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(54) Papermaking process and apparatus for use therewith

Verfahren zur Herstellung von Papier und damit verwendete Vorrichtung

Procédé de fabrication du papier et appareil l'utilisant

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(73) Proprietor: **The Wiggins Teape Group Limited
Basingstoke Hampshire RG21 2EE (GB)**

(72) Inventor: **Harris, Colin Austin
Ivybridge, Devon. PL21 0AR (GB)**

(74) Representative: **Norris, Richard John
Intellectual Property Department,
Arjo Wiggins Appleton plc,
Butler's Court,
Wattleton Road
Beaconsfield, Buckinghamshire HP9 1RT (GB)**

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Description

This invention relates to a papermaking process and apparatus for use therewith. More particularly, it is concerned with such a process and apparatus having as its purpose to improve the retention of solids materials within the process, thereby reducing both materials wastage and the unacceptable discharge of such materials as effluent into the environment.

Extensive amounts of water are used in the papermaking process. A substantial proportion of this water is continually recycled within the process, but for practical reasons, it is necessary to introduce a quantity of fresh water, thereby necessitating the discharge of a similar amount as waste in order to keep the system in balance. Depending upon the level of water re-usage in the system, the fresh water introduced can be from 10 to 50 m³ per tonne.

The papermaking process involves the slushing together of papermaking fibres and water in a machine such as a hydropulper to form an aqueous slurry. The papermaking fibres may be introduced as sheet wood-pulp or (where the papermachine forms part of an integrated pulping and papermaking process) as a pulp slurry fed from the pulp mill. Mineral fillers may also be added at this stage, typically being china clay, calcium carbonate or titanium dioxide.

The slurry from the pulper is held in stock chests and then fed through refiners and stock cleaners to the paper machine after dilution to a suitable consistency. Small quantities of polyelectrolyte may also be added so as to improve retention of the solids materials after the aqueous dispersion has been laid down to form a web on the papermachine wire.

As the web progresses along the papermachine, it progressively drains, assisted by foils and vacuum boxes and a small proportion of the fibrous and mineral components of the stock are lost during the drainage process. At the same time, a substantial amount of fresh water is used in order to clean the papermachine wire after the web has been formed. Fresh water is also used for other purposes in the machine, for example pump gland seals. The added fresh water represents a typical increase of about 30% in the total volume of water drained through the wire. The drained water is commonly referred to as backwater, or sometimes as white water due to the appearance conferred by the entrained fibrous and mineral residues. It is therefore normal practice to recycle the backwater or white water to a backwater tank from which it can be withdrawn to feed the hydropulper during the slushing of pulp newly introduced into the system.

Due to the 30% of fresh water introduced there will be an excess of water available at the backwater tank, and 30% of the backwater is therefore discharged for effluent treatment. Since the water discharged contains a substantial amount of fibrous and mineral solids, it represents a significant wastage of materials. Furthermore,

a substantial effluent treatment cost is incurred, and solids recovered at the treatment plant will need to be dried and burnt or concentrated and sent to landfill.

In order to reduce material losses from the process, and to minimise the costs associated with disposing of the solids from the effluent treatment plant, it has been common practice to install a saveall system such as a disc filter, which separates out suspended solids from the surplus backwater and returns these to the process. However, such systems involve substantial energy usage and are costly to purchase, install and operate.

It is among the objectives of the present invention to substantially improve the retention of solids materials in the papermaking process without substantial increased energy usage and thereby significantly reduce both wastage of those materials and the effluent load which results if they are allowed to pass out of the system.

According to the present invention therefore, a papermaking process includes preparing a papermaking stock and delivering that stock to a headbox of a paper machine for delivery onto a machine wire, draining the stock on the wire and processing the backwater or white water thus obtained to obtain a first fraction which has a higher solids content than a second fraction characterised by delivering said backwater to a centrifugal and sedimentation separator device which comprises a tank open to atmosphere in which the backwater is introduced tangentially to produce a slow peripheral rotation defining a single vortex with low turbulence to cause the solids to migrate towards an outer annular region adjacent a peripheral wall of said tank and to sediment towards a bottom of the tank, withdrawing said first fraction from the bottom of the tank and delivering it for use in preparing papermaking stock and withdrawing said second fraction from the centre of the single vortex and discharging said second fraction to waste or for re-use as process water in the papermaking process.

Thus, the centrifugal separator can supply a volume of water containing concentrated solids to each new fill of pulp to be slushed in a hydropulper. The residual clarified water is either allowed to flow to waste, perhaps after more limited effluent treatment, or used for other purposes. Due to the substantial reduction in the solids content of the clarified water, there is a corresponding substantial reduction in the load on the effluent treatment plant.

It will therefore be appreciated that the centrifugal separator combines the normal storage function of a backwater tank with the function of a saveall system so as to reduce material losses.

The separator thus permits storage of an appropriate volume of backwater or white water carrying concentrated solids for re-use in the pulp slushing process whilst leaving a residual low solids concentration in the surplus water flowing to waste. By using this method rather than employing a separate saveall system such as a disc filter, both capital and running costs are reduced

significantly. In addition, since the separation is generated solely due to the hydro-dynamic effect of the stream of backwater or white water entering the separator, both energy and maintenance costs are minimised since there are no moving parts to the system.

