply board, e.g. top and/or back ply.

Example 4

Sizing performance was evaluated with higher additions of hydrotalcite (CC-22, Akzo Nobel Catalyst B.V.) and talc (Finntalc P05, Omya), respectively. Hand sheets were made and sizing performance was measured as Cobb 60 (SCAN-P 12:64) values.

A thick cellulosic suspension was used based on furnish from a LPB mill consisting of hydrogen peroxide bleached softwood and hardwood sulphate pulp at ~4% consistency. This suspension was stirred and heated to 50°C. Hydrotalcite or talc was added to the suspension which was allowed to stand for 20 minutes. The thick suspension was then diluted with bleach filtrate to ~3.9 g/l consistency. To the furnish AKD, 1.6 kg/t rosin size, 1.6 kg/t alum, 5.0 kg/t cationic starch and 0.35 kg/t silica-based particles (Eka NP 590, Eka Chemicals) were added before making hand sheets (Rapid-Köthen former). The sheets had a basis weight of approximately 100 g/m^2. Table 4 summarized the sizing results obtained by sizing the liquid packaging board furnish.

Table 4

Test No.	AKD [kg/t]	Talc [kg/t]	CC-22 [kg/t]	COBB 60
1	0	0	0	258
2	0.5	0	0	250
3	0.8	0	0	131
4	1	0	0	59
5	1.4	0	0	39
6	0.5	5	0	211
7	0.8	5	0	115
8	1	5	0	61
9	1.4	5	0	39

10	0.5	0	10	198
11	0.8	0	10	87
12	1	0	10	45
13	1.4	0	10	33

Table 4 shows that the sizing performance was improved (lower Cobb 60 values) using hydrotalcite compared to talc. The cellulosic sheet containing bleached pulp and hydrotalcite can be used as a ply of single ply board and multi ply board, e.g. top and/or back ply.

Example 5

This example was made in a de-inked pulp (DIP) mill. An aqueous pulp suspension from the DIP mill was treated with hydrotalcite (CC-22, Akzo Nobel Catalyst B.V.). The turbidity of the pulp filtrate was then measured.

The pulp suspension used was a taken between the disc filter and the screw press in the DIP plant. The pulp suspension had a consistency of ~7%, and was diluted with tap water to ~4.2%. This suspension pulp was stirred and heated at 50°C. The hydrotalcite was added to the pulp suspension which was allowed to stand for 30 minutes. The pulp suspension was then filtrated through a GF/A glass fibre filter (~2 µm hole diameters). The filtrate was analysed for turbidity in a Hach 2100P turbidity meter. Table 5 shows the results.

Table 5

Test No.	CC-22 [kg/t]	Turbidity [NTU]
1	0	71.8
2	2	63.5
3	5	42.3

The turbidity of the filtrate improved (decreased) when mixing de-inked pulp with hydrotalcite before filtering. A cellulosic sheet containing DIP and hydrotalcite can be used as a ply of multi ply board, e.g. undertop and/or middle ply.

Claims

1. A process for producing board which comprises
   (i) providing an aqueous suspension comprising cellulosic fibres;
   (ii) adding hydrotalcite to the suspension;
   (iii) dewatering the obtained suspension to provide a single ply board.

2. A process for producing board which comprises
   (i) providing an aqueous suspension comprising cellulosic fibres;
   (ii) adding hydrotalcite to the suspension;
   (iii) dewatering the obtained suspension to provide a ply comprising cellulosic fibres and hydrotalcite; and
   (iv) attaching said ply to one or more plies comprising cellulosic fibres to provide a multi ply board comprising two or more plies.

3. The process of claim 1 or 2, wherein it further comprises adding a cationic polymer to the suspension.

4. The process of any one of the preceding claims, wherein it further comprises adding a siliceous material to the suspension.

5. The process of any one of the preceding claims, wherein it further comprises adding a sizing agent to the suspension.

6. Board comprising one or more plies containing cellulosic fibres, wherein the board further comprises hydrotalcite distributed throughout at least one of said one or more plies.

7. A method for producing a packaging material which comprises
   (i) providing board comprising one or more plies containing cellulosic fibres and hydrotalcite; and
   (ii) subjecting the board to one or more converting operations selected from printing, varnishing, coating, laminating, metallizing, die cutting, scoring, creasing, foil blocking, embossing and folding.

8. Packaging material comprising board which comprises one or more plies containing cellulosic fibres and hydrotalcite, wherein it further comprises one or more grooves, scores or creases.

9. A procedure of making a package which comprises:

(i) providing a blank of packaging material comprising board which comprises one or more plies containing cellulosic fibres and hydrotalcite;

(ii) filling the blank with a solid or liquid content to form an unsealed package; and

(iii) sealing the obtained package.

