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(72) Inventor: **Cecchini, Juan**
40520 Jyväskylä (FI)

(74) Representative: **TBK**
Bavariering 4-6
80336 München (DE)

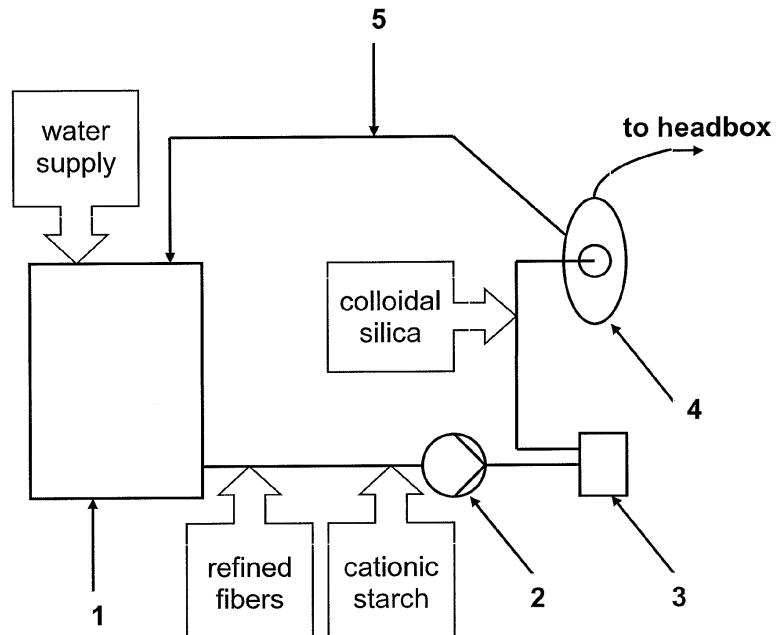
(71) Applicant: **Valmet Technologies, Inc.**
02150 Espoo (FI)

(54) Feed water supply for a multi-layer headbox

(57) A feed water supply for a multi-layer headbox of a paper machine which is capable of forming an aqueous layer is provided. Such a feed water supply comprises a storage means (1), a pump unit (2), a supply of water, and a connecting means including an inlet connector to the headbox. The storage means (1), the pump unit (2), the supply of water and the connecting means are connected with each other via pipes, and the feed water sup-

ply feeds the water to a multi-layer headbox separate from a supply of stock. The feed water supply additionally comprises a feeding and dosing device for feeding and dosing an additive into the feed water which is arranged in the feed water supply downstream of the storage means (1), between the storage means (1) and the pump unit (2).

Fig. 1



Description**Technical field**

[0001] The invention relates to a water supply for a headbox in a paper making process, particularly to a feed water supply to a paper machine having a multi-layer headbox.

Background art

[0002] DE 31 12 972 A1 discloses a multi-layer headbox which is arranged so as to generate plural layers in order to form the paper web. One of these layers is an aqueous layer which is generated by white water which is supplied from the downstream paper making process to the multi-layer headbox. The other layer is formed from fresh stock which is likewise supplied to the multi-layer headbox.

[0003] WO 99/040256 A1 teaches a method for applying a layer of admixture in the web former unit of a board machine. The flow of fresh stock is divided into at least two component flows of stock. At least to one of these component flows forms a face which will be placed against the face of the layer to be combined with it. At a point before the pump admixtures are added in order to increase the contents of fines in the layers and the bonding strength between the faces, and after this the component flows are passed into the multi-layer headbox and further into the gap former.

[0004] In other words, the fresh stock is mixed with additives to increase the bonding strength of the fibers in the paper web. In the conventional art, the stock fibers are mixed with white water after a machine chest. The thus generated pulp is then fed to the multi-layer headbox for forming the paper web. Stock fiber dosage is controlled based on the basis weight measurement in the paper machine.