The design of the separator utilised the combined effects of sedimentation and centrifugal action to cause separation and concentration of solids in the water entering the separator. Thus, surplus water overflowing to waste or utilised for other process requirements is much lower in solids concentration than water entering the separator.

Preferably the process uses a centrifugal separator comprising an upper cylindrical portion and a lower portion which can be tapered or dish-shaped and includes introducing the liquid tangentially near an outer wall in the upper portion so as to generate a slow peripheral rotation defining a single vortex with low turbulence, thus causing the solids in the liquid to be retained and concentrated in the annular region adjacent said wall and to sediment to the bottom of the lower portion.

The water separating from the solids migrates inwardly and is then caused to flow upwardly in the centre of the separator as a result of displacement by new incoming backwater. As it is withdrawn this water is discharged directly or through an effluent plant to waste, or alternatively is re-used as appropriate in the papermaking process.

Apparatus for carrying out the process set forth above comprises means for preparing papermaking stock, a papermachine having a headbox and a machine wire, means for delivering prepared stock to the headbox of the papermachine and, means for removing backwater drained through said machine wire during formation of a paper web characterised by means for delivering said backwater to a centrifugal and sedimentation separator device comprising a tank open to atmosphere for generating a first fraction having a higher solids content than a second fraction having a lower solids content than that of the first fraction, means for introducing the backwater tangentially into said tank to produce a slow peripheral rotation defining a single vortex with low turbulence to cause the solids in the water to migrate towards an outer annular region adjacent an outer wall of said tank and to sediment towards the bottom of the tank, means for delivering the first fraction from the bottom of the tank to said means for preparing papermaking stock, and means to deliver said second fraction from the centre of said single vortex to waste or for re-use in the process.

The invention can be performed in various ways, but one embodiment thereof and an example of a centrifugal and sedimentation separator for use therein will now be described by way of example and with reference to the accompanying drawings in which :

Figure 1 is as diagram showing a stock flow system for a papermachine incorporating the invention;

Figure 2 is a diagrammatic cross-sectional view on the lines II-II of Figure 3 of a centrifugal sedimentation separator for use in the process; and,

5 Figure 3 is a diagrammatic plan view of the separator shown in Figure 2.

Referring first to Figure 1, this shows a hydropulper 1 into which raw pulp is fed as indicated at P to be slushed with water from a combined backwater tank and centrifugal separator 2 (which is described in more detail below with reference to Figures 2 and 3). The pulp P fed to the hydropulper 1 may be in the form of bales of dry papermaking pulp, or when the system is embodied in an integrated pulp and papermaking system, a pulp slurry fed from the pulping plant. Slushed pulp from the pulping plant is stored into stock chests 3 from which it is then withdrawn as required by a pump 4 and fed through refiners 5 to a small header chest 6.

20 The slurry is withdrawn from the chest 6 by pump 8 through a valve 7 and fed to cyclone cleaners 9 to the headbox 10 of the papermachine. Slurry entering the pump 8 is reduced to an acceptable consistency for paper formation by the addition of high solids backwater, the source of which is described below, through the connection 11. Before the papermaking stock enters the headbox 10, a polyelectrolyte may be added from a supply 12 thereof as to improve retention of papermaking materials on the papermachine.

30 Papermaking stock from the headbox 10 is laid down on a papermachine wire 13 and drained with the assistance of underwire foils 14 and vacuum boxes 15. The formed web 16 is then lifted from the wire and fed into the press section of the papermachine, the first press of which is shown at 17.

35 During the return run 18 of the papermachine wire beneath the foils and vacuum boxes, sprays 19, utilising clean water, are used to wash solids residues from the wire.

40 Water withdrawn by drainage through the first set 20 of the foils 14 is drained directly into a high solids backwater tank 21. Vacuum is applied to the vacuum box 15 by a vacuum pump or exhaustor 22 which applies vacuum through a vacuum separator 23. Water collected in the holding tank 23 is withdrawn by a pump 24 and fed into the backwater tank 21.

45 Water drained from the set of foils 20 and from the vacuum boxes 15 has a relatively high solids content and is fed through the line 11 in order to adjust the consistency of the aqueous slurry being withdrawn from the header chest 6 by the pumps.

50 Water from the second set 25 of foils 14 has a lower solids content and is allowed to drain directly into the machine pit 26. This water together with the wash water from the sprays 19 which collects in the machine pit 26 is passed to a medium solids backwater tank 28. Further water extracted from the sheet or derived from the felt washing sprays (not shown) in the first press 17 is with-

drawn by a pump 29 and also fed to the medium solids backwater tank 28. Water collected in the hogpit 27 is derived from the sprays 32 immediately thereabove and has a high fibre content. This water is returned directly to the stock chests 3 through connection 33.

The medium solids backwater collected in the tank 28 is withdrawn by a pump 30 and fed to the separator 2, the operation of which is described below with reference to Figures 2 and 3.

