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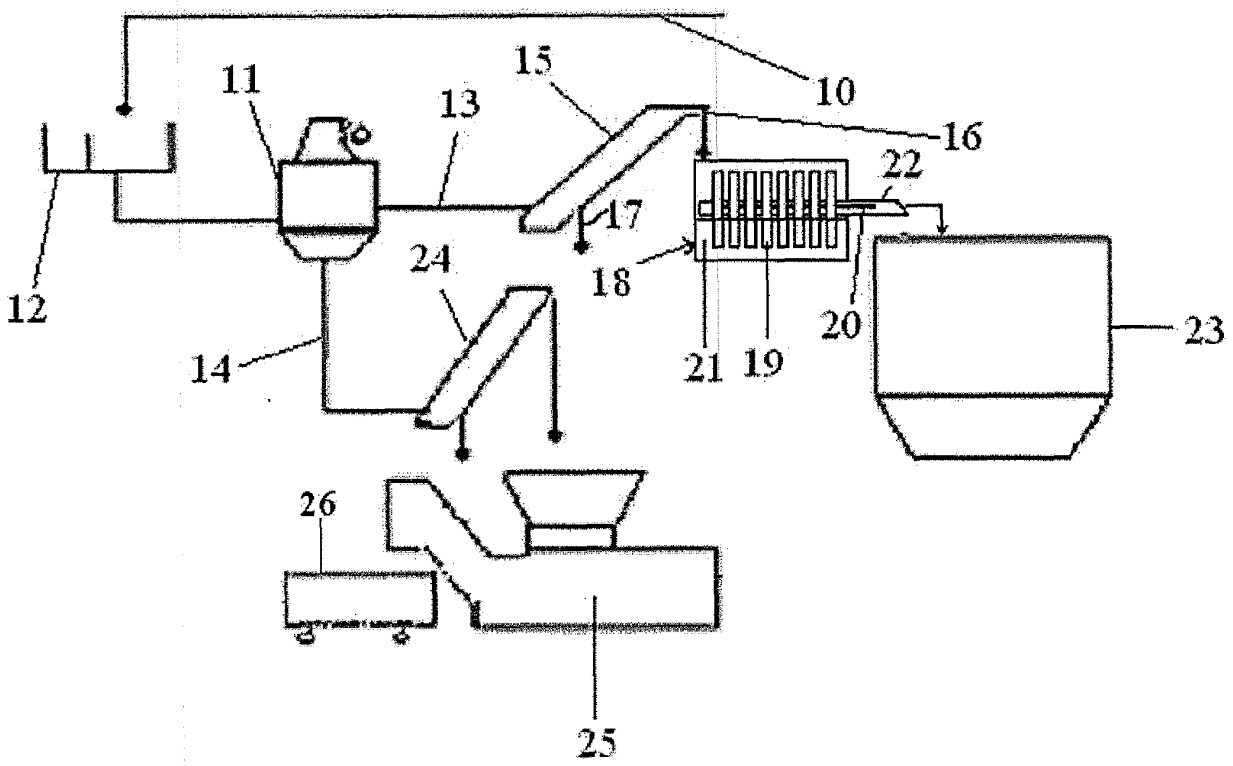
(71) Applicant: **Industrial Technology & Services LLC**
Sacramento, CA 95814 (US)

(72) Inventor: **Mondon, Francis**
Mahe (SC)

(74) Representative: **Meissner, Bolte & Partner**
Anwaltssozietät GbR
Postfach 86 06 24
81633 München (DE)

(54) **Method and apparatus for the integrated cleaning for use in a paper-pulp processing plant**

(57) The present invention discloses a method for the integrated cleaning of a paper-pulp processing plant including one or more high density cleaners. The method comprises the steps of supplying the rejected flow (10) from one of said high density cleaners to a screening centrifugal separator (11); screening out contaminants in the separator (11) using a screen hole size of less than 3.5 mm; and thickening any fibrous material accepted by the separator (11) and returning same to stock being processed in the processing plant. In particular, thickening of the fibrous material accepted by the separator (11) is via a two-stage process. Preferably, the first these two stages is via a gravity dewatering process (15) and the second of these stages is via a hydrostatic dewatering process (18). The invention further comprises apparatus for performing said method.