[0005] Furthermore, it is known in the art that the pulp may be admixed with certain additives such that the pulp and the paper web, respectively, get their desired properties. In order to achieve these properties, the additives are admixed to the pulp before the headbox. In this way, the additives will become easily distributed and diluted within the pulp without a need for arranging any additional process elements.

[0006] However, it is desired to further increase the bonding strength of the paper to be produced. This is, because if the bonding strength between the stock fibers can be further increased, the percentage of stock within the pulp can be further reduced, for instance. This missing percentage can then be replaced by fillers which are less expensive or by refined fibers or fiber fines which improve paper properties. An increased bonding strength can, however, certainly also lead to a more resistant paper. It is also desired to reduce consumption of chemicals because this raises production costs.

Summary of the invention

[0007] The above-mentioned object is achieved by a device and a method according to the independent claims of the present invention. Further advantageous developments are subject-matters of the dependent claims.

[0008] The present invention provides a feed water supply for a multi layer headbox of a paper or board machine which is capable of forming an aqueous layer. This feed water supply comprises a storage means, a pump unit, a supply of water, and a connecting means including an inlet connector to the headbox. The storage means, the pump unit, the supply of water and the connecting means are connected with each other via pipes. This feed water supply feeds the water to a multi layer headbox separate from a supply of stock. In this feed water supply a feeding and dosing device is arranged for feeding and dosing an additive into the feed water. This feeding and dosing device is arranged in the feed water supply downstream of the storage means, particularly between the storage means and the pump unit.

[0009] In line with this arrangement, the water which is used for forming the aqueous layer in the multi-layer headbox to form a multi-layer paper or board web is admixed with an additive. In other words, the additive is not admixed with the stock as known in the conventional art. Superficially seen, such an arrangement requires further additional process elements which can be omitted in the conventional art.

[0010] However, this arrangement provides an additional advantage which will be described in greater detail in the following. Namely, with this arrangement, the time of the admixture of an additive with the pulp can be identified. If the additive is admixed with the stock, the instant of time when the additive is added cannot be clearly identified anymore, especially when the additive is added in a continuous manner to the pulp.

[0011] In detail, it has been found that the mixture made of stock, white water and additives significantly changes over the course of time. In particular, with respect to the kind of additives, the properties of the mixture, e.g. the consistency thereof, changes. However, the respective properties which shall be changed or adjusted by the additives do not continuously improve with the lapse of time. These properties rather go up and down when time passes. In other words, the paper properties themselves as well as the paper forming properties can be advantageously affected, if the admixture timing and/or the reaction time could be additionally considered during the paper forming process.

[0012] According to the device and the method of the present invention an admixture timing and/or the reaction time of an additive is considered during the paper forming. The at least one additive is added to the feed water which is fed to the multi-layer headbox for forming an aqueous layer in a multi-layer paper or board web. Hence, the time when the additive gets into contact with

the stock fibers of the pulp is exactly defined. This instant of time is that when the pulp which comprises the stock fibers, and the aqueous layer constituted by the feed water leave the multi-layer headbox so as to commonly form the multi-layer web.

[0013] In order that the feed water supply is sufficiently supplied with feed water, the feed water supply is equipped with a storage means in which the feed water is stored. The feed water mainly consists of white water which is present in the paper making process to a sufficient extent. Before a pipe which discharges the feed water from the storage means and supplies the feed water to the pipe system of the feed water supply reaches a pump unit for pumping the feed water, a feeding and dosing device is arranged in the pipe system. This feeding and dosing device feeds a predetermined amount of at least one additive to the feed water supplied from the storage means. The pump unit which feeds the feed water toward the multi-layer headbox is also used for mixing the at least one additive to the feed water. In this manner, the at least one additive is evenly distributed within the feed water. Furthermore, since the time interval which is necessary for supplying or injecting the feed water containing the additive to the paper web is known due to the length of the piping and the flow speed of feed water, a reaction time of the additive with the feed water can also be taken into account. For example, if the additive is normally a solid material, the reaction time can be used for solving the solid material into the feed water, for instance.

