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(54) **PAPER MAKING PROCESSES USING ENZYME AND POLYMER COMBINATIONS**

VERFAHREN ZUR PAPIERHERSTELLUNG MITTELS ENZYMEN UND POLYMER
KOMBINATIONEN

PROCEDES DE FABRICATION DE PAPIER UTILISANT DES COMBINAISONS D'ENZYME ET DE
POLYMERES

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(56) References cited:
**EP-A- 0 433 258 FR-A- 2 775 990
US-A- 5 507 914 US-A- 5 879 509**

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EP 1 250 487 B1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to paper making processes and products made from these processes. More particularly, the present invention relates to treating paper making pulp with a cellulytic enzyme and one or more polymers.

[0002] Particular paper making processes using an enzymatic treatment of paper making pulp are described in, for example, U.S. Patent Nos. 4,923,565 to Fuentes et al., 5,110,412 to Fuentes et al., 5,169,497 to Sarkar et al., and 5,308,449 to Fuentes et al.. According to these processes, a paper making pulp is contacted with an enzyme composition for a substantial period of time before the pulp is worked on a conventional paper making machine. According to these processes, the pulp must remain in contact with the enzyme composition for at least 20 minutes before the pulp can be treated with a conventional synthetic polymeric composition. The contact time allows the enzyme an adequate reaction period prior to addition of the synthetic polymer. Accordingly, the process requires a separate addition of the synthetic polymer downstream from where the enzyme first contacts the pulp, which is time consuming and complicated.

[0003] There is a need for a paper making process that is simplified and/or avoids the lengthy contact times.

SUMMARY OF THE INVENTION

[0004] The present invention provides a method of making paper or paperboard as set out in claim 1 that includes introducing at least one cellulytic enzyme composition and at least one cationic polymer composition to a paper making pulp within 5 minutes of each other, to form a treated pulp. The enzyme composition and polymer composition can be added to the pulp separately, or they can be pre-combined and then added. The pulp may also be further treated with at least one cationic starch. The resulting pulp is then formed into a sheet of pulp, preferably having improved drainage and/or retention properties compared to conventional treatments. After drainage and drying, the resulting paper or paperboard preferably exhibits excellent opaqueness and other physical properties.

[0005] The present invention further relates to a method of making paper or paperboard that includes treating pulp in a blend chest with a cationic polymer composition and then passing the treated pulp to a machine chest wherein an enzyme composition is added to the treated pulp. The enzyme-treated pulp is then refined and passed to a stuff box. From the stuff box, the pulp is then passed through a white water silo where a second cationic polymer composition is added to the pulp and then the pulp is formed into paper or paperboard.

[0006] The present invention also provides a paper making system for carrying out the above-described

methods, and paper and paperboard made according to the methods.

[0007] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are only intended to provide a further explanation of the present invention, as claimed. The accompanying drawings, which are incorporated in and constitute a part of this application, illustrate several embodiments of the present invention and together with description, serve to explain the principles of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Figure 1 is a flow chart showing a paper making process according to an embodiment of the present invention.

Figure 2 is a flow chart showing a paper making process according to another embodiment of the present invention.

Figure 3 is a flow chart showing a paper making process according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0009] The present invention provides methods of making paper or paperboard. In one method, at least one cellulytic enzyme composition and at least one cationic polymer composition are introduced to a paper making pulp within 5 minutes of each other. The enzyme composition and polymer composition can be added to the pulp separately, or they can be pre-combined and then added. The resulting pulp is then formed into a paper or paperboard. According to the present invention, a cationic starch can also be added to the pulp or treated pulp either at about the same time as the cationic polymer composition and enzyme composition are added, or at a later time. The cationic starch can be the same as or different from the cationic polymer added earlier. Paper and paperboard products made according to the method preferably exhibit excellent opaqueness and/or other physical properties. Sheets of pulp from which the paper and paperboard products are made preferably exhibit excellent drainage and/or excellent retention of pulp fines.

[0010] The method of the present invention can be practiced on conventional paper making machines with modifications that can be easily made in view of the present invention. The method can employ many different types of paper making pulp or combinations thereof. For example, the pulp may comprise virgin and/or recycled pulp, such as virgin sulfite pulp, broke pulp, a hardwood kraft pulp, a softwood kraft pulp, mixtures of such pulps, and the like.

[0011] As discussed above, the enzyme composition

and the cationic polymer composition are added at about the same time. Adding these two components at about the same time means that the two components are added within 5 minutes of each other and more preferably are added within 2 minutes or within 1 minute of each other and most preferably are added essentially simultaneously to the pulp.

[0012] Furthermore, the enzyme composition and the polymer composition can generally be added at any location of the paper making process but preferably are added prior to the whitewater silo in a paper making process and more preferably are added prior to the machine chest and even more preferably are added prior to the blend chest. Most preferably, the enzyme composition and cationic polymer composition are added prior to the first refiner in a paper making process, which is generally located before the blend chest.

[0013] The enzyme composition used for treating the pulp may contain any conventional paper making pulp-treating enzyme that has cellulytic activity. Other components can be present as long as these other components do not negatively affect the cellulytic activity of the enzyme composition. Preferably, the enzyme composition also exhibits hemicellulolytic activity. Suitable enzymes and enzyme-containing compositions include those described in U.S. Patent No. 5,356,800 to Jaquess, U.S. Patent No. 6,342,381 and International Publication No. WO 99/43780. Other exemplary paper making pulp-treating enzymes are BUZYME™ 2523 and BUZYME™ 2524, both available from Buckman Laboratories International, Inc., Memphis, Tennessee. The cellulytic enzyme composition preferably contains from about 5% to about 20% by weight enzyme. The preferred enzyme composition can further contain polyethylene glycol, hexylene glycol, polyvinylpyrrolidone, tetrahydrofuryl alcohol, glycerine, water, and other conventional enzyme composition additives, as for example, described in U.S. Patent No. 5,356,800. The enzyme may be added to the pulp in an amount of from about 0.001 to about 0.100% by weight enzyme based on the dry weight of the pulp, for example, from about 0.005 to about 0.05% by weight.

[0014] In a preferred embodiment of the present invention, the enzyme composition contains at least one polyamide oligomer and at least one enzyme. The polyamide is present in an effective amount to stabilize the enzyme. Exemplary enzyme compositions containing polyamide oligomers and enzymes are described in International Published Application No. WO 99/43780.

