METHOD FOR PRODUCING PAPER, PAPERBOARD AND CARDBOARD IN THE PRESENCE OF WATER-SWELLABLE POLYMERS

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ABSTRACT

A process for the production of paper, board and cardboard in the presence of a water-swellable polymer by adding the water-swellable polymer to a fiber suspension, the fiber suspension comprising water-swellable polymers being beaten.
METHOD FOR PRODUCING PAPER, PAPERBOARD AND CARDBOARD IN THE PRESENCE OF WATER-SWELLEABLE POLYMERS


[0002] Water-swellable polymers in the context of the invention are polymers which can absorb at least 1% of their own weight of water. They preferably absorb at least 10% of their own weight, particularly preferably at least 25% of their own weight and especially preferably at least 50% of their own weight of water. Water-swellable polymers in the context of the present invention are in particular so-called superabsorbent polymers which can absorb at least 100% of their own weight of water. These are, for example, polymers of (co)polymerized hydrophilic monomers, graft (co)polymers of one or more hydrophilic monomers on a suitable grafting base, crosslinked cellulose ethers or starch ethers, crosslinked carboxymethylcellulose, partly crosslinked polyalkylene oxide or natural products, such as, for example, guar derivatives, which are swellable in aqueous liquids. Such hydrogels are usually used as a gelatious suspension of absorbent product for the production of diapers, tampons, sanitary towels and other hygiene articles, but also as water-retaining agents in horticulture.

[0003] The use of water-swellable polymers can, however, also be of interest in other areas. To date, polyurethane foams and so-called airlaid cellulose mats have been used for increasing the water absorptivity of tissue paper while at the same time maintaining the wet strength. These are also used in the production of packaging material, the packaging material being said also to retain the strength while simultaneously absorbing liquids. This is, for example, packaging material for frozen foods. In papermaking, an increase in the bulk is desired without the strength of the paper suffering. These could also be potential applications for water-swellable polymers.

[0004] EP 0 437 816 A1 describes a highly absorbent wet-laid woven material which is obtained by a process comprising the following steps: mixing of the superabsorber polymer particle with a liquid to form a slurry, mixing of the slurry thus obtained with fibers, filtration of the superabsorber polymer/fiber mixture and subsequent drying to obtain a highly absorbent wet-laid nonwoven material. The materials thus obtained are used, inter alia, in diapers, incontinence articles, packaging papers for food and dressing materials, such as plasters.

[0005] EP 1 068 392 B1 discloses an improved wet process for the production of an absorbent structure. According to it, a fiber suspension which additionally comprises water-swellable, water-insoluble superabsorber particles is processed in an apparatus for the formation of nonwovens by a wet process. A wet nonwoven comprising wetted superabsorber particles is formed, from which nonwoven water is withdrawn and which nonwoven is then transported into the dry end. It is decisive here that the contact between superabsorber and suspension until the nonwoven runs into the dry end is not more than 45 seconds, with the result that the superabsorber does not have sufficient time for swelling.

[0006] U.S. Pat. No. 5,907,690 and U.S. Pat. No. 6,290,813 B1 disclose a process for the production of highly absorbent wet-laid nonwoven material, first a slurry of water-swellable, water-insoluble superabsorber particles with fibers being produced, the superabsorber particles having a particle size of less than 250 micrometers before addition. A salt-containing solution is then added to this slurry. A wet web is then formed and is washed with water and then dried. The wet-laid nonwoven materials thus obtained have a residual salt content of less than 40% in the dry state.

[0007] US 2002/0060013 A1 relates to a process for the production of wet-laid nonwoven materials which comprise at least 1% by weight of an absorbent polymer having a thermal-reversible liquid absorption capacity.

[0008] US 2003/0014038 A1 discloses superabsorbent articles which comprise a core having swellable branched superabsorbent particles which is in a liquid-permeable shell. Effective amounts of an antibiotic or of an antibacterial agent can be added to the articles disclosed in this publication, so that the end product can be used in the medical sector.

[0009] A disadvantage of the processes of the prior art is that the abovementioned problems are not sufficiently solved or eliminated.