Clarified water withdrawn from outlet 31 of the separator 2 is fed either to an effluent pit 34 or for reuse in the cleaner sprays 19, pump seals etc. in the process as indicated at 35. Water flowing to the effluent pit 34 is withdrawn by a pump 36 and fed to an effluent plant 37 of known kind. Clean water from the effluent plant may then be discharged to the environment through line 38 whilst residual solids are retained at 39 for disposal. The volume of residual solids is substantially less than in the same process in which a conventional backwater tank is used in place of the separator 2.

Turning now to Figures 2 and 3, these show the detailed construction of the backwater separator 2.

The separator comprises a stainless steel circular tank 40 with a conical lower portion 41. In one paper-machine stock flow system the tank had a diameter of 4 metres and a capacity of the order of 30 m³. Incoming backwater was pumped from the medium solids backwater tank 28 into the outer zone of the separator through a pipe 42, the water discharge being tangential so as to produce a vortex with a slow liquid rotation at a minimum velocity of approximately 0.3 m/sec. as indicated by arrows 43 in Figure 3. To achieve efficient separation the minimum velocity should be calculated according to the formula.

$$V = \sqrt{.03D}$$

where:

V = velocity of incoming backwater in metres/sec.
D = diameter of the tank in metres.

The combined effect of the vortex and the tendency of the solids to sediment results in the solids being drawn outwardly and downwardly, as indicated by reference numeral 44. The residual clarified water, indicated by arrows 45 in Figure 2, passes upwardly in towards the centre of the vessel. The construction of the vessel and the vortex effect together ensure that water with a high concentration of suspended solids moves downwardly in the vessel, whilst the residual clarified water flows upwardly.

In order to prevent mingling of incoming backwater and the upwardly flowing clarified water, a cylindrical baffle 46 extends downwards into the water in the tank and a weir 47 is provided in the form of an annular trough 48. The trough 48 has a lower wall 49, an outer side wall

50 and an inner annular wall 51, the upper edge 52 of which is below the upper level 53 of the liquid in the tank when it is full. Liquid escaping over the weir is indicated by arrows 54 and the clarified water is removed from the trough 48 by a pipe 55 which exists from the lower wall 49 of the trough.

In the construction described above the lower portion 41 is conical but it could be dish-shaped or any other convenient shape which promotes the collection of solids.

Operation of such apparatus was typically as follows. For a backwater separator of 30 m³ capacity, the rate of flow of backwater from the papermachine to the separator was 80 m³/hour. The concentration of solids in the incoming backwater was measured at 165 mg/l with the solids comprising cellulose fibre, kaolin and titanium dioxide. During a period of one hour, the pulper was filled twice with a total of 60 m³ of backwater. Clarified water overflowed from the separator for 15 minutes flowing to waste and then to Effluent Treatment. The suspended solids present in the clarified water was measured and was found to be 40 mg/l. The backwater separator therefore functioned to reduce the solids in the waste water from 165 mg/l to 40 mg/l. This represents a typical saving.

It has been found that even with backwater having a concentration of solids ranging between 120 - 400 mg/l the suspended solids in the clarified water did not exceed 40 mg/l. Polyelectrolyte additions may be made to the incoming backwater if desired to increase flocculation of the solids, but a substantial economic benefit results even without the use of such a flocculant.

In order to improve retention of cellulose fibre, it may under certain circumstances be advantageous, as mentioned above, to add a flocculant before the backwater enters the separator. If a heavy floc is formed, the backwater will be less mobile and this will in turn reduce the tendency for fibre to be lost with the upwardly flowing waste water. An alternative means of improving fibre retention is to add both a flocculant and air to the incoming backwater. This will cause the fibre to both flocculate and float. The fibre will then be held in the outer part of the vessel while the clarified water continues to flow upwardly in the central portion as before. This results in very clear waste water. The accumulation of solids from both the outer portion and the conical part of the vessel are then fed to the hydrapulper as described above, thereby providing good overall solids retention in the system.

A problem which can arise in a closed circuit system in which a high proportion of the water is recycled. Such water tends to rise in temperature as it is continually recycled through the system due to the fact that work is done on it by means of pumps etc., part of which becomes converted into heat and this is undesirable. To hold the temperature down therefore it may sometimes be necessary to increase the addition of cold fresh water to the system. To keep the system in balance therefore

an increased amount of water recovered from the separator has to be discharged from the system. Because this additional water being discharged contains a small amount of solids which is removed in the effluent plant, these solids are lost to the system and the system as a whole is marginally less efficient in retaining the solids materials. However, this does not seriously detract from the benefits of the present invention.

Some papermaking machines employ a backwater silo. In such machines the separator of the present invention will be operated in place of this silo.

In earlier papermaking processes, no separation is made between high and medium solids backwater. All backwater is collected and returned to the backwater tank or used for consistency adjustment. The separator system of the invention is also applicable to such a process and, indeed, greater benefits in terms of material savings and reductions in effluent load may sometimes be achieved.