[0014] The feed water which is fed by the feed water supply of the present invention can also be provided with a feeding and dosing device for feeding and dosing refined fibers to the feed water. Such a feeding and dosing device can be arranged downstream of the storage means and upstream of the multi layer headbox. Preferably, the feeding and dosing device is arranged between the feed water storage means and the pump unit as already described above with respect to the additive feeding and dosing device. As mentioned above, the arrangement upstream of the pump unit provides that the refined fibers are mixed with the feed water and distributed in the feed water. The feeding and dosing device for feeding and dosing an additive may be a different device being different from the feeding and dosing device for feeding and dosing refined fibers. However, the feeding and dosing device may also be provided for feeding a ready-mixed mixture of refined fibers and additive in a specific mixing ratio to the feed water. Among plural possible additives, the respectively fed and dosed additive is preferably a cationic polymer. More preferably, the cationic polymer is cationic starch.

[0015] In principle, after the addition of a cationic polymer such as cationic starch, the cationic polymer adheres at the stock fibers. After a while the cationic starch starts entering into the fibers, the available connections which are responsible for the bonding with the adjacent fibers or fiber fibrils become shorter outside the

fibers. As a result the connectivity of the fiber-starch mixture decreases. That is, the starch-fiber particles become less inclined to connect themselves with other starch-fiber particles as time passes.

[0016] In other words, in order to achieve the same results, e.g. bonding strength, with longer reacting cationic starch compared to those achieved with sufficiently short reacting cationic starch, the amount of used cationic starch needs to be higher. Hence, if the reacting time of the cationic polymer / cationic starch is controlled or at least taken into consideration, the required amount of additives can be reduced. This improves cost efficiency and environmental sustainability at the same time. Furthermore, since the flocculation starts later, if the cationic starch is added to the stock layers after leaving the headbox, the pumping of the paper web source materials to the headbox requires less energy. In short, the device and method of the present invention allows for a paper forming with less chemicals and less energy and achieves at the same time improved paper properties.

[0017] In a conventional pulp generating machine chest, the cationic starch is added within the pulp storage means. As such, the pulp begins to flocculate after the addition of the additive, i.e. the cationic starch, in the pulp storage. This beginning flocculation which is basically beneficial for the paper forming is then partially reversed when the pulp passes a machine screen to remove foreign matter from the pulp. After this re-dispersion associated with the passage of the screening device, the stock fibers re-flocculate again before the pulp is again redispersed by the proceeding in the multi-layer headbox. The above process takes about 80 to 120 seconds. In the conventional art, no beneficial effects can be transferred to the paper forming and resultant paper properties, since the pulp is mixed and held in the pulp storage for a longer time.

[0018] Contrary to that, the present invention provides that the cationic starch is initially added to the stock fibers of the stock layers at the outlet of the headbox after the stock layer pulp has already passed the screening device. I.e., the flocculation level is not set back or lowered like in the conventional art.

[0019] In the device and the method according to the present invention, the above-mentioned facts and findings form the basis for further investigations in advantageous timings of adding additives and advantageous timings of adding additives and refined fibers, respectively.

[0020] If the addition of the cationic polymer / cationic starch to the stock / pulp is not anymore carried out in the pulp generation in the machine chest, but is shifted to the outlet of the multi-layer headbox (as the additive in the feed water), the mixing time of the additive to the fibers of the pulp is specified. Furthermore, the complete potential of the cationic polymer for forming connections between the stock fibers can be utilized in the paper making process, since the above-mentioned re-dispersion can be reduced to a desired amount.

[0021] The activation timing of the cationic starch can

be used in adjusting the formation of inter-fiber connections. Namely, if the feed water is provided with a cationic polymer such as cationic starch and a certain amount of refined fibers, this mixture can already react such that the fiber fibrils of the refined fibers form a "gel like" formation with the cationic starch. This provides a maximum of connectivity which promotes the bonding strength during the paper forming. As already mentioned above, in this case the required amount of stock fibers can be reduced and the saved amount of stock fibers can be replaced by less expensive raw materials, like fillers due to utilization of the maximum potential of fiber connections of the remaining stock fibers.