[0010] It was therefore an object of the present invention to provide a process for the production of paper, board and cardboard in the presence of a water-swellable polymer, which process eliminates the abovementioned problems, namely the size of the swollen polymer in comparison with the paper thickness and, on the other hand, the high water content of the swollen polymer, which is usually up to 99.9% by weight.

[0011] The object was achieved by a process for the production of paper, board and cardboard in the presence of a water-swellable polymer by adding the water-swellable polymer to a fiber suspension, the fiber suspension comprising water-swellable polymers being beaten.

[0012] A water-swellable polymer in the context of the present invention is understood as meaning water-absorbent polymers which can absorb at least 1% of their own weight of water. Preferably, they absorb at least 10% of their own weight, particularly preferably at least 25% of their own weight and particularly preferably at least 50% of their own weight of water. Water-swellable polymers in the context of the present invention are in particular so-called superabsorbent polymers which can absorb at least 100% of their own weight of water. These are, for example, polymers of (co)polymerized hydrophilic monomers, graft (co)polymers of one or more hydrophilic monomers on a suitable grafting base, crosslinked cellulose ethers or starch ethers, crosslinked carboxymethylcellulose, partly crosslinked polyalkylene oxide or natural products, such as, for example, guar derivatives, which are swellable in aqueous liquids. Such hydrogels are usually used as aqueous solutions of absorbent products for the production of diapers, tampons, sanitary towels and other hygiene articles.

[0013] In the process according to the invention, the fiber suspension comprising water-swellable polymers is beaten. This beating is usually effected up to a Schopper-Kiegler freeness of 10, preferably of 25, particularly preferably of 35, very particularly preferably of 50 and particularly preferably of 70. The beating can be effected, for example, in a conventional pulper.
The fiber suspension comprising water-swellable polymers is then subjected to the customary papermaking process. After the beating, paper process chemicals are preferably added. However, it is of course possible to add paper process chemicals to the fiber suspension even before the addition of the water-swellable polymer.

The mixture comprising water-swellable polymers can pass through one or more shearing stages both before the addition of the paper process chemicals and thereafter. The mixture is then drained with sheen formation on a wire and drying of the sheets.

The paper process chemicals added are the additives usually used in papermaking, in the conventional amounts, for example fixing agents, retention aids, including microparticle systems, and wet strength agents, engine sizes, biocides and/or dyes.

In the process according to the invention, from 0.1 to 20% by weight of a water-swellable polymer are added to the fiber suspension. The amount of water-swellable polymers in the fiber suspension is preferably from 0.5 to 10% by weight, particularly preferably from 0.8 to 5% by weight and very particularly preferably from 1 to 2.5% by weight, based in each case on the solids content of the suspension.

The fiber suspension to which the water-swellable polymer is added comprises, as a rule, from 0.5 to 4% by weight of fibers, preferably from 0.5 to 2.5% by weight of fibers and very particularly preferably from 0.8 to 1.5% by weight of fibers, based in each case on the solids content of the suspension. Particularly preferably, the suspension has a proportion of about 1% by weight of fibers, based on the solids content of the suspension.

Before swelling in aqueous solution, the water-swellable polymers may have any particle size; the particle size is preferably in the range from 10 nm to 10 mm, particularly preferably in the range from 50 nm to 5 mm and particularly preferably in the range from 100 nm to 1 mm. After swelling, the water-swellable polymers usually have particle sizes in the range from 100 nm to 10 mm, preferably in the range from 0.5 mm to 25 mm and particularly preferably in the range from 0.1 mm to 10 mm.

The form in which the water-swellable polymer is added to the fiber suspension is unimportant. Thus, for example, a solid mixture of the fibers with a solid mixture of the water-swellable polymers can be mixed with one another in the abovementioned quantity ranges of the individual components. Sufficient water is then added to the mixture so that a fiber suspension comprising water-swellable polymers forms. In this way, the water-swellable polymer is given the opportunity to swell in the presence of the fibers.