[0015] According to the present invention, the enzyme composition can include a combination of two or more different enzymes. The enzyme composition can include, for example, a combination of a lipase and a cellulase, and optionally can include a stabilizing agent. The stabilizing agent may be a polyamide oligomer as described herein.

[0016] The cationic polymer composition, added to the pulp at about the same time as the enzyme composition, is added in an amount effective to preferably improve the

drainage or retention of the pulp compared to no cationic polymer being present. In general, the cationic polymer is added in an amount of at least about 0.227 (0.5 pound) cationic polymer per 907.18 kg (ton) of paperstock, based on dried solids of the pulp, and preferably in an amount of at least about 0.454 kg per 907.18 kg (1 pound per ton) of paperstock. Preferably, the cationic polymer is added in an amount of from about 0.907 kg per 907.18 kg (2 pounds per ton) of paperstock to about 2.722 kg per 907.18 kg (6 pounds per ton) of paperstock, based on dried solids. The cationic polymer may preferably be added in an amount of from about 0.0001 % to about 0.0100% by weight based on the dried solids weight of the pulp.

[0017] Any cationic polymer or mixture thereof may be used and preferably conventional cationic polymers commonly associated with paper making can be used in the cationic polymer composition. Examples of cationic polymers include, but are not limited to, cationic starches, cationic polyacrylamide polymers, for example, copolymers of an acrylamide with a cationic monomer, wherein the cationic monomer may be in a neutralized or quaternized form. Nitrogen-containing cationic polymers are preferred. Exemplary cationic monomers which may be copolymerized with acrylamide to form preferred cationic polymers according to the present invention, include amino alkyl esters of acrylic or methacrylic acid, and diallylamines in either neutralized or quaternized form. Exemplary cationic monomers and cationic polyacrylamide polymers are described in U.S. Patent No. 4,894,119 to Baron, Jr., et al.

[0018] The cationic polymer may also be a polyacrylamide formed from comonomers that include, for example, 1-trimethylammonium-2-hydroxypropylmethacrylate methosulphate. Other examples of cationic polymers, include, but are not limited to, homopolymers of diallylamine monomers, homopolymers of aminoalkylesters of acrylic acids, and polyamines, as described in U.S. Patent No. 4,894,119. Co-polymers, terpolymers or high forms of polymers may also be used. Further, for purposes of the present invention, a mixture of two or more cationic polymers may be used.

[0019] When the cationic polymer is a cationic polyacrylamide, nonionic acrylamide units are preferably present in the copolymer, and preferably present in an amount of at least about 30 mol% and generally in an amount of no greater than 95 mol%. At least about 5 mol%, and generally no greater than about 70 mol%, of the polymer is preferably formed from a cationic comonomer.

[0020] The weight average molecular weight of the cationic polymer is preferably over 1,000, for example, from about 10,000 to about 15,000,000, or from about 100,000 to about 10,000,000.

[0021] In a preferred embodiment of the present invention, the cationic polymer present has a weight average molecular weight of at least about 10,000 and is precombined with the enzyme composition before the cationic

onic polymer composition and enzyme composition are added together to the pulp.

[0022] After treating the paper making pulp with the enzyme composition and cationic polymer composition at about the same time, the resulting treated pulp may then be processed by a conventional paper making machine and techniques. The treated pulp may be additionally treated with one or more components, including other polymers such as anionic and non-ionic polymers, clays, other fillers, dyes, pigments, defoamers, biocides, pH adjusting agents such as alum, and other conventional paper making or processing additives. One particularly preferred additive for use according to the methods of the present invention is a cationic starch.

[0023] Cationic starch may be added to the pulp or treated pulp of the present invention to form a starch treated pulp. Starch may be added at one or more points along the flow of paper making pulp through the paper making apparatus or system of the present invention. For instance, cationic starch can be added to a pulp at about the same time that the enzyme and cationic polymer are added to the pulp. The cationic starch can alternatively or additionally be added to the treated pulp after the pulp is first treated with both the enzyme and cationic polymer. Preferred cationic starches include, but are not limited to, potato starches, corn starches, and other wet-end starches, or combinations thereof.

[0024] Conventional amounts of starch can be added to the pulp. An exemplary amount of starch that can be used according to the present invention is from about 2.27 to about 11.34 kg per 907.18 kg (5 to about 25 pounds per ton) based on the dried solids weight of the pulp.

[0025] In addition to or in place of the starch, a micro-particle additive may be added to the pulp at any time during the process. The microparticle additive can modify the charge of the pulp or the charge of a component of the pulp. The microparticle additive can be, for example, a charging or modifying agent, a filler, a coagulating agent, and/or a retention aid. The microparticle additive can be a natural or synthetic hectorite, bentonite, zeolite, alumina sol, or any of conventional particulate additives as are known to those skilled in the art.

[0026] A biocide may be added to the pulp or treated pulp in accordance with conventional uses of biocides in paper making processes. For example, a biocide may be added to the treated pulp in a blend chest after the pulp has been treated with the enzyme and cationic polymer. Biocides useful in the paper making pulps according to the present invention include biocides well known to those skilled in the art, for example, BUSAN™ 1130, available from Buckman Laboratories International, Inc., Memphis, Tennessee.

[0027] A flow chart of a paper making system for carrying out the method of the present invention is set forth in Figure 1. It is to be understood that the system shown is exemplary of the present invention and is in no way intended to restrict the scope of the invention. In the sys-

tem of Figure 1, a supply of enzyme composition and a supply of cationic polymer composition are simultaneously combined at desired respective concentrations with a flowing stream of paper making pulp to form a treated pulp. The supply of pulp shown represents a flow of pulp, as for example, supplied from a pulp holding tank or silo. The supply of pulp shown in Figure 1 can be a conduit, holding, or mixing tank, or other container, passageway, or mixing zone for the flow of pulp. The supply of enzyme composition can be, for example, a holding tank having an outlet in communication with an inlet of a treated pulp tank. The supply of cationic polymer composition can be, for example, a holding tank having an outlet in communication with an inlet of the treated pulp tank.

[0028] The pulp treated with the enzyme composition and cationic polymer composition is passed from the treated pulp tank through a refiner and then through a blend chest where optional additives including a biocide are combined with the treated pulp. The refiner has an inlet in communication with an outlet of the treated pulp tank, and an outlet in communication with an inlet of the blend chest.