[0022] According to the present invention, the feed water can be additionally admixed with a retention chemical or retention aid helper, preferably colloidal silica or microparticle, before the feed water enters the multi-layer headbox. Colloidal silica or microparticle is used as a drainage aid. It increases the amount of cationic starch that can be retained in the paper. The retention chemical is also introduced and dosed via a feeding and dosing device. This feeding and dosing device is placed in the feed water supply as required such that the desired properties can be achieved. This feeding and dosing device for the retention chemical can be placed separate from the other feeding and dosing devices for the additive and for the refined fibers. The feeding and dosing of these components can, however, also be carried out by one single device.

[0023] In other words, in the device and the method according to the present invention, the feed water supply which is capable of feeding such a mixture of water, cationic polymer and refined fibers can achieve the generation of an aqueous layer within the paper web to be formed, which provides the maximum amount of fiber connectivity. This aqueous layer is capable of optimally gluing the stock layers to each other. In turn, this increases the bonding strength of the formed paper.

[0024] After this relationship has been found, further investigations in the most effective component amounts have been made. It has been realized that the admixture of cationic starch as the cationic polymer into the feed water which is directly supplied to the so called "aqua wedge headbox" being the multi-layer headbox forming the aqueous layer achieves the same results than the admixture of cationic starch into the machine chest with about one half (50%) of admixed cationic starch less. Hence, this provides a paper or board forming process with less chemicals and less energy and achieves improved paper properties at the same time.

[0025] The results out of plural experiments disclose that an amount of cationic starch between 5 and 20 kg cationic starch per one ton of feed fibers is advantageous. 10 to 14 kg cationic starch per one ton of feed fibers turned out to achieve even better results in view of internal bond (J/m²). Within this specific range a ratio of around 11 kg/t proved to be the most preferable.

[0026] As a reference, the Huygen value (J/m²) of pa-

per is taken to the pulp of which 14 kg/t cationic starch have been admixed in the machine chest. This value has been 222 J/m². In comparison to that, the Huygen value of paper which is produced with the aqueous layer which comprises 14 kg/t cationic starch as well has been measured to be 341 J/m². Hence, only the shifting of the admixture of cationic starch as the cationic polymer to the aqueous layer instead of an admixture to the stock layer pulp provides an increase of the internal bond of about 53%. Apart from that, also further different representative values such as geometrical tensile strength, burst index, SCT or CMT could be increased therewith.

[0027] Similar to the investigations of the most preferable cationic starch ratio, investigations regarding the most preferable amount of refined fibers in the feed water, i.e. in the aqueous layer, had been carried out. The result thereof showed that percentages of 2 to 15% of added refined fibers significantly increase the Huygen values, i.e. the internal bond, of the respectively produced paper. Within this specific range an amount of around 5% - 10% of added refined fibers proved to be the most preferable. These refined fiber percentages are compared to the total fiber volumes fed to the headbox.

[0028] Here as well, the Huygen value of paper is taken as a reference to the pulp of which 14 kg/t cationic starch have been admixed in the machine chest. This reference value (222 J/m², as above) is compared to that of a paper which is produced with an aqueous layer which comprises 14 kg/t cationic starch and 5% of added refined fibers. The thus produced paper shows a Huygen value of 435 J/m². This corresponds to an increase of internal bond of about 90%. Here as well, representative values of geometrical tensile strength, burst index, SCT or CMT could be further increased.

[0029] With respect to the feed water supply arrangement, it is noted that the main component of the feed water can be white water which is present at a sufficient amount in the paper making process. However, it might be necessary that the feed water which is supplied to the multi-layer headbox has to be provided with additional fresh water, for example when the optimal concentrations of refined fibers, cationic polymer and/or retention chemicals are exceeded.