It is also possible to prepare a gelatinous suspension of a water-swellable polymer in water, in which the water-swellable polymer swells, this gelatinous suspension then being added to the fiber suspension. In this embodiment of the process according to the invention, it is possible, if the gelatinous suspension comprising swollen water-swellable polymer is subjected to a shearing stage. The duration and shearing rate depend on the water-swellable polymer used. The optimum duration and shearing rate are determined by the person skilled in the art as part of his customary experiments.

In another embodiment of the process according to the invention, the water-swellable polymer is introduced into the fiber suspension by spraying.

It is of course also possible to use a plurality of water-swellable polymers in the process according to the invention. These may be added to the fiber suspension both simultaneously as a mixture and separately from one another. Preferably, however, one water-swellable polymer is used.

Preparation processes for superabsorbent polymers are described in “Modern Superabsorbent Polymer Technology”, F. L. Buchholz and A. T. Graham, Wiley-VCH, 1998, pages 69 to 118. There, a monomer solution is polymerized to give a base polymer, for example in a kneader or a belt reactor.

The superabsorbent polymer particles which can be used in the process according to the invention can be prepared by polymerization of a monomer solution comprising

1. at least one ethylenically unsaturated monomer carrying acid groups,
2. at least one crosslinking agent,
3. if appropriate, one or more ethylenically and/or allylically unsaturated monomers copolymerizable with i) and
4. if appropriate, one or more water-swellable polymers onto which the monomers i), ii) and, if appropriate, iii) can be at least partly grafted,
5. if appropriate, postcrosslinked agent, dried and thermally post-crosslinked.

Suitable monomers i) are, for example, ethylenically unsaturated carboxylic acids, such as acrylic acid, methacrylic acid, maleic acid, fumaric acid and itaconic acid, or derivatives thereof, such as acrylamide, methacrylamide, acrylates and methacrylates. Particularly preferred monomers are acryric acid and methacrylic acid. Acrylic acid is very particularly preferred.

The monomers ii) in particular acrylic acid, preferably comprise up to 0.025% by weight of a hydroquinone monoether. Preferred hydroquinone monoethers are hydroquinone monomethyl ether (MEHQ) and/or tocopherols.

Tocopherol is understood as meaning compounds of the formula below

where \( R^1 \) is hydrogen or methyl, \( R^2 \) is hydrogen or methyl, \( R^3 \) is hydrogen or methyl and \( R^4 \) is hydrogen or an acid radical having 1 to 20 carbon atoms.
[0034] Preferred radicals R³ are acetyl, ascorbyl, succinyl, nicotinyl and other physiologically tolerated carboxylic acids. The carboxylic acids may be mono-di- or tricarboxylic acids.

[0035] alpha-Tocopherol where R¹-R²=R³-methyl is preferred, in particular racemic alpha-tocopherol. R⁴ is particularly preferably hydrogen or acetyl. RRR-alpha-tocopherol is particularly preferred.

[0036] The monomer solution preferably comprises not more than 130 ppm by weight, particularly preferably not more than 70 ppm by weight, preferably at least 10 ppm by weight, particularly preferably at least 30 ppm by weight, especially preferably about 50 ppm by weight, of hydroquinone monoester, based in each case on acrylic acid, acrylic acid salts being taken into account in the calculation as acrylic acid. For example, an acrylic acid having a corresponding content of hydroquinone monoester can be used for the preparation of the monomer solution.

[0037] The superabsorbent polymers are crosslinked, i.e. the polymerization is carried out in the presence of compounds having at least two polymerizable groups which can be incorporated in the form of polymerized units into the polymer network by free radical polymerization. Suitable crosslinking agents i) are, for example, ethylene glycol dimethacrylate, diethylene glycol diacrylate, allyl methacrylate, trimethylolpropane triacrylate, triallylamine, tetraallyloxethane, as described in EP-A-0 530 438, di- and triacrylates, as described in EP-A 554 476, and trimethylolpropane and triallyloxethane and in the German Patent Application with the application number DE 103 31 450.4, mixed acrylates which comprise further ethylenically unsaturated groups in addition to acrylate groups, as described in the German Patent Applications with the application numbers DE 103 31 456.3 and DE 103 55 401.7, or mixtures of crosslinking agents, as described, for example, in DE-A-195 43 368, DE-A-196 48 484, WO-A-90 15830 and WO-A-02 32962.