[0029] According to the embodiment of Figure 1, the pulp treated in the blend chest is passed from an outlet of the blend chest through a communication to an inlet of a machine chest. The blend chest and machine chest can be of any conventional type known to those skilled in the art. The machine chest ensures a level head, that is, a constant pressure on the treated pulp or stock throughout the downstream portion of the system, particularly at the head box.

[0030] In the system of Figure 1, drained pulp resulting from paper making in the headbox is recirculated to the white water silo.

[0031] In the embodiment shown in Figure 2, a cationic starch is added to the refined treated pulp at the blend chest, and the system includes a conventional stuff box. Additional cationic starch may be added at the stuff box although not depicted in Figure 2. The system of Figure 2 has a second refiner between the machine chest and the stuff box. Other additives, including pH adjustment agents such as alum, may also be added at the stuff box. pH adjusting agents can be added at other points along the flow of pulp or treated pulp through the apparatus.

[0032] The apparatus of the present invention can also include metering devices for providing a suitable concentration of enzyme to the flow of pulp, for example, from about 0.001 to about 0.100 percent by weight enzyme, based on the dried solids weight of the pulp. The apparatus can include a metering device for providing a suitable amount of the cationic polymer to the flow of pulp, for example, from about 0.0001 to about 1.000 percent by weight cationic polymer, based on the dried solids weight of the pulp. Other metering or dosing devices are preferably provided for the other additives and ingredients that may be used during the method.

[0033] Another embodiment of the present invention

is depicted in Figure 3. Pulp is treated in a blend chest with a cationic polymer composition, such as a nitrogen-containing cationic polymer or a cationic starch. The treated pulp is passed from the blend chest to a machine chest wherein an enzyme composition is added to the treated pulp to form an enzyme-treated pulp. The enzyme-treated pulp is then refined and passed to a stuff box where optional cationic polymer composition is optionally added to the pulp. The optional cationic polymer composition, if used, may be the same or different than the first cationic polymer composition, added to the pulp at the blend chest. Alternatively, no additional cationic polymer is added to the pulp at the stuff box. From the stuff box, the pulp is then passed to a white water silo where a nitrogen-containing cationic polymer composition is added to the pulp. The pulp is then passed through a fan pump to a screen and subsequently to a head box. The drained stock resulting from sheet making in the head box is recirculated to the white-water silo.

[0034] According to the embodiment of the present invention shown in Figure 3, the nitrogen-containing cationic polymer composition can be, for instance, a cationic polymer containing acrylamide units and units of a cationic monomer. The first cationic polymer composition added, on the other hand, can be a nitrogen-containing polymer, a cationic starch, or another cationic polymer. The optional cationic polymer composition can also be a nitrogen-containing polymer, a cationic starch, or another cationic polymer. The first cationic polymer composition, the nitrogen-containing cationic polymer composition, and the optional cationic polymer composition can be the same or different. According to a preferred embodiment of the present invention shown in Figure 3, at least one of the cationic polymer compositions and the optional cationic polymer composition comprises a starch. Further, preferably the nitrogen-containing cationic polymer composition contains acrylamide units and units of a cationic monomer.

[0035] A cleaner, for example, a centrifugal force cleaning device, can be disposed between, for instance, the fan pump and the screen, according to any of the embodiments of Figures 1-3 above.

[0036] The method and apparatus of the present invention provide extended interaction time between the pulp, enzyme, and cationic polymer. Treated pulp reaching the headbox in the system of the present invention can be formed into a paper or paperboard precursor sheet. Preferably, the sheet exhibits excellent drainage and/or retention of fines. Resulting paper and paperboard made according to the method of the present invention exhibit excellent opaqueness and other physical properties.

[0037] It will be apparent to those skilled in the art that various modifications and variations can be made to the embodiments of the present invention without departing from the scope of the present invention. Thus, it is intended that the present invention covers other modifications and variations of this invention provided they come

within the scope of the appended claims and their equivalents.

5 Claims

1. A method of making paper or paperboard comprising:
 - a) introducing at least one cellulytic enzyme composition and at least one cationic polymer composition to a paper making pulp within 5 minutes of each other to form a treated pulp; and
 - b) forming the treated pulp into paper or paperboard.
2. The method of claim 1, further comprising introducing at least one first cationic starch to the treated pulp.
3. The method of claim 1 or claim 2 wherein said cellulytic enzyme composition contains from 5% to 20% by weight enzyme.
4. The method of any one of the preceding claims, wherein said cellulytic enzyme composition is added to said pulp in an amount of from 0.100% to 0.001% by weight enzyme based on the dry weight of the pulp.
5. The method of any one of the preceding claims, wherein said cellulytic enzyme composition comprises at least one polyamide oligomer and at least one cellulytic enzyme.
6. The method of any one of the preceding claims, wherein said pulp comprises or consists of a sulphite pulp.
7. The method of any one of claims 2 to 5, wherein a second cationic starch, which is the same or different from the first cationic starch, is introduced to the treated pulp before step b).
8. The method of any one of the preceding claims, wherein said at least one cationic polymer composition comprises a synthetic cationic polymer.
9. The method of any one of the preceding claims, wherein said at least one cationic polymer composition comprises a polyacrylamide polymer.
10. The method of any one of the preceding claims, wherein said at least one cationic polymer composition is a synthetic, water-soluble cationic polymer containing acrylamide units and cationic monomeric units.