[0030] The feed water supply of the present invention might also be provided with a measuring device which is capable of measuring the relevant contents of the feed water, e.g. cationic polymer concentration, refined fiber percentage and the like. The measurements can be taken as a basis for adequately adjusting the respective components in the feed water to remain at the desired level.

[0031] As a further advantageous development, the feed water supply of the present invention can comprise connecting means which have an outlet connector for connecting a return line to return surplus feed water from a water header of the multi-layer headbox to the feed water storage means. The return line brings the advantage that the feed water supply is operated as a feed

water circuit. In this connection, the pump unit of the feed water supply / feed water circuit is not absolutely responsible for the output pressure of the feed water at the headbox outlet. The pump unit may be operated at a higher pressure than that of the aqua layer output at the headbox which can then be kept at a constant level, even if the pump unit output varies. This can be achieved by the provision of a pressure relief valve or a spillover, for instance. It is only necessary that the surplus feed water is discharged from the water header of the headbox. This can be done via the outlet connector of the connecting means which is connected to the return line. The connection to the water header of the headbox can be achieved in that the feed water supply pipe is connected to the header via an inlet connector and the feed water return line is connected to the header via an outlet connector such that the feed water passes through the header. The connection to the water header of the headbox can alternatively be achieved in that the feed water supply line turns into the feed water return line at a point where a branch line is provided which branches off to the water header. This branch line is then the only supply line to the water header supplying the feed water for the aqueous layer.

[0032] The supply of water to the feed water supply can be arranged arbitrarily, if the feed water supply is designed as a circuit. In case the feed water supply is not designed as a circuit, it is preferable to arrange the supply of water such that the water is supplied to the storage means. The supply of water includes introducing of white water as well as introducing of fresh water.

[0033] The present invention also provides a method for generating a multi layer web with a multi layer headbox which generates at least one aqueous layer, wherein feed water is supplied to a water header and the feed water is mixed with an additive such that fiber fibrils included in the stock layers, for instance, and the additive can form a gel-like formation in the paper during web forming.

[0034] Preferably the feed water itself is further mixed with refined fibers, and the additive which is preferably a cationic polymer such as cationic starch, and the refined fibers added to the feed water are mixed therewith by the pump unit.

[0035] Preferably the additive is cationic starch which is mixed at an amount between 5 and 20 kg/t, preferably between 10 and 14 kg/t and most preferably at 11 kg/t. The refined fibers, if present in the feed water, are preferably mixed to the feed water at an amount between 2 and 15%, more preferably at around 5% - 10%.

[0036] Also preferably, the feed water is mixed with a retention chemical such as colloidal silica preferably downstream of the pump unit and, if a screening device is provided, preferably downstream of a screening device and upstream of the multi-layer headbox. In the same position it is possible to feed microparticles. An amount of microparticles varies depending on the starch dosage and starch properties. Typically an amount of starch is

100-400 g/t, preferably 200-300 g/t.

[0037] In the method according to the invention, surplus feed water for the water header of the multi-layer headbox is preferably returned to the storage means via a return line.

[0038] In the invention, multi layer paper or board web layers can contain the same or different raw materials. In the most simple case, this aqueous layer is fed between two stock layers with same furnish or raw material for improving strength properties of the web.

Brief Description of the drawing

[0039]

Fig. 1 illustrates a feed water supply according to an embodiment of the present invention.

Best mode for carrying out the invention

[0040] Fig. 1 depicts an embodiment of the present invention which is designed as a feed water circuit. Even if the feed water supply is designed as a circuit, the supply of water supplies water to storage means 1 in this embodiment. Downstream of the storage means 1 a pump unit 2 is arranged. The pipe between the storage means 1 and the pump unit 2 is provided with a feeding and dosing device for refined fibers at an amount of 5% to the feed water and a feeding and dosing device for cationic starch at an amount of 11 kg/t to the feed water.