[0038] Suitable crosslinking agents ii) are in particular N,N'-methylenebisacrylamide and N,N'-methylenebis-methacrylamide, esters of unsaturated mono- or polyacrylic acids with polyls, such as diacrylate or triacrylate, for example butanediol or ethylene glycol diacrylate or dimethacrylate and trimethylolpropane triacrylate, and allyl compounds, such as allyl (meth)acrylate, triallycyanurate, diallyl maleate, polyallyl esters, tetraallyloxethane, triallylamine, tetraallyladeniamine, allyl esters of phosphoric acid and vinylphosphonic acid derivatives, as described, for example, in EP-A-0 343 427. Further suitable crosslinking agents ii) are pentaerythritol tri-, pentaerythritol tri- and pentacyrthrityl tetraallyl ethers, polyethylene glycol diallyl ether, ethylene glycol diallyl ethers, glyceryl diallyl ethers, glyceryl triallyl ethers, polyallyl ethers based on sorbitol and ethoxylated variants thereof. Di-(meth)acrylates of polyethylene glycols can be used in the process according to the invention, the polyethylene glycol used having a molecular weight of from 300 to 1000.

[0039] Particularly advantageous crosslinking agents ii) are, however, di- and triacylates of glycerol having a degree of ethoxylation of from 3 to 20, of trimethylol propane having a degree of ethoxylation of from 3 to 20, and of trimethylethylene having a degree of ethoxylation of from 3 to 20, in particular di- and triacylates of glycerol or of trimethylolpropane having a degree of ethoxylation of from 2 to 6, of tripropoxylated glycerol or trimethylolpropane, and of glycerol trialkoxylated with a mixture of ethylene oxide and propylene oxide, of glycerol or trimethylolpropane having a degree of ethoxylation of 15, and of glycerol, trimethylethylene or trimethylolpropane having a degree of ethoxylation of at least 40.

[0040] Very particularly preferred crosslinking agents ii) are the polyethoxylated and/or propoxylated glycerols esterified with acrylic acid or methacrylic acid to give di- or triacylates, as described, for example, in the prior German Application with the application number DE 103 19 462.2. Di- and/or triacylates of glycerol having a degree of ethoxylation of from 3 to 10 are particularly preferred. Di- or triacylates of ethoxylated and/or propoxylated glycerol having a degree of alkyloxation of from 1 to 5 are very particularly preferred. Most preferred are the triacylates of ethoxylated and/or propoxylated glycerol having a degree of alkyloxation of from 3 to 5. These are distinguished by particularly low residual contents (typically less than 10 ppm by weight) in the superabsorbent polymer, and the aqueous extracts of the superabsorbent polymers prepared therewith have a virtually unchanged surface tension (typically at least 0.068 N/m) in comparison with water at the same temperature.

[0041] Ethylenically unsaturated monomers iii) copolymerizable with the monomers i) are, for example, acrylicamide, methacrylamide, crotonamide, dimethylaminoethy1 methacrylate, dimethylaminoethyl acrylate, dimethylaminopropyl acrylate, diethylaminoacrylate, dimethylaminobutyl acrylate, dimethylaminopropyl methacrylate, diethylaminobutyl methacrylate, dimethylaminopropyl acrylate and dimethylaminonopropyl methacrylate.

[0042] Polyvinyl alcohol, polyvinylpyrrolidone, starch, starch derivatives, polyglycols or polyacrylic acids, preferably polyvinyl alcohol and starch, can be used as water-soluble polymers iv).


[0044] The reaction is preferably carried out in a kneader, as described, for example in WO 01 34802, or on a belt reactor, as described, for example, in EP-A 955 086.

[0045] After leaving the polymerization reactor, the hydrogel is advantageously stored at a relatively high temperature, preferably at least 50°C, particularly preferably at least 70°C, very particularly preferably at least 80°C, and preferably less than 100°C, for example in insulated containers. As a result of the storage, usually from 2 to 12 hours, the monomer conversion is further increased.