11. The method of any one of the preceding claims, wherein cationic polymer in said cationic polymer composition is added to said pulp in an amount of from 0.0001% by weight to 1.000% by weight, based on the dried solids weight of said pulp. 5
12. The method of any one of claims 2 to 11, wherein said at least one cationic starch is added to said treated pulp in an amount of from 2.27 to 11.34kg per 907.18kg (5 to 25 pounds per ton) based on the dried solids weight of the pulp. 10
13. The method of any one of the preceding claims, wherein cationic polymer in said cationic polymer composition has a weight average molecular weight of at least 10,000 and said cationic polymer composition is pre-combined with the enzyme composition before the polymer and enzyme are added together to the pulp. 15
14. The method of any one of the preceding claims, wherein said at least one cellulytic enzyme composition and at least one cationic polymer composition are added within 1 minute of each other. 20
15. The method of any one of the preceding claims, wherein said at least one cellulytic enzyme composition and at least one cationic polymer composition are added simultaneously. 25
16. The method of any one of the preceding claims, wherein said at least one cellulytic enzyme composition and at least one cationic polymer composition are added prior to a blend chest in a paper making process. 30
17. The method of any one of the preceding claims, wherein said at least one cellulytic enzyme composition and at least one cationic polymer composition are added prior to a first refiner which is located before the blend chest. 40
18. The method of claim 17, further comprising introducing at least one first cationic starch to the treated pulp prior to the blend chest. 45
19. The method of any one of the preceding claims, wherein said at least one cationic polymer composition comprises a synthetic polymer having at least one nitrogen-containing polymer. 50
20. The method of claim 18, further comprising introducing at least a second cationic starch to the treated pulp and wherein said first and second cationic starches are the same or different. 55
21. A method of making paper or paperboard according to any one of claims 1 to 6 or 11 comprising:
- a) introducing a cationic polymer composition to a pulp to form treated pulp;
 - b) introducing at least one cellulytic enzyme composition to said treated pulp to form an enzyme-treated pulp;
 - c) adding a nitrogen-containing cationic polymer composition to the enzyme-treated pulp; and
 - d) forming the pulp into paper or paperboard.
22. The method of claim 21, further comprising introducing a second cationic polymer composition to the enzyme-treated pulp prior to introducing the nitrogen-containing cationic polymer composition to the enzyme-treated pulp.
23. The method of claim 21 or 22, wherein said cationic polymer composition comprises a nitrogen-containing polymer or a starch.
24. The method of any one of claims 21 to 23, wherein said second cationic polymer composition comprises a nitrogen-containing polymer or a starch.
25. A method of claim 21, wherein said cationic polymer composition is introduced at the blend chest in a paper making process and said at least one cellulytic enzyme composition is introduced at the machine chest of the same paper making process and said nitrogen-containing cationic polymer composition is added at about the whitewater silo in the same paper making process.
26. The method of claim 25, wherein said optional cationic polymer is introduced at the stuff box which is located between said machine chest and said whitewater silo.
27. A paper making apparatus comprising a supply of an enzyme composition, a supply of a cationic polymer composition, a supply of a paper making pulp, a device for feeding an enzyme composition from the supply of enzyme composition and cationic polymer composition from the supply of cationic polymer to the supply of paper making pulp at about the same time to form a supply of treated pulp, and a device for forming the treated pulp into a treated paper or paperboard.
28. The apparatus of claim 27, wherein said device for forming the treated pulp comprises a blend chest in communication with said supply of treated pulp, a fan pump in communication with the blend chest, a screen in communication with said fan pump, and a head box in communication with said screen.
29. The apparatus of claim 27, wherein a supply tank is provided for holding a supply of the treated pulp, and the communication between said supply tank and

said blend chest includes a refining apparatus for refining the treated pulp before entering the blend chest.

30. The apparatus of claim 27, further comprising a supply of cationic starch, an outlet from the supply of said cationic starch in communication with an inlet to said supply of treated pulp and further comprising a white-water silo, wherein said white water silo has an inlet in communication with said blend chest, an inlet in communication with said head box, and an outlet in communication with said fan pump.
31. The apparatus of claim 27, further comprising one or more refiners for refining the pulp or treated pulp prior to forming the pulp in said head box.

Patentansprüche

1. Verfahren zur Herstellung von Papier oder Pappe, welches die folgenden Schritte aufweist:
 - a) Einbringung mindestens einer cellulytischen Enzymzusammensetzung und mindestens einer kationischen Polymerzusammensetzung in Papier, wodurch innerhalb 5 Minuten eine Pulpe zur Erzeugung einer behandelten Pulpe hergestellt wird; und
 - b) Formen der behandelten Pulpe zu Papier oder Pappe.
2. Verfahren nach Anspruch 1, welches des Weiteren den Schritt der Einbringung mindestens einer ersten kationischen Stärke in die behandelte Pulpe aufweist.
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die cellulytische Enzymzusammensetzung von 5 Gew.-% bis 20 Gew.-% Enzym enthält.
4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die cellulytische Enzymzusammensetzung der Pulpe in einer Menge von 0,100 Gew.-% bis 0,001 Gew.-% Enzym basierend auf dem Trockengewicht der Pulpe beigefügt wird.
5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die cellulytische Enzymzusammensetzung mindestens ein Polyamid-Oligomer und mindestens ein cellulytisches Enzym aufweist.
6. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Pulpe Sul-

fitzellstoff bzw. Sulfimpulpe aufweist bzw. aus diesem/dieser besteht.

7. Verfahren nach einem der Ansprüche 2 bis 5, **dadurch gekennzeichnet, dass** eine zweite kationische Stärke, welche identisch oder unterschiedlich zu der ersten kationischen Stärke ist, in die behandelte Pulpe vor Schritt b) eingebracht wird.
8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine kationische Polymerzusammensetzung ein synthetisches kationisches Polymer aufweist.
9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine kationische Polymerzusammensetzung ein Polyacrylamid-Polymer aufweist.
10. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine kationische Polymerzusammensetzung ein synthetisches, wasserlösliches kationisches Polymer ist, welches Acrylamid-Einheiten und kationische Monomereinheiten enthält.
11. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das kationische Polymer in der kationischen Polymerzusammensetzung der Pulpe in einer Menge von 0,0001 Gew.-% bis 1,000 Gew.-% basierend auf dem Trockengewicht der Feststoffe der Pulpe zugesetzt wird.
12. Verfahren nach einem der Ansprüche 2 bis 11, **dadurch gekennzeichnet, dass** die mindestens eine kationische Stärke der behandelten Pulpe in einer Menge von 2,27 bis 11,34 kg pro 907,18 kg (5 bis 25 Pound pro Tonne) basierend auf dem Trockengewicht der Feststoffe der Pulpe zugesetzt wird.
13. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** kationisches Polymer in der kationischen Polymerzusammensetzung einen Gewichtsmittelwert des Molekulargewichts von mindestens 10,000 aufweist, und dass die kationische Polymerzusammensetzung mit der Enzymzusammensetzung kombiniert wird, bevor das Polymer und das Enzym zusammen der Pulpe beigefügt werden.
14. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine cellulytische Enzymzusammensetzung und die mindestens eine kationische Polymerzusammensetzung innerhalb einer Minute voneinander beigefügt werden.
15. Verfahren nach einem der vorhergehenden Ansprüche