[0041] The feed water containing the refined fibers and the cationic starch is pumped and mixed by the pump unit arranged downstream of the two feeding devices. Downstream of the pump unit a screening device 3 is positioned in order to remove foreign matter from the feed water. The screening device 3 is positioned such that the corresponding re-dispersion of the low flocculated mixture occurs at an adequate timing before the aqueous layer leaves the multi-layer headbox such that the main flocculation can be performed in the web after leaving the headbox.

[0042] In the present embodiment, a feeding and dosing device for colloidal silica as the retention chemical is provided between the screening device 3 and a water header 4 arranged upstream of the multi-layer headbox (not shown in Fig. 1). Further, according to the embodiment of Fig. 1, the mixed feed water is supplied to the headbox's water header via an inlet connector. This inlet connector is arranged on one side of the paper machine in the cross direction. The feed water passes then through the water header such that the feed water is evenly distributed over the entire machine cross direction which is important for an uniform web formation. After that, the feed water leaves the water header on the other side in the machine cross direction via an outlet connector. The outlet connector constitutes the connection to a return line 5 which returns surplus feed water from the water header 4 to the feed water storage means 1.

[0043] The arrangement of this embodiment achieves the object underlying the present invention. Namely, the arrangement of this embodiment provides a paper forming process with fewer chemicals and less energy as in the conventional art and achieves improved paper properties at the same time.

[0044] Numerous modifications are feasible within the scope of the invention as defined by the appended claims.

Claims

1. Feed water supply for a multi-layer headbox of a paper machine which is capable of forming an aqueous layer, comprising:

a storage means,
a pump unit,
a supply of water, and
a connecting means including an inlet connector to the headbox,
wherein the storage means, the pump unit, the supply of water and the connecting means are connected with each other via pipes, and
wherein the feed water supply feeds the water to a multi-layer headbox separate from a supply of stock,

characterized by

a feeding and dosing device for feeding and dosing an additive into the feed water which is arranged in the feed water supply downstream of the storage means, between the storage means and the pump unit.

2. Feed water supply according to claim 1, wherein a feeding and dosing device for feeding and dosing refined fibers is arranged downstream of the storage means and upstream of the multi-layer headbox.

3. Feed water supply according to claim 2, wherein the feeding and dosing device for the refined fibers is arranged between the storage means and the pump unit.

4. Feed water supply according to one of the preceding claims, wherein the additive is cationic polymer, preferably cationic starch.

5. Feed water supply according to one of the preceding claims, wherein refined fibers and the cationic polymer are added to the feed water upstream of the headbox such that fiber fibrils and cationic polymer can form a gel like formation in the paper during web forming.

6. Feed water supply according to one of the preceding claims, wherein a retention aid helper, preferably col-

loidal silica, or microparticle is added to the feed water before the feed water enters the multi-layer headbox.

5 7. Feed water supply according to claim 4 to 6, wherein the feeding and dosing device for the cationic starch is capable to supply an amount between 5 and 20 kg/t, preferably between 10 and 14 kg/t and most preferably at 11 kg/t of cationic starch to the feed water.

10 8. Feed water supply according to claim 2 to 7, wherein the feeding and dosing device for the refined fibers is capable to supply an amount between 2 and 15%, preferably 5% - 10% of refined fibers to the feed water.

15 9. Feed water supply according to one of the preceding claims, wherein the connecting means further comprises an outlet connector for connecting a return line to return surplus feed water from the water header to the storage means.

20 10. Method for generating a multi-layer web with a multi-layer headbox which provides at least one aqueous layer, wherein feed water is supplied to a water header and the feed water is mixed with a cationic additive such that fiber fibrils and cationic additive can form a gel like formation in the paper during web forming.

25 11. Method according to claim 10,
wherein the feed water is further mixed with refined fibers, and
the cationic additive and the refined fibers added to the feed water are mixed therewith by the pump unit.