[0046] Some, preferably from 25 to 95 mol %, preferably from 27 to 80 mol %, particularly preferably from 27 to 30 mol % or from 40 to 75 mol %, of the acid groups of the hydrogels obtained are usually neutralized, it being possible to use the conventional neutralizing agents, preferably alkali metal hydroxides, alkali metal oxides, alkali metal carbonates or alkali metal bicarbonates, and mixtures thereof. Instead of alkali metal salts, it is also possible to use ammonium salts. Sodium and potassium are particularly preferred as alkali metals, but sodium hydroxide, sodium carbonate and sodium bicarbonate and mixtures thereof are very particularly preferred. Usually, the neutralization is achieved by mixing in the neutralizing agent as aqueous solution, as melt or preferably as solid. For example, sodium hydroxide may be present with a water content substantially lower than 50% by weight.
as a waxy material having a melting point above 23°C. In this case, metering in the form of fragments or as a melt at elevated temperature is possible.

[0047] The neutralization can be carried out after the polymerization at the stage of the hydrogel. However, it is also possible to neutralize up to 40 mol%, preferably from 10 to 30 mol%, particularly preferably from 15 to 25 mol%, of the acid groups before the polymerization by adding a part of the neutralizing agent to the monomer solution beforehand and establishing the desired final degree of neutralization only after the polymerization at the stage of the hydrogel. The monomer solution can be neutralized by mixing in the neutralizing agent. The hydrogel can be mechanically comminuted, for example by means of a chopping machine, being possible for the neutralizing agent to be sprayed on, sprinkled over or poured on and then carefully mixed in. For this purpose, the gel material obtained can be treated several times in the chopping machine for homogenization. The neutralization of the monomomer solution directly to the final degree of neutralization is preferred.

[0048] The neutralized hydrogel is then dried using a belt or drum drier until the residual moisture content is preferably below 15% by weight, in particular below 10% by weight, the water content being determined by test method No. 430-2-02 “Moisture content” recommended by EDANA (European Disposables and Nonwovens Association). Alternatively, however, a fluidized-bed drier or a heated plowshare mixer can also be used for the drying.

[0049] The dried hydrogel is then milled and classified; it usually being possible to use one-speed or multispeed roll mills, preferably two- or three-speed roll mills, pinned-disk mills, hammer mills or vibratory mills for the milling.

[0050] In order to improve the performance characteristics, such as, for example, liquid conductivity (SFC) in the diaphragm and absorption under load (AUL), superabsorbent polymer particles are generally postcrosslinked. This postcrosslinking can be carried out in the aqueous gel phase. Preferably, however, milled and sieved polymer particles (base polymer) are coated on the surface with a postcrosslinking agent, dried and thermally postcrosslinked. Crosslinking agents suitable for this purpose are compounds which comprise at least two groups which can form covalent bonds with the carboxylate groups of the hydrophilic polymer or which can crosslink at least two carboxyl groups or other functional groups of at least two different polymer chains of the base polymer with one another.

[0051] Postcrosslinking agents suitable for this purpose are compounds which comprise at least two groups which can form covalent bonds with the carboxylate groups of the polymers. Suitable compounds are, for example, alkoxysilicon compounds, polyaziridines, polyanimes, polymericamines, di- or polyglycidyl compounds, as described in EP-A 083 022, EP-A 543 303 and EP-A 937 736, polyhydric alcohols, as described in DE-C 35 14 019, DE-C 35 23 617 and EP-A 450 922, or β-hydroxylalkylamides, as described in DE-A 102 04 938 and US 6,239,230. Furthermore suitable are compounds having a mixed functionality, such as glycidol, 3-ethyl-3-oxetanemethanol (trimethylpropanoexetane), as described in EP-A 1 199 327, aminothanol, diethanolamine, triethanolamine or compounds which form a further functionality after the first reaction, such as ethylene oxide, propylene oxide, isobutylene oxide, aziridine, azetidine or oxetane.