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Description

[0001] The present invention relates to a method and apparatus for the integrated cleaning of a paper-pulp processing plant used primarily, but not exclusively, for the production of corrugated paper and cardboard. The invention is particularly concerned with the cleaning of a plant used for processing paper-pulp produced from recycled paper and cardboard.

[0002] In EP2112272 is described a method and apparatus for the integrated cleaning of a paper-pulp processing plant including one or more high density cleaners wherein the rejected flow from the high density cleaner or cleaner is supplied to a screening centrifugal separator. This separator screens out contaminants using a screen hole size of less than 3.5 mm. Fibrous material accepted by the separator is returned to stock being processed in the processing plant and liquid from any material rejected by the separator is recovered prior to disposing of the rejected material.

[0003] The term 'integrated cleaning' means that the cleaning process is integrated into the pulp processing process and operates continuously as the pulp processing is in operation rather than being a separate cleaning process that is carried out during downtime of the plant.

[0004] The object of EP2112272 is to provide a method and apparatus for the integrated cleaning of a paper-pulp processing plant in order to remove or substantially reduce the quantity of pollutants, specifically anionic colloids, from the plant. The object of the present invention is similar. However, within this object the focus of the present invention is to improve the quality of the fibrous material accepted by the separator that is returned to the stock being processed in the processing plant.

[0005] According to a first aspect of the present invention there is provided a method for the integrated cleaning of a paper-pulp processing plant including one or more high density cleaners comprising the steps of

> supplying the rejected flow from one of said high density cleaners to a screening centrifugal separator;
> screening out contaminants in the separator using a screen hole size of less than 3.5 mm; and
> thickening any fibrous material accepted by the separator and returning same to stock being processed in the processing plant;
> characterized in that thickening of the fibrous material accepted by the separator is via a two-stage process.

[0006] The advantage of using a two-stage thickening process is that it improves the efficiency of the thickening process and ensures an increase in the fibre density of the accepted flow to at least 4% prior to its reintroduction into the stock. This means the stock withstands subsequent processing without a deterioration in the quality of the paper being produced. It also has another significant advantage in that, because the thickening process is more efficient, it permits the screen hole size in the separator to be reduced whereby colloidal pollutants of a smaller size than would otherwise be the case are screened out. This improves the cleaning process to the point where the paper being produced includes virtually no impurities. Although such a reduction in the screen hole size reduces the fibre density of the flow accepted by the separator, the subsequent two-stage thickening process undergone by this flow ensures that its fibre density is increased to a level such that it does not deleteriously affect the overall fibre density of the stock into which it is reintroduced.

[0007] Various combinations of thickening processes can be used in the two stages. For example, any combination of conventional gravity dewatering processes and hydrostatic dewatering processes can be used. The point of the two-stage process being that the first stage of the process reduces the liquid content and increases the fibre density of the flow to a level where the second stage of the process is capable of producing a flow with a fibre density similar to that of the stock to which it is to be reintroduced. Preferably, however, the first stage of the two stage thickening process is via a gravity dewatering process and the second stage is via a hydrostatic dewatering process. Such an arrangement is highly efficient. The gravity dewatering process is efficient in draining away large quantities of excess liquid and is therefore best used as in the first stage of the thickening process, particularly in the present case where the accepted flow has a reduced fibre content if the contaminants in the separator are screened using a small hole size. In contrast, a hydrostatic dewatering process is capable of rapid and efficient thickening provided the flow on which it operates is not too dilute.

[0008] Preferably also, therefore, the contaminants in the separator are screened using a screen hole size of approximately 1.8 mm.

[0009] According to a second aspect of the present invention there is provided a paper-pulp processing plant including one or more high density cleaners and incorporating apparatus for the integrated cleaning of same, said apparatus comprising

> a screening centrifugal separator set up to receive the rejected flow from one of said high density cleaners and adapted to screen out contaminants from the rejected flow using a screen hole size of less than 3.5 mm; and
> a first thickener for thickening fibrous material accepted by the separator; characterised in that
> a second thickener is provided for thickening the fibrous material output by the first thickener prior to return of said fibrous material to stock being processed in the processing plant.

[0010] The first and second thickeners may comprise any arrangement of inclined screw thickeners and disk thickeners, for example two of the former or of the latter,

or one of each type of thickener. Preferably, however, the first thickener comprises an inclined screw thickener and the second thickener comprises a disk thickener.