Claims

1. A papermaking process which includes preparing a papermaking stock and delivering said stock to the headbox (10) of a papermachine for delivery onto a machine wire (13), draining the stock on the wire (13) and processing the backwater thus obtained to obtain a first fraction which has a higher solids content than a second fraction characterised by delivering said backwater to a centrifugal and sedimentation separator device (2) which comprises a tank (40) open to atmosphere in which the backwater is introduced tangentially to produce a slow peripheral rotation defining a single vortex with low turbulence to cause the solids to migrate towards an outer annular region adjacent a peripheral wall of said tank and to sediment towards a bottom of the tank, withdrawing said first fraction from the bottom of the tank and delivering it for use in preparing papermaking stock and withdrawing said second fraction from the centre of the single vortex and discharging said second fraction to waste or for re-use as process water in the papermaking process.
2. A papermaking process as claimed in claim 1 characterised in that said centrifugal separator comprises an upper cylindrical portion and a lower portion (41) which is tapered or dish-shaped and which includes introducing the liquid tangentially near an outer wall in the upper portion so as to generate a slow peripheral rotation defining a single vortex with low turbulence, thus causing the solids in the liquid to be retained and concentrated in the annular region adjacent said wall and to sediment to the bottom of the lower portion (41).
3. A papermaking process as claimed in claim 1 or claim 2 characterised in that it includes introducing water into the centrifugal separator to cause a single vortex with a slow liquid rotation at a minimum velocity of 0.3 m/sec.
4. A papermaking process as claimed in any one of preceding claims 1 to 3 characterised in that it includes introducing water into the separator (2) at a minimum velocity calculated according to the formula $V = \sqrt{.03D}$, where V = the velocity of incoming water in metres/sec and D = the diameter of the separator (2) in metres.
5. A papermaking process as claimed in any one of preceding claims 1 to 4 characterised in that it includes causing the liquid separated from the solids to migrate inwardly and upwardly where it is withdrawn and discharged directly or through an effluent plant (37) to waste, or for re-use in the papermaking process.
6. A papermaking process as claimed in any one of preceding claims 1 to 5 characterised in that it includes delivering the fraction having a higher solids content to a hydropulper (1).
7. A papermaking process as claimed in claim 6 characterised in that it includes using said centrifugal separator (2) as a backwater tank and delivering said fraction having a higher solids content to each new fill of pulp to be slushed in said hydropulper (1).
8. A papermaking process as claimed in any one of preceding claims 1 to 7 characterised in that it includes adding polyelectrolyte (12) to the backwater delivered to the centrifugal separator (2) to increase flocculation of the solids.
9. A papermaking process as claimed in any one of preceding claims 1 to 8 characterised in that it includes adding a flocculant and air to the incoming backwater or white water delivered to the centrifugal separator (2).
10. Papermaking apparatus comprising means for preparing papermaking stock (1), a papermachine having a headbox (10) and a machine wire (13), means for delivering prepared stock to the headbox (10) of the papermachine and, means for removing backwater drained through said machine wire (13) during formation of a paper web (16) characterised by means for delivering said backwater to a centrifugal and sedimentation separator device (2) comprising a tank (40) open to atmosphere for generating a first fraction having a higher solids content than a second fraction having a lower solids content than that of the first fraction, means for introducing the backwater tangentially into said tank (40) to produce a

slow peripheral rotation defining a single vortex with low turbulence to cause the solids in the water to migrate towards an outer annular region adjacent an outer wall of said tank (40) and to sediment towards the bottom of the tank, means for delivering the first fraction from the bottom of the tank to said means (1) for preparing papermaking stock, and means to deliver said second fraction from the centre of said single vortex to waste or for re-use in the process.

11. Apparatus as claimed in claim 10 characterised in that said tank comprises an upper cylindrical portion with an outer wall, a lower portion (41) which is tapered or dish-shaped, and means for introducing the backwater tangentially near the outer wall in the upper portion.
12. Apparatus as claimed in claim 10 or claim 11 characterised by including means to cause the second fraction to migrate inwardly and upwardly, and means (48,55) for withdrawing and discharging said second fraction directly to an effluent plate (37) to waste, or for re-use in the papermaking process.
13. Apparatus as claimed in claim 12 characterised in that the means for withdrawing and discharging said second fraction includes a weir (48) located at the centre of the single vortex and over which liquid can escape from the tank (2).
14. Apparatus as claimed in any one of the preceding claims 10 to 13 characterised in that the capacity of said centrifugal and sedimentation separator device (2) in respect of the higher solids fraction is sufficient to hold enough liquid to act as a backwater tank to deliver said first fraction to each new fill of pulp to be slushed in said means (1) for preparing papermaking stock.
15. Apparatus as claimed in any one of preceding claims 10 to 14 characterised in that the means for preparing the papermaking stock includes a hydro-pulper (1) to which the first fraction is delivered.