[0052] Furthermore, DE-A 40 20 780 describes cyclic carbonates, DE-A 198 07 502 describes 2-oxazolidinone and derivatives thereof, such as N-(2-hydroxyethyl)-2-oxazolidone, DE-A 198 07 992 describes bis- and poly-2-oxazolidinones, DE-A 198 54 573 describes 2-oxotetrahydro-1,3-oxazine and derivatives thereof, DE-A 198 54 574 describes N-acetyl-2-oxazolidones, DE-A 102 04 937 describes cyclic ureas, the German Patent Application with the application number DE 103 34 584.1 describes bicyclic amidoacetals, EP-A 199 327 describes oxetanes and cyclic ureas and WO 03/01482 describes morpholine-2,3-dione and derivatives thereof as suitable postcrosslinking agents v).

[0053] The postcrosslinking is usually carried out in a manner such that a solution of the postcrosslinking agent is sprayed onto the hydrogel or the dried base polymer particles. After the spraying on, thermal drying is effected, it being possible for the postcrosslinking reaction to take place both before and during the drying.

[0054] Spraying on of a solution of the crosslinking agent is preferably carried out in mixers having moving mixing tools, such as screw mixers, paddle mixers, disk mixers, plowshare mixers and blade mixers. Vertical mixers are particularly preferred and plowshare mixers and blade mixers are very particularly preferred. Suitable mixers are, for example, Lodige® mixers, Bepe® mixers, Neut® mixers, Proces-sall® mixers and Schulig® mixers.

[0055] The thermal drying is preferably carried out in contact driers, particularly preferably paddle driers, very particularly preferably disk driers. Suitable driers are, for example, Bepe® driers and Nair® driers. In addition, fluidized-bed driers may also be used.

[0056] The drying can be effected in the mixer itself, by heating the jacket or blowing in warm air. A downstream drier, such as, for example, a tray drier, a rotary kiln or a heatable screw, is also suitable. However, it is also possible to use, for example, azeotropic distillation as a drying method.

[0057] Preferred drying temperatures are in the range from 50 to 250°C, preferably from 50 to 200°C and particularly preferably from 50 to 150°C. The preferred residence time at this temperature in the reaction mixer or drier is less than 30 minutes, particularly preferably less than 10 minutes.

[0058] The papers, boards and cardboards produced by the process according to the invention have higher water absorption capacities compared with conventional paper qualities, without losses in strength having to be accepted. The papers can absorb water and can retain it even under the action of heat, such as, for example, when used in laser printers.

[0059] All paper qualities can be produced by the process according to the invention, for example cardboard, single-layer/multilayer folding boxboard, single-layer/multilayer liner, corrugated material, papers for newspapers, so-called medium writing and printing papers, natural gravure printing papers and light-weight coating papers. In order to produce such papers, it is possible to start from, for example, groundwood, thermomechanical pulp (TMP), chemomechanical pulp (CTMP), pressure groundwood (PGW), mechanical pulp and sulfite and sulfate pulp. The chemical pulps may be both short-fiber and long-fiber.

[0060] Preferably, so-called tissue papers, such as lavatory paper, paper handkerchiefs and cosmetic cloths and kitchen paper, and furthermore hygiene and sanitary papers, packaging papers, for example for food, or multilayer papers which can be used in hygiene articles or packaging materials are preferably produced by the process according to the invention. The last-mentioned multilayer papers consist of a plurality of different paper layers, the paper layer which was
produced by the process according to the invention being incorporated either above a conventional paper layer or between two conventional paper layers.

Example 1

1% by weight, based on the solids content of the paper stock suspension, of the previously swollen water-swellable polymer 1 was added to the mixture of bleached birch sulfate and bleached pine sulfate in the ratio of 70:30 at a solids concentration of 1%. This mixture was beaten in a laboratory pulper until free of fiber bundles and until a Schopper-Riegler freeness of 35 was reached. Immediately thereafter, a cationic polyacrylamide as a retention aid (Polymin® KE 2020 from BASF Aktiengesellschaft) and a filler (Hydrocarb® OG from Omya) were metered into this mixture. The amount of retention aid and of filler metered was 0.03% by polymer and 20% of filler, based on the solids content of the paper stock suspension.