[0011] Preferably also, the screening centrifugal separator is adapted to screen out contaminants from the rejected flow using a screen hole size of approximately 1.8 mm. Further preferred but non-essential features of the various aspects of the present invention are further described in the dependent claims appended hereto.

[0012] The various aspects of the present invention will now be described by way of example with reference to the accompanying drawing which is a process diagram showing apparatus forming part of a paper-pulp processing plant for use in accordance with the present invention for the removal of pollutants from the stock.

[0013] In the present invention, the rejected flow from the final high density cleaner in a conventional pulp processing plant is subjected to a cleaning process as will now be described.

[0014] The rejected flow 10 is supplied to a screening centrifugal separator 11 that preferably comprises a conventional 'Separplast' separator that has been modified as described below. Separplast separators were designed to separate light contaminants such as plastics, polystyrene, hot melts and the like originating from recycled paper waste from stock. Conventionally, in a paper-pulp processing plant a Separplast separator is positioned after the pulper and the high density cleaner. The accepted flow is then recycled back to the pulper and the rejected flow is thickened for disposal. They are not, however, designed to remove colloidal waste.

[0015] Centrifugal separators operate by rotating a cylinder carrying rotor blades at high peripheral speed inside a perforated basket. The rotor typically has an overall diameter of 997 mm. The rejected flow enters the separator 11 at the top from a constant level box 12 which regulates the flow and is provided with an on/off valve (not shown). Within the separator 11 the flow passes down through the rotor blades and the basket where it is deflaked and screened. Lateral sprinklers spray clarified washing water onto the basket to lubricate the zone between the basket and the rotors and to prevent clogging. 'Accepted' fibrous material passes through the basket laterally along flowpath 13 while rejects are caught and, after being washed by flushing water that minimizes their fibre content, are conveyed to a strainer to separate them from the water. The rejects exit from the lower part of the separator along the flowpath 14.

[0016] In a conventional Separplast separator 11, the basket has a screen hole diameter between 3.5 and 6 mm dependent on the degree of cleaning required. However, in the present invention, the screen hole diameter of the basket is reduced to less than 3.5 mm and preferably to around 1.8 mm in order to separate out the colloidal pollutants that it is desired to catch. Reduction of the screen hole diameter can reduce flow through the basket and, therefore, regulation of the flow by the constant level box 12 and its consistency is important. Sufficient water must be provided to lubricate the zone between the basket and the rotors. This is achieved by increasing the pressure of the clarified water sprayed onto the basket from a pressure of around 1.5 bar in a conventional Separplast machine to a pressure of around 4 bar. The nozzles of the sprinklers spraying this water are also increased in size from a diameter of around 1 mm to around 2 mm. In addition, the diameter of the rotor is increased from around 997mm to around 999 mm. All of these changes have the effect of improving the output of the separator 11 by reducing clogging of the basket. In addition, the pressure of the flushing water used to wash the rejects is increased from around 2 bar in a conventional separator 11 to around 6 bar in the separator 11 of the present invention. This increased quantity of flushing water reduces to a minimum the presence of usable fibres in the rejects. All of the washing and flushing water is recovered and reintroduced into the initial pulping bath so that any usable fibres mixed with the water are reintroduced into the process and are not lost.

[0017] The overall effect of these modifications is that there is a significant increase in the quantity of water used, namely from around 250 litres per minute to around 600 litres per minute. Hence, whereas a conventional Separplast machine operates at an inlet consistency ranging between 3.5% and 5% fibre density with an accept consistency slightly lower, by around 0.2%, than inlet consistency owing to the addiction of washing water, in the modified Separplast machine of the present invention the accept consistency is of the order of 1.0% to 1.5% and the reject consistency is of the order of 0.5%.

[0018] The accepted flow passing along flowpath 13 can be reintroduced into the stock being processed in the main processing apparatus, preferably at an initial part of the cycle. However, before reintroduction it is thickened to prevent undue dilution of the stock.

[0019] The process as described so far is similar to that described in EP2112272 except that as a result of the changes to the process that will now be described the screen hole diameter of the basket in the separator 11 can be reduced to a significantly smaller size than the 2.5 mm holes described therein to the 1.8 mm holes described above so that virtually all colloidal pollutants can be removed from the stock prior to its reintroduction back into the main processing apparatus.

[0020] Thickening of