10. Package comprising board comprising one or more plies containing cellulosic fibres and hydrotalcite, wherein it further comprises a solid or liquid content.

11. The process of any one of claims 1 to 5; the board of claim 6; the method of claim 7; the packaging material of claim 8; the procedure of claim 9; or the package of claim 10; wherein the hydrotalcite has a $3R_1$ stacking.

12. The process of any one of claims 1 to 5; the board of claim 6; the method of claim 7; the packaging material of claim 8; the procedure of claim 9; or the package of claim 10; wherein the hydrotalcite has a $3R_2$ stacking.

13. The process of any one of claims 1 to 5, 11 and 12; the board of any one of claims 6, 11 and 12; the method of any one of claims 7, 11 and 12; the packaging material of any one of claims 8, 11 and 12; the procedure of any one of claims 9, 11 and 12; or the package of any one of claims 10 to 12; wherein the board comprises one ply containing cellulosic fibres.

14. The process of any one of claims 1 to 5, 11 and 12; the board of any one of claims 6, 11 and 12; the method of any one of claims 7, 11 and 12; the packaging material of any one of claims 8, 11 and 12; the procedure of any one of claims 9, 11 and 12; or the package of any one of claims 10 to 12; wherein the board comprises two or more plies containing cellulosic fibres.

15. The process of any one of claims 1 to 5 and 11 to 14; the board of any one of claims 6 and 11 to 14; the method of any one of claims 7 and 11 to 14; the packaging material of any one of claims 8 and 11 to 14; the procedure of any one of claims 9 and 11 to 14; or the package of any one of claims 10 to 14; wherein the hydrotalcite is substantially uniformly distributed throughout at least one ply of the board.

16. The process of any one of claims 1 to 5 and 11 to 15; the board of any one of claims 6 and 11 to 15; the method of any one of claims 7 and 11 to 15; the packaging material of any one of claims 8 and 11 to 15; the procedure of any one of claims 9 and 11 to 15; or the

package of any one of claims 10 to 15; wherein the board has a grammage of at least 130 g/m^2.

17. The process of any one of claims 1 to 5 and 11 to 16; the board of any one of claims 6 and 11 to 16; the method of any one of claims 7 and 11 to 16; the packaging material of any one of claims 8 and 11 to 16; the procedure of any one of claims 9 and 11 to 16; or the package of any one of claims 10 to 16; wherein the board has a grammage of from 150 to 450 g/m^2.

18. The process of any one of claims 1 to 5 and 11 to 17; the board of any one of claims 6 and 11 to 17; the method of any one of claims 7 and 11 to 17; the packaging material of any one of claims 8 and 11 to 17; the procedure of any one of claims 9 and 11 to 17; or the package of any one of claims 10 to 17; wherein the board comprises at least 50 % by weight of cellulosic fibres.

19. The process of any one of claims 1 to 5 and 11 to 18; the board of any one of claims 6 and 11 to 18; the method of any one of claims 7 and 11 to 18; the packaging material of any one of claims 8 and 11 to 18; the procedure of any one of claims 9 and 11 to 18; or the package of any one of claims 10 to 18; wherein the board has a bulk density of 200 to 600 kg/m^3.

20. The procedure of any one o claims 9 and 11 to 19; or the package of any one of claims 10 to 19; wherein the solid or liquid content is foodstuffs, beverages, pharmaceuticals, cosmetics, chocolates, cigarettes or tobacco.

21. The procedure of any one o claims 9 and 11 to 19; wherein it further comprises sterilizing.

22. Use of the packaging material of any one of claims 8 and 11 to 19 for packaging of solid or liquid foodstuffs, beverages, pharmaceuticals, cosmetics, chocolates, cigarettes or tobacco.

INTERNATIONAL SEARCH REPORT

Intern I Application No
PCT/SE2005/000708

A. CLASSIFICATION OF SUBJECT MATTER
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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)
IPC 7 D21H B32B D21J B65D

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 practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 89/03863 A (HUBER CORP J M) 5 May 1989 (1989-05-05) page 14, line 25 - page 15, line 1; claims 1-20	1,6
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 08, & JP 09 095900 A (OJI PAPER CO LTD), 8 April 1997 (1997-04-08) abstract	1,6
X	US 5 941 037 A (SPEER DREW VE ET AL) 24 August 1999 (1999-08-24) claims 1-27; examples 1,12	8-10,20, 22
A	US 4 927 465 A (HYDER WALTER J ET AL) 22 May 1990 (1990-05-22) the whole document	1-22

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
19 August 2005	25/08/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Karlsson, L

INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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