Example 2

Example 3

1% by weight, based on the solids content of the paper stock suspension, of the previously swollen water-swellable polymer 1 was added to the mixture of bleached birch sulfate and bleached pine sulfate in the ratio of 70:30 at a solids concentration of 1%. This mixture was beaten in a laboratory pulper until free of fiber bundles and until a Schopper-Riegler freeness of 35 was reached. Immediately thereafter, a cationic polyacrylamide was metered as a retention aid (Polymin® KE 2020 from BASF Aktiengesellschaft) into this mixture. The amount of retention aid metered was 0.03% of polymer, based on the solids content of the paper stock suspension.

Example 4

Example 3 was repeated, except that 2.5% by weight, based on the solids content of the paper stock suspension, of the previously swollen water-swellable polymer 1 was added to the mixture of bleached birch sulfate and bleached pine sulfate.

Example 5

1% by weight, based on the solids content of the paper stock suspension, of the previously swollen water-swellable polymer 1 was added to a mixture of bleached birch sulfate and bleached pine sulfate in the ratio of 70:30 at a solids concentration of 1%. This mixture was beaten in a laboratory pulper until free of fiber bundles and until a Schopper-Riegler freeness of 35 was reached. Immediately thereafter, a cationic polyacrylamide as a retention aid (Polymin® KE 2020 from BASF Aktiengesellschaft) and a filler (Hydrocarb® OG from Omya) were metered into this mixture. The amount of retention aid and of filler metered was 0.03% of polymer and 20% of filler, based on the solids content of the paper stock suspension.

Example 6

Example 5 was repeated, except that 2.5% by weight, based on the solids content of the paper stock suspension, of the previously swollen water-swellable polymer 1 were added to the mixture of bleached birch sulfate and bleached pine sulfate.
### TABLE 1-continued

<table>
<thead>
<tr>
<th>Example</th>
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<tr>
<td>4</td>
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<td>5</td>
<td>4862</td>
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<tr>
<td>6</td>
<td>4727</td>
</tr>
<tr>
<td>Comparative example 1</td>
<td>5219</td>
</tr>
<tr>
<td>Comparative example 2</td>
<td>2790</td>
</tr>
</tbody>
</table>

**[0078]** Testing of the Water Absorption by the Wicking Test

**[0079]** The paper sheets were cut in each case to a size of 200 mm x 15 mm. These cut paper strips were each suspended in a beaker which was filled with water, the upper end of the paper strip having been fastened with a clip to the edge of the beaker. At the beginning of the test, the paper strips dipped about 10 to 20 mm into the water, the position of immersion (lower limit) being marked. After 10 minutes, the paper strips were withdrawn from the water. The upper limit up to which the water had run was also marked. The distance between lower and upper limits, i.e. the distance covered by the water, was then measured. The results are summarized in table 2.

### TABLE 2

<table>
<thead>
<tr>
<th>Example</th>
<th>Distance between the lower and upper limits [mm]</th>
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<tr>
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</tr>
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<td>6</td>
<td>87</td>
</tr>
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</table>

**[0080]** The paper according to claim 9, characterized in that it is tissue paper, hygiene or sanitary paper, packaging paper or multilayer paper.

**[0081]**

1. A process for the production of paper, board and cardboard in the presence of water-swellable polymers by adding the water-swellable polymer to a fiber suspension, wherein the fiber suspension comprising water-swellable polymers is beaten.
2. The process according to claim 1, wherein the water-swellable polymer can absorb at least 1% of its own weight of water.
3. The process according to claim 1, wherein the water-swellable polymers are superabsorbent polymers.
4. The process according to claim 1, wherein paper process chemicals are added after the beating of the fiber suspension comprising water-swellable polymers.
5. The process according to claim 1, wherein the water-swellable polymer is added as a gelatinous suspension to the fiber suspension.
6. The process according to claim 1, wherein the water-swellable polymer is introduced into the fiber suspension by spraying.
7. The process according to claim 1, wherein from 0.1 to 20% by weight of a water-swellable polymer are added to the fiber suspension.
8. (canceled)
9. A paper, board or cardboard produced by the process according to claim 1.
10. The paper according to claim 9, characterized in that it is tissue paper, hygiene or sanitary paper, packaging paper or multilayer paper.

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