Patentansprüche

1. Verfahren zur Papierherstellung, welches die Aufbereitung eines Stoffes zur Papierherstellung und das Fördern dieses Stoffes zum Stoffauflaufkasten (10) einer Papiermaschine zum Weiterfördern auf einem Maschinensieb (13), sowie das Entwässern des Stoffes auf dem Sieb (13) und die Aufbereitung des auf diese Weise gewonnenen Rückwassers umfaßt, um eine erste Fraktion zu erhalten, welche einen höheren Feststoffgehalt aufweist, als eine zweite Fraktion,

dadurch gekennzeichnet,

daß man das Rückwasser zu einer Zentrifugal- und Sedimentations-Trennvorrichtung (2) fördert, wobei diese Zentrifugal- und Sedimentations-Trennvorrichtung einen zur Umgebung hin offenen Behälter (40) umfaßt, in welchen das Rückwasser tangential eingeleitet wird, um eine langsame, einen einzigen Wirbel mit geringer Turbulenz bildende Umfangsdrehung zu erzeugen, um die Feststoffe zu veranlassen, zu einem äußeren, einer Umfangswandung des Behälters benachbarten Ringbereich zu wandern und sich in Richtung eines Bodens des Behälters abzusetzen, daß man die erste Fraktion von dem Boden des Behälters entnimmt und sie zur Verwendung bei der Aufbereitung des Stoffes zur Papierherstellung fördert, und daß man die zweite Fraktion aus der Mitte des einzigen Wirbels entnimmt und die zweite Fraktion zur Entsorgung oder zur Wiederverwendung als Prozeßwasser in dem Verfahren zur Papierherstellung ableitet.

2. Verfahren zur Papierherstellung nach Anspruch 1, **dadurch gekennzeichnet,** daß die Zentrifugal-Trennvorrichtung einen oberen zylindrischen Abschnitt und einen unteren Abschnitt (41) umfaßt, welcher sich verjüngt oder schüsselförmig ist und welcher das tangentiale Einleiten der Flüssigkeit nahe einer äußeren Wand in dem oberen Abschnitt umfaßt, um so eine langsame, einen einzigen Wirbel mit geringer Turbulenz bildende Umfangsdrehung zu erzeugen, was dazu führt, daß die Feststoffe in der Flüssigkeit in dem der Wand benachbarten Ringbereich zurückgehalten und konzentriert werden und sich in Richtung des Bodens des unteren Abschnitts (41) absetzen.
3. Verfahren zur Papierherstellung nach Anspruch 1 oder 2, **dadurch gekennzeichnet,** daß es das Einführen des Wassers in die Zentrifugal-Trennvorrichtung umfaßt, zur Herbeiführung eines einzigen Wirbels mit langsamer Flüssigkeitsrotation bei einer Mindestgeschwindigkeit von 0,3 Metern/Sekunde.

4. Verfahren zur Papierherstellung nach einem der vorhergehenden Ansprüche 1 bis 3, **dadurch gekennzeichnet,** daß es das Einführen des Wassers in die Trennvorrichtung (2) bei einer Mindestgeschwindigkeit umfaßt, die gemäß der Formel $V = \sqrt{0.03D}$, berechnet wird, wobei V der Geschwindigkeit des einlaufenden Wassers in Metern/Sekunde und D dem Durchmesser der Trennvorrichtung (2) in Metern entspricht.

5. Verfahren zur Papierherstellung nach einem der

vorhergehenden Ansprüche 1 bis 4,

dadurch gekennzeichnet,

daß es umfaßt, daß die von den Feststoffen getrennte Flüssigkeit veranlaßt wird, nach innen und oben zu wandern, wo sie entnommen und direkt oder durch eine Abwasseranlage (37) zur Entsorgung, oder zur Wiederverwendung in dem Verfahren zur Papierherstellung abgeleitet wird.

6. Verfahren zur Papierherstellung nach einem der vorhergehenden Ansprüche 1 bis 5,

dadurch gekennzeichnet,

daß es umfaßt, die Fraktion mit einem höheren Feststoffgehalt einem Hydrapulper (1) zuzuführen.

7. Verfahren zur Papierherstellung nach Anspruch 6,

dadurch gekennzeichnet,

daß es die Verwendung der Zentrifugal-Trennvorrichtung (2) als einen Rückwasserbehälter, und die Zuführung der Fraktion mit einem höheren Feststoffgehalt zu jeder neuen Zellstofffüllung, die in dem Hydrapulper (1) aufzuschlämmen ist, umfaßt.

8. Verfahren zur Papierherstellung nach einem der vorhergehenden Ansprüche 1 bis 7,

dadurch gekennzeichnet,

daß es die Zugabe von Polyelektrolyten (12) zu dem Rückwasser umfaßt, welches der Zentrifugal-Trennvorrichtung (2) zugeführt wird, um das Ausflocken der Feststoffe zu erhöhen.

9. Verfahren zur Papierherstellung nach einem der vorangegangenen Ansprüche 1 bis 8,

dadurch gekennzeichnet,

daß es die Zugabe eines Ausflockungsmittels sowie von Luft zu dem einlaufenden Rückwasser oder weißem Wasser, welches der Zentrifugal-Trennvorrichtung (2) zugeführt wird, umfaßt.