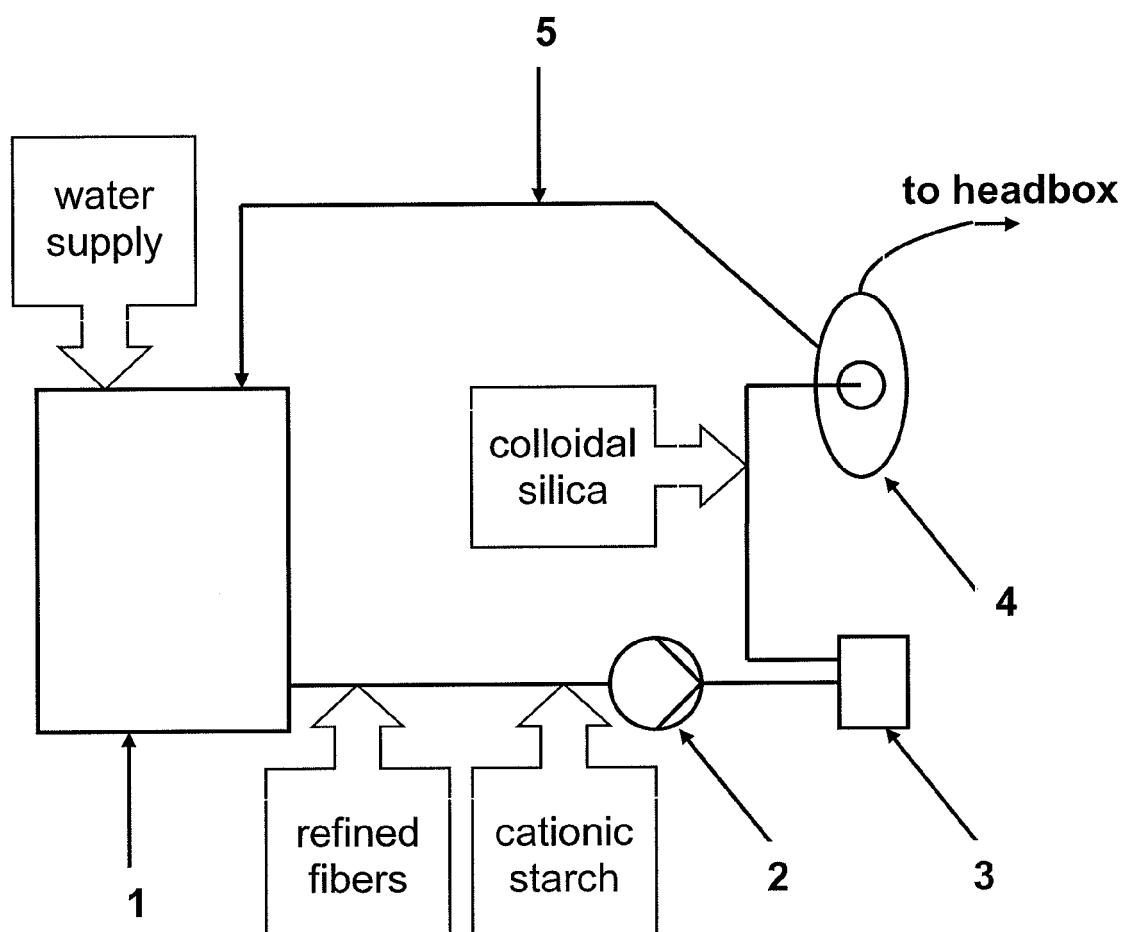
30 12. Method according to claim 11,
wherein the cationic additive is cationic starch which is mixed at an amount between 5 and 20 kg/t, preferably between 10 and 14 kg/t and most preferably at 11 kg/t, and
wherein the refined fibers are mixed at an amount between 2 and 15%, preferably 5% - 10%.

35 13. Method according to claim 11 or 12,
wherein colloidal silica or microparticle is mixed with the feed water downstream of the pump unit and a screening device and upstream of the multi-layer headbox.

40 14. Method according to any of claims 10 to 13, wherein the surplus feed water for the water header of the multi-layer headbox is returned to the storage means via a return line.

45 50 55

Fig. 1





EUROPEAN SEARCH REPORT

Application Number

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