- che, **dadurch gekennzeichnet, dass** die mindestens eine cellulytische Enzymzusammensetzung und die mindestens eine kationische Polymerzusammensetzung zeitgleich beigefügt werden.
16. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine cellulytische Enzymzusammensetzung und die mindestens eine kationische Polymerzusammensetzung vor einem Abmischkasten in einem Papierherstellungsprozess beigefügt werden.
17. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine cellulytische Enzymzusammensetzung und die mindestens eine kationische Polymerzusammensetzung vor einem ersten Refiner beigefügt werden, welcher vor dem Abmischkasten angeordnet ist.
18. Verfahren nach Anspruch 17, welches des Weiteren den Schritt der Einbringung mindestens einer ersten kationischen Stärke in die behandelte Pulpe vor der Abmischkammer aufweist.
19. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die mindestens eine kationische Polymerzusammensetzung ein synthetisches Polymer aufweist, welches mindestens ein stickstoffhaltiges Polymer aufweist.
20. Verfahren nach Anspruch 18, welches des Weiteren den Schritt der Einbringung mindestens einer zweiten kationischen Stärke in die behandelte Pulpe aufweist, und wobei die erste und die zweite kationische Stärke identisch oder unterschiedlich sind.
21. Verfahren zur Herstellung von Papier oder Pappe nach einem der Ansprüche 1 bis 6 oder 11, welches die folgenden Schritte aufweist:
- a) Einbringung einer kationischen Polymerzusammensetzung in eine Pulpe zur Erzeugung einer behandelten Pulpe;
 - b) Einbringung mindestens einer cellulytischen Enzymzusammensetzung in die behandelte Pulpe zur Erzeugung einer enzymbehandelten Pulpe;
 - c) Beifügung einer stickstoffhaltigen kationischen Polymerzusammensetzung zu der enzymbehandelten Pulpe; und
 - d) Formen der Pulpe zu Papier oder Pappe.
22. Verfahren nach Anspruch 21, welches des Weiteren den Schritt der Einbringung einer zweiten kationischen Polymerzusammensetzung in die enzymbehandelte Pulpe vor Einbringung der stickstoffhaltigen kationischen Polymerzusammensetzung in die
- enzymbehandelte Pulpe aufweist.
23. Verfahren nach Anspruch 21 oder 22, **dadurch gekennzeichnet, dass** die kationische Polymerzusammensetzung ein stickstoffhaltiges Polymer oder Stärke aufweist.
24. Verfahren nach einem der Ansprüche 21 bis 23, **dadurch gekennzeichnet, dass** die zweite kationische Polymerzusammensetzung ein stickstoffhaltiges Polymer oder Stärke aufweist.
25. Verfahren nach Anspruch 21, **dadurch gekennzeichnet, dass** die kationische Polymerzusammensetzung an dem Abmischkasten in einem Papierherstellungsprozess eingebracht wird, und dass die mindestens eine cellulytische Enzymzusammensetzung an dem Zwischenbehälter der Maschine desselben Papierherstellungsprozesses eingebracht wird und die stickstoffhaltige kationische Polymerzusammensetzung in etwa an dem Siebwasser-Silo bzw. -Speicher in demselben Papierherstellungsprozess beigefügt wird.
26. Verfahren nach Anspruch 25, **dadurch gekennzeichnet, dass** das optionale kationische Polymer an dem Materialkasten eingebracht wird, welcher zwischen dem Maschinen-Zwischenbehälter und dem Siebwasser-Speicher angeordnet ist.
27. Papierherstellungsvorrichtung, welche eine Bereitstellung einer Enzymzusammensetzung, einen Anschluss für eine kationische Polymerzusammensetzung, einen Anschluss für eine Papierherstellungspulpe, eine Vorrichtung zur Zuführung einer Enzymzusammensetzung von dem Enzymzusammetzungs-Anschluss und einer kationischen Polymerzusammensetzung von dem kationischen Polymer-Anschluss zu dem Papierherstellungspulpe-Anschluss in etwa zur gleichen Zeit, um eine Bereitstellung behandelter Pulpe zu erzeugen, sowie eine Vorrichtung zur Formung der behandelten Pulpe zu behandeltem Papier oder zu behandelter Pappe, aufweist.
28. Vorrichtung nach Anspruch 27, **dadurch gekennzeichnet, dass** die Vorrichtung zur Formung bzw. Bildung der behandelten Pulpe einen Abmischkasten in Kommunikation mit der Bereitstellung behandelte Pulpe, eine Lüfterpumpe in Kommunikation mit dem Abmischkasten, eine Blende in Kommunikation mit der Lüfterpumpe, sowie einen Stoffauflauf in Kommunikation mit der Blende aufweist.
29. Vorrichtung nach Anspruch 27, **dadurch gekennzeichnet, dass** ein Behälter zur Speicherung einer Bereitstellung der behandelten Pulpe vorgesehen ist, und dass die Kommunikation zwischen dem

Speicherbehälter und dem Abmischkasten eine Refiner-Vorrichtung zum Aufbereiten der behandelten Pulpe einschließt, bevor diese in die Abmischkammer gelangt.

30. Vorrichtung nach Anspruch 27, welche des Weiteren eine Bevorratung kationischer Stärke, einen Auslass aus der Bevorratung der kationischen Stärke in Kommunikation mit einem Einlass in die Bevorratung behandelte Pulpe, und des Weiteren einen Siebwasser-Speicher aufweist,
dadurch gekennzeichnet, dass der Siebwasser-Speicher einen Einlass in Kommunikation mit dem Abmischkasten, einen Einlass in Kommunikation mit dem Stoffauflauf sowie einen Auslass in Kommunikation mit der Lüfterpumpe aufweist.
31. Vorrichtung nach Anspruch 27, welche des Weiteren einen oder mehrere Refiner zur Aufbereitung der Pulpe oder behandelten Pulpe vor der Formung der Pulpe in dem Stoffauflauf aufweist.

Revendications

1. Procédé de fabrication de papier ou de carton comprenant le fait :
 a) d'introduire au moins une composition d'enzyme cellulosique et au moins une composition de polymère cationique dans une pâte à papier l'une dans un intervalle de 5 minutes après l'autre afin de former une pâte traitée ; et
 b) de former la pâte traitée en du papier ou du carton.
2. Procédé de la revendication 1, comprenant en outre le fait d'introduire au moins un premier amidon cationique dans la pâte traitée.
3. Procédé de la revendication 1 ou de la revendication 2, dans lequel ladite composition d'enzyme cellulosique contient 5% à 20% en poids d'enzyme.
4. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite composition d'enzyme cellulosique est ajoutée à ladite pâte en une proportion allant de 0,100 à 0,001 % en poids d'enzyme selon le poids à sec de la pâte.
5. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite composition d'enzyme cellulosique comprend au moins un oligomère polyamide et au moins une enzyme cellulosique.
6. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite pâte comprend ou consiste en une pâte au bisulfite.

7. Procédé de l'une quelconque des revendications 2 à 5, dans lequel un deuxième amidon cationique, qui peut être le même ou qui peut être différent du premier amidon cationique, est introduit dans la pâte traitée avant l'étape b).
8. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite au moins une composition de polymère cationique comprend un polymère cationique synthétique.
9. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite au moins une composition de polymère cationique comprend un polymère polyacrylamide.
10. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite au moins une composition de polymère cationique est un polymère cationique synthétique soluble dans l'eau contenant des unités d'acrylamide et des unités monomères cationiques.
11. Procédé de l'une quelconque des revendications précédentes, dans lequel le polymère cationique dans ladite composition de polymère cationique est ajouté à ladite pâte en une proportion allant de 0,0001% en poids à 1,000 % en poids, selon le poids des matières sèches de ladite pâte.
12. Procédé de l'une quelconque des revendications 2 à 11, dans lequel ledit au moins un amidon cationique est ajouté à ladite pâte traitée en une proportion allant de 2,27 à 11,34 Kg par 907,18 Kg (5 à 25 livres par tonne) selon le poids des matières sèches de la pâte.
13. Procédé de l'une quelconque des revendications précédentes, dans lequel le polymère cationique dans ladite composition de polymère cationique a un poids moléculaire moyen en poids d'au moins 10,000 et ladite composition de polymère cationique est pré-combinée avec la composition d'enzyme avant que le polymère et l'enzyme ne soient ajoutés ensemble à la pâte.
14. Procédé de l'une quelconque des revendications précédentes, dans lequel lesdites au moins une composition d'enzyme cellulosique et au moins une composition polymère cationique sont ajoutées l'une dans un intervalle d'une minute après l'autre.
15. Procédé de l'une quelconque des revendications précédentes, dans lequel lesdites au moins une composition d'enzyme cellulosique et au moins une composition de polymère cationique sont ajoutées simultanément.

16. Procédé de l'une quelconque des revendications précédentes, dans lequel lesdites au moins une composition d'enzyme cellulitique et au moins une composition polymère cationique sont ajoutées avant un cuvier de mélange dans un processus de fabrication de papier. 5
17. Procédé de l'une quelconque des revendications précédentes, dans lequel lesdites au moins une composition d'enzyme cellulitique et au moins une composition polymère cationique sont ajoutées avant un premier raffineur qui est situé avant le cuvier de mélange. 10
18. Procédé de la revendication 17, comprenant en outre le fait d'introduire au moins un premier amidon cationique à la pâte traitée avant le cuvier de mélange. 15
19. Procédé de l'une quelconque des revendications précédentes, dans lequel ladite au moins une composition polymère cationique comprend un polymère cationique ayant au moins un polymère contenant de l'azote. 20
20. Procédé de la revendication 18, comprenant en outre le fait d'introduire au moins un deuxième amidon cationique dans la pâte traitée et dans lequel lesdits premier et deuxième amidons cationiques sont les mêmes ou sont différents. 25 30
21. Procédé de fabrication de papier ou de carton selon l'une quelconque des revendications 1 à 6 ou 11 comprenant le fait : 35
- a) d'introduire une composition de polymère cationique dans une pâte à papier afin de former une pâte traitée ;
 - b) d'introduire au moins une composition d'enzyme cellulitique dans ladite pâte traitée afin de former une pâte traitée à l'enzyme ; 40
 - c) d'ajouter une composition de polymère cationique contenant de l'azote à la pâte traitée à l'enzyme ; et
 - d) de former la pâte en du papier ou du carton. 45
22. Procédé de la revendication 21, comprenant en outre le fait d'introduire une deuxième composition de polymère cationique à la pâte traitée à l'enzyme avant d'introduire la composition de polymère cationique contenant de l'azote à la pâte traitée à l'enzyme. 50
23. Procédé de la revendication 21 ou 22, dans lequel ladite composition de polymère cationique comprend un polymère contenant de l'azote ou un amidon. 55
24. Procédé de l'une quelconque des revendications 21 à 23, dans lequel ladite deuxième composition de polymère cationique comprend un polymère contenant de l'azote ou un amidon.
25. Procédé de la revendication 21, dans lequel ladite composition de polymère cationique est introduite au niveau du cuvier de mélange dans un processus de fabrication de papier et ladite au moins une composition d'enzyme cellulitique est introduite au niveau du cuvier de tête de la machine à papier du même processus de fabrication de papier et ladite composition de polymère cationique contenant de l'azote est ajoutée environ au niveau du silo d'eau blanche dans le même processus de fabrication de papier.
26. Procédé de la revendication 25, dans lequel ledit polymère cationique facultatif est introduit au niveau du château de pâte qui est situé entre ledit cuvier de tête de la machine à papier et ledit silo d'eau blanche.
27. Appareil de fabrication de papier comprenant une alimentation d'une composition d'enzyme, une alimentation d'une composition de polymère cationique, une alimentation de pâte à papier, un dispositif pour fournir une composition d'enzyme depuis l'alimentation de composition d'enzyme et une composition de polymère cationique depuis l'alimentation de polymère cationique à l'alimentation de pâte à papier environ au même moment afin de former une alimentation de pâte traitée, et un dispositif pour former la pâte traitée en du papier ou carton traité.
28. Appareil de la revendication 27, dans lequel ledit dispositif pour former la pâte traitée comprend un cuvier de mélange communiquant avec ladite alimentation de pâte traitée, une pompe de dilution communiquant avec le cuvier de mélange, un tamis communiquant avec ladite pompe de dilution, et une caisse d'arrivée communiquant avec ledit tamis. 35 40
29. Appareil de la revendication 27, dans lequel un réservoir d'alimentation est prévu pour contenir une alimentation de la pâte traitée, et la communication entre ledit réservoir d'alimentation et ledit cuvier de mélange comporte un appareil de raffinage pour raffiner la pâte traitée avant qu'elle ne rentre dans le cuvier de mélange.
30. Appareil de la revendication 27, comprenant en outre une alimentation d'amidon cationique, une sortie de l'alimentation dudit amidon cationique en communication avec une entrée à ladite alimentation de pâte traitée et comprenant en outre un silo d'eau blanche, dans lequel ledit silo d'eau blanche possède une entrée communiquant avec ledit cuvier de mélange, une entrée communiquant avec ladite caisse d'arri-

vée, et une sortie communiquant avec ladite pompe de dilution.

- 31.** Appareil de la revendication 27, comprenant en outre un ou plusieurs raffineurs pour raffiner la pâte ou la pâte traitée avant de former la pâte dans ladite caisse d'arrivée.

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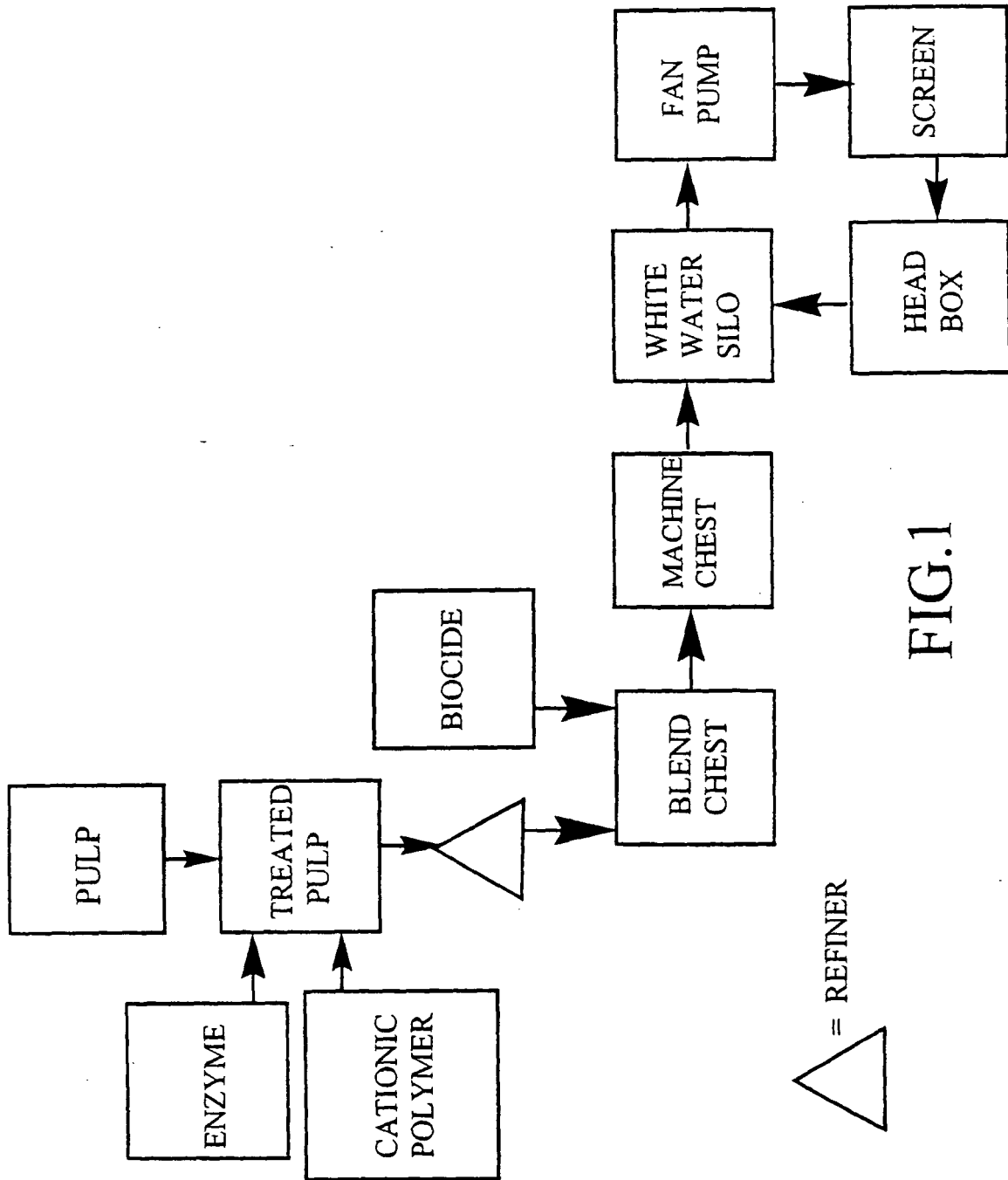


FIG.1

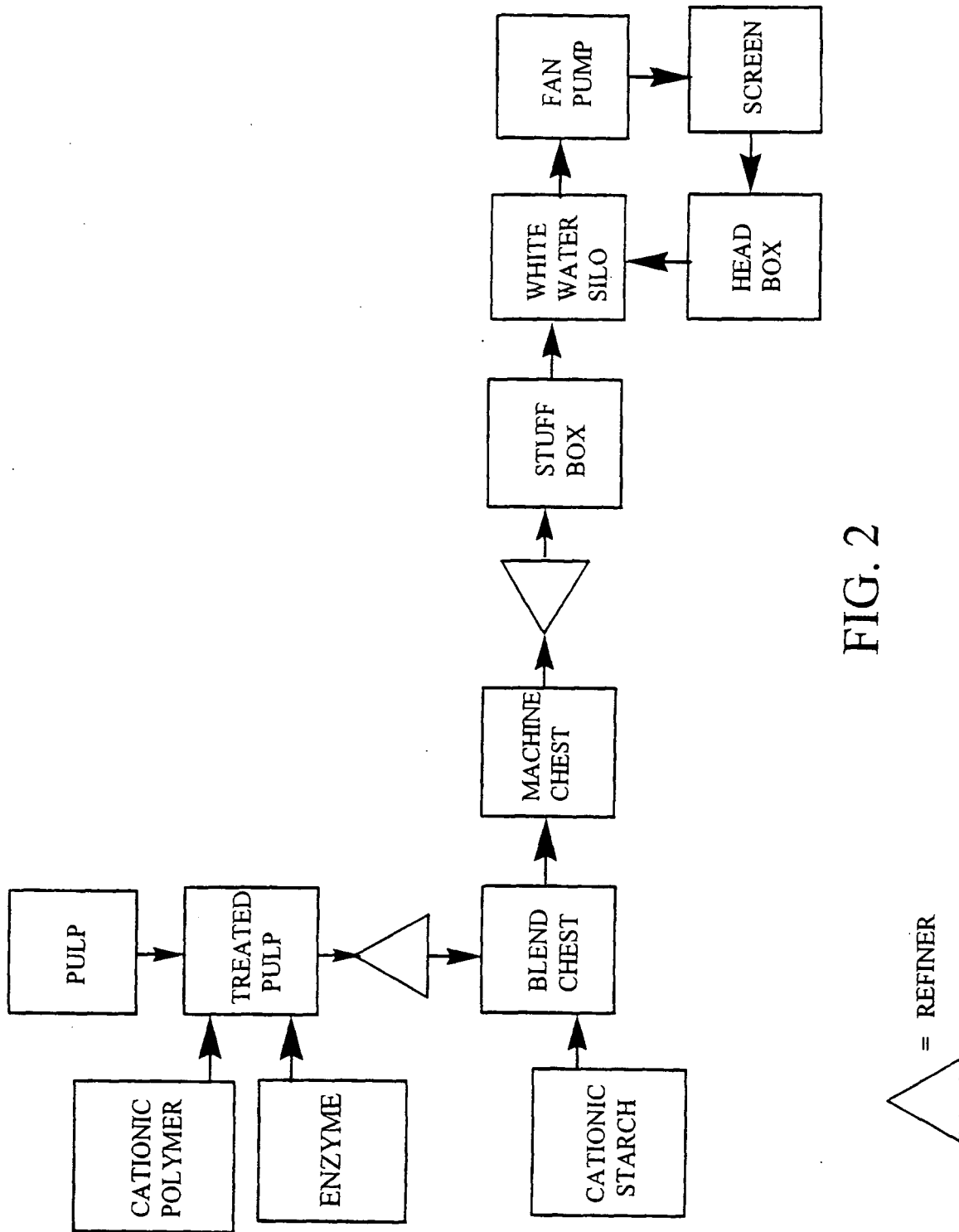


FIG. 2

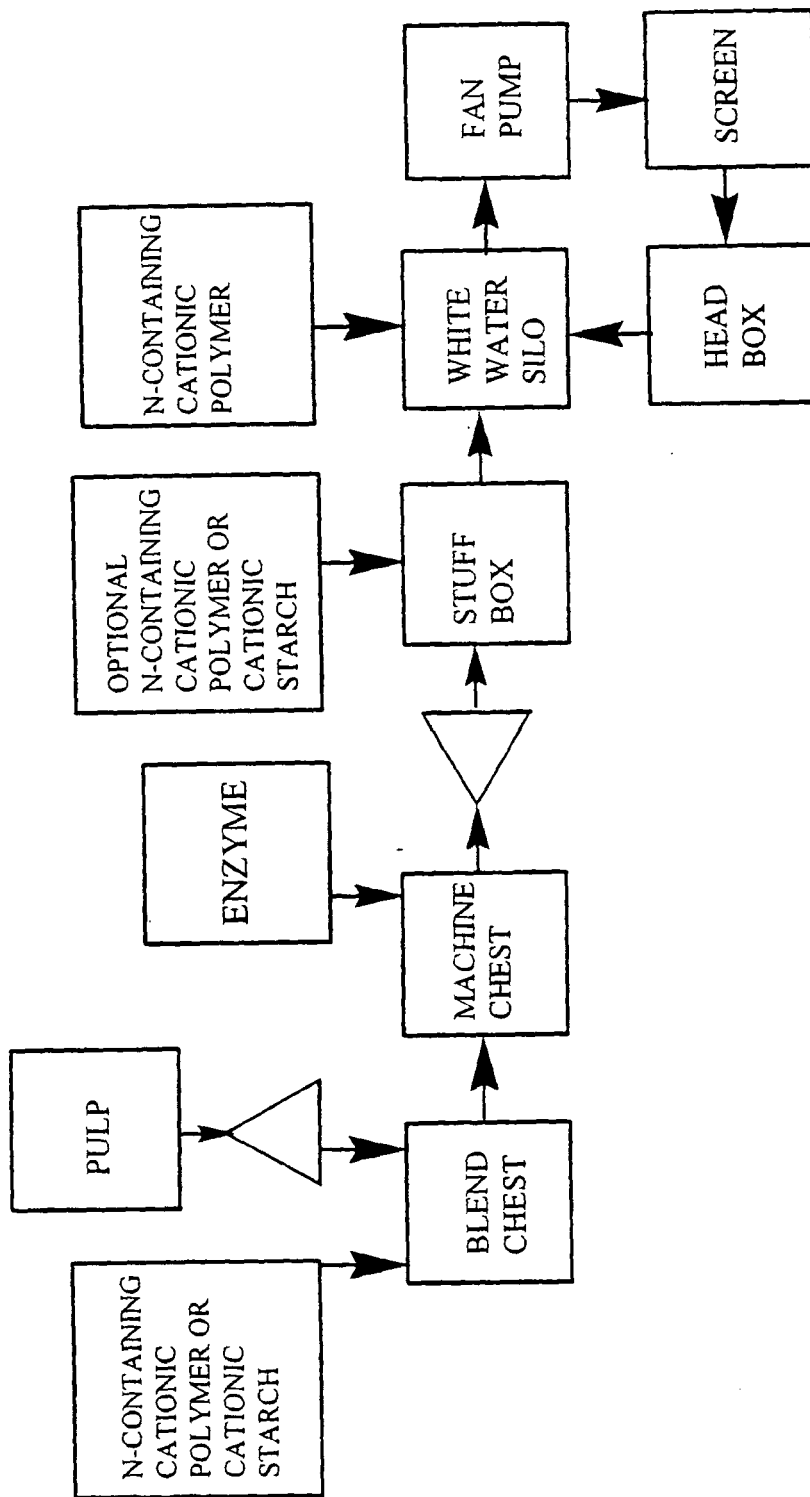


FIG. 3

△ = REFINER

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4923565 A, Fuentes [0002]
- US 5110412 A, Fuentes [0002]
- US 5169497 A, Sarkar [0002]
- US 5308449 A, Fuentes [0002]
- US 5356800 A, Jaquess [0013]
- US 6342381 B [0013]
- WO 9943780 A [0013] [0014]
- US 4894119 A, Baron, Jr. [0017] [0018]