10. Vorrichtung zur Papierherstellung, welche Mittel (1)

zur Aufbereitung des Stoffes zur Papierherstellung, eine Papiermaschine, welche einen Stoffauflaufkasten (10) und ein Maschinensieb (13) aufweist, sowie Mittel zum Fördern des aufbereiteten Stoffes zu dem Stoffauflaufkasten (10) der Papiermaschine und Mittel zum Entfernen des durch das Maschinensieb (13) während der Entstehung einer Papierbahn (16) entzogenen Rückwassers, umfaßt,

gekennzeichnet durch,

Mittel zum Fördern des Rückwassers zu einer Zentrifugal- und Sedimentations-Trennvorrichtung (2), wobei diese Zentrifugal- und Sedimentations-Trennvorrichtung einen zur Umgebung hin offenen Behälter (40) umfaßt, um eine erste Fraktion zu erzeugen, die einen höheren Feststoffgehalt hat, als eine zweite Fraktion, welche einen geringeren Feststoffgehalt hat, als die erste Fraktion, Mittel zum tangentialen Einleiten des Rückwasser in den Be-

hälter (40), um eine langsame, einen einzigen Wirbel mit geringer Turbulenz bildende Umfangsdrehung zu erzeugen, um die Feststoffe in dem Wasser zu veranlassen, zu einem äußeren, einer äußeren Wandung des Behälters (40) benachbarten Ringbereich zu wandern und sich in Richtung des Bodens des Behälters abzusetzen, Mittel zum Fördern der ersten Fraktion von dem Boden des Behälters zu den Mitteln (1) zur Aufbereitung des Stoffes zur Papierherstellung, und Mittel zur Förderung der zweiten Fraktion aus der Mitte des einzigen Wirbels zur Entsorgung oder zur Wiederverwendung in dem Verfahren.

11. Vorrichtung nach Anspruch 10,

dadurch gekennzeichnet,

daß der Behälter einen oberen zylindrischen Abschnitt mit einer äußeren Wand, einen unteren Abschnitt (41) umfaßt, welcher sich verjüngt oder schüsselförmig ist, und Mittel zum tangentialen Einleiten des Rückwassers nahe der äußeren Wand in den oberen Abschnitt umfaßt.

12. Vorrichtung nach Anspruch 10 oder 11,

dadurch gekennzeichnet,

daß die Vorrichtung Mittel umfaßt, um die zweite Fraktion zu veranlassen nach innen und oben zu wandern, sowie Mittel (48,55) zur Entnahme und zur direkten Ableitung der zweiten Fraktion zur Entsorgung in eine Abwasseranlage (37), oder zur Wiederverwendung in dem Verfahren zur Papierherstellung.

13. Vorrichtung nach Anspruch 12,

dadurch gekennzeichnet,

daß die Vorrichtung Mittel zur Entnahme und zur Ableitung der zweiten Fraktion, einen in der Mitte des einzigen Wirbels angeordneten Überlauf (48) umfaßt, über welchen die Flüssigkeit aus dem Behälter (2) austreten kann.

14. Vorrichtung nach einem der vorhergehenden Ansprüche 10 bis 13, **dadurch gekennzeichnet,**

daß das Fassungsvermögen der Zentrifugal- und Sedimentations-

Trennvorrichtung (2) bezüglich der Fraktion mit dem hohen Feststoffanteil ausreichend ist, um genug Flüssigkeit bereitzuhalten, um als ein Rückwasserbehälter zu dienen, zur Beförderung der ersten Fraktion zu jeder neuen Zellstofffüllung, die in den Mitteln (1) zur Aufbereitung des Stoffes zur Papierherstellung aufzuschlämmen ist.

15. Vorrichtung nach einem der vorhergehenden Ansprüche 10 - 14,

dadurch gekennzeichnet,

daß die Mittel zur Aufbereitung des Papierstoffes einen Hydrapulper (1) umfassen, zu welchem die

erste Fraktion gefördert wird.

Revendications

1. Procédé de fabrication de papier qui comporte les étapes consistant à préparer une pâte à papier et à envoyer ladite pâte vers la bêche d'alimentation (10) d'une machine à papier pour distribution sur une toile de machine (13), à drainer la pâte située sur la toile (13) et traiter l'eau de drainage ainsi obtenue pour obtenir une première fraction qui a un contenu en matières solides plus élevé qu'une seconde fraction, caractérisé par les étapes consistant à envoyer ladite eau de drainage vers un dispositif (2) formant séparateur de sédimentation et centrifuge qui comporte un réservoir (40) ouvert à l'atmosphère dans lequel l'eau de drainage est introduite tangentiellement pour fournir une rotation périphérique lente définissant un seul tourbillon ayant une faible turbulence pour entraîner les matières solides à se diriger vers une zone annulaire extérieure adjacente à la paroi périphérique dudit réservoir et à se déposer vers une partie inférieure du réservoir, à retirer ladite première fraction de la partie inférieure du réservoir et à la distribuer pour l'utiliser dans la préparation de la pâte à papier et à retirer ladite seconde fraction du centre du seul tourbillon et à décharger ladite seconde fraction pour la rejeter ou pour la réutiliser en tant qu'eau de traitement dans le procédé de fabrication de papier.
2. Procédé de fabrication de papier selon la revendication 1, caractérisé en ce que ledit séparateur centrifuge comporte une partie cylindrique supérieure et une partie inférieure (41) qui est conique ou en forme de plat et qui comporte l'étape consistant à introduire le liquide tangentiellement à proximité de la paroi extérieure de la partie supérieure de manière à créer une rotation périphérique lente définissant un seul tourbillon ayant une faible turbulence, entraînant ainsi les matières solides situées dans le liquide à être retenues et concentrées dans la zone annulaire adjacente à ladite paroi et à se déposer vers la partie inférieure de la partie inférieure (41).
3. Procédé de fabrication de papier selon la revendication 1 ou 2, caractérisé en ce qu'il comporte l'étape consistant à introduire de l'eau dans le séparateur centrifuge pour entraîner un seul tourbillon ayant une rotation de liquide lente, à une vitesse minimum de 0,3 m/sec.
4. Procédé de fabrication de papier selon l'une quelconque des revendications 1 à 3, caractérisé en ce qu'il comporte l'étape consistant à introduire de l'eau à l'intérieur du séparateur (2) à une vitesse mi-

nimum calculée selon la formule $V = \sqrt{0,03D}$, où V = la vitesse d'entrée de l'eau en mètres/sec. et D = le diamètre du séparateur (2) en mètres.

5. Procédé de fabrication de papier selon l'une quelconque des revendications 1 à 4, caractérisé en ce qu'il comporte l'étape consistant à amener le liquide séparé des matières solides à se diriger vers l'intérieur et vers le haut où il est retiré et déchargé directement ou à travers une usine d'effluents (37) sous forme de rejet, ou pour être réutilisé dans le procédé de fabrication de papier.
6. Procédé de fabrication de papier selon l'une quelconque des revendications 1 à 5, caractérisé en ce qu'il comporte l'étape consistant à envoyer la fraction ayant un contenu en matières solides plus élevé vers un hydropulpeur (1).
7. Procédé de fabrication de papier selon la revendication 6, caractérisé en ce qu'il comporte les étapes consistant à utiliser ledit séparateur centrifuge (2) en tant que réservoir d'eau de drainage et à envoyer ladite fraction ayant le contenu en matières solides plus élevé dans ledit hydropulpeur (1) à chaque nouveau remplissage de pulpe pour être mise en boue.
8. Procédé de fabrication de papier selon l'une quelconque des revendications 1 à 7, caractérisé en ce qu'il comporte l'étape consistant à ajouter du polyélectrolyte (12) à l'eau de drainage envoyée vers le séparateur centrifuge (2) pour augmenter la floculation des matières solides.
9. Procédé de fabrication de papier selon l'une quelconque des revendications 1 à 8, caractérisé en ce qu'il comporte l'étape consistant à ajouter un flocculant et de l'air à l'eau de drainage entrante ou à de l'eau propre envoyée vers le séparateur centrifuge (2).
10. Dispositif de fabrication de papier comportant des moyens pour préparer une pâte à papier (1), une machine à papier ayant une bêche d'alimentation (10) et une toile de machine (13), des moyens pour envoyer la pâte préparée vers la bêche d'alimentation (10) de la machine à papier et, des moyens pour enlever l'eau de drainage drainée à travers la toile machine (13) pendant la formation d'une bande de papier (16), caractérisé par des moyens pour envoyer ladite eau de drainage vers un dispositif (2) formant séparateur de sédimentation et centrifuge comportant un réservoir (40) ouvert à l'atmosphère pour créer une première fraction ayant un contenu en matières solides plus élevé qu'une seconde fraction ayant un contenu en matières solides inférieur à la première fraction, des moyens pour introduire

de l'eau de drainage tangentiellement dans ledit réservoir (40) pour fournir une rotation périphérique lente définissant un seul tourbillon ayant une faible turbulence pour amener les matières solides à se diriger vers une zone annulaire extérieure adjacente à la paroi extérieure dudit réservoir (40) et à se déposer vers la partie inférieure du réservoir, des moyens pour envoyer ladite première fraction de la partie inférieure du réservoir vers lesdits moyens (1) pour préparer la pâte à papier, et des moyens pour retirer ladite seconde fraction du centre du seul tourbillon sous forme de rejet ou pour une réutilisation dans le procédé de fabrication de papier.

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11. Dispositif selon la revendication 10, caractérisé en ce que ledit réservoir comporte une partie cylindrique supérieure ayant une paroi extérieure, une partie inférieure (41) qui est conique ou en forme de plat, et des moyens pour introduire l'eau de drainage de manière tangentielle à proximité de la paroi extérieure de la partie supérieure. 15
20
12. Dispositif selon la revendication 10 ou 11, caractérisé en ce qu'il comporte des moyens pour amener la seconde fraction à se diriger vers l'intérieur et vers le haut, et des moyens (48, 55) pour retirer et décharger ladite seconde fraction directement vers une plaque d'effluent (37) pour être rejetée, ou pour réutilisation dans le procédé de fabrication de papier. 25
30
13. Dispositif selon la revendication 12, caractérisé en ce que les moyens pour retirer et décharger ladite seconde fraction comportent un barrage (48) situé au niveau du centre du seul tourbillon et par dessus lequel le liquide peut s'échapper du réservoir (2). 35
14. Dispositif selon l'une quelconque des revendications 10 à 13, caractérisé en ce que la capacité dudit dispositif (2) formant séparateur de sédimentation et centrifuge par rapport à la fraction de matières solides plus élevée est suffisante pour maintenir assez de liquides pour agir en tant que réservoir d'eau de drainage pour envoyer dans lesdits moyens (1) pour préparer la pâte à papier ladite première fraction à chaque nouveau remplissage de pulpe pour laquelle soit mise en boue. 40
45
15. Dispositif selon l'une quelconque des revendications 10 à 14, caractérisé en ce que les moyens pour préparer la pâte à papier comportent un hydro-pulpeur (1) vers lequel la première fraction est envoyée. 50
55

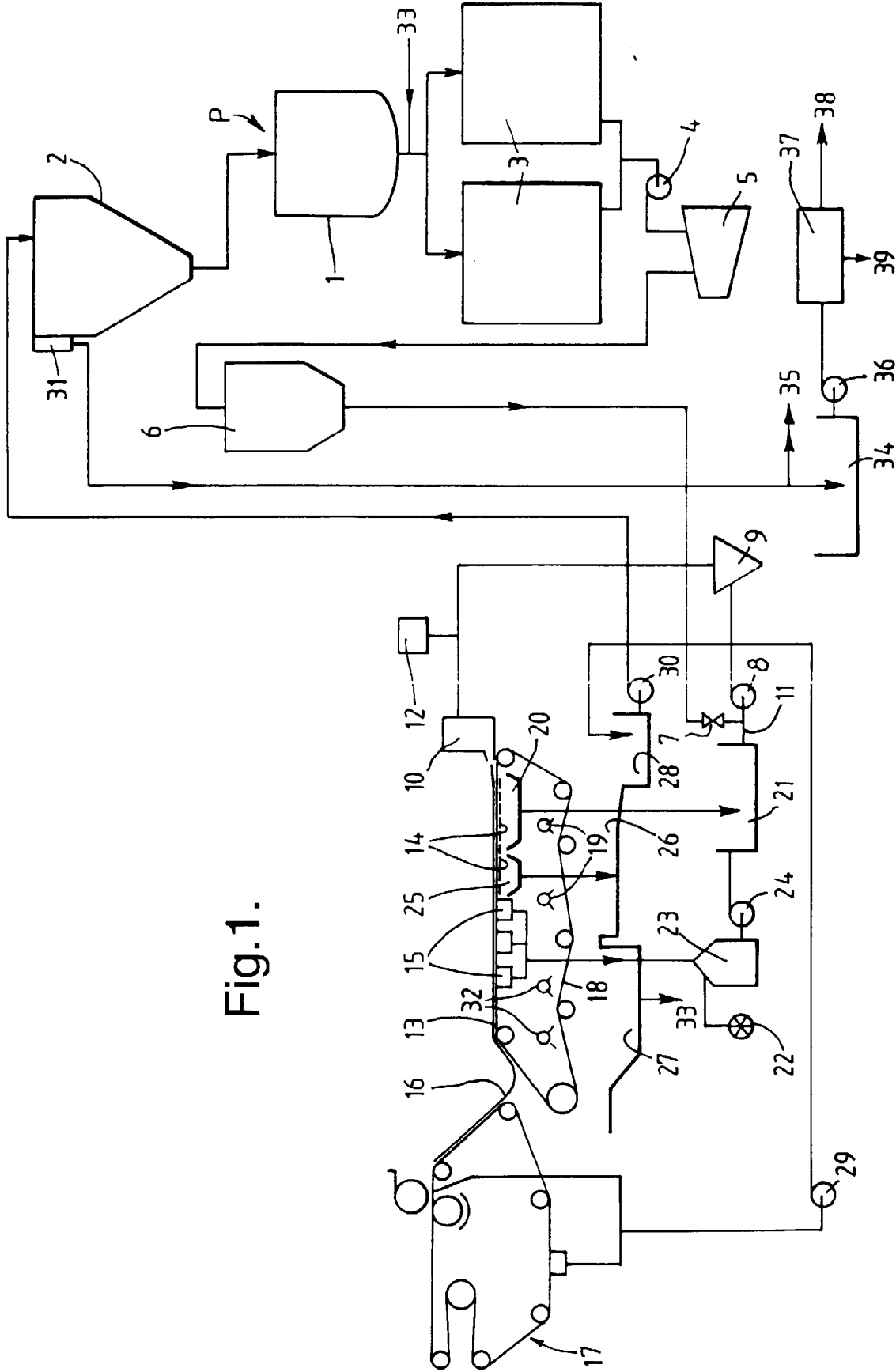


Fig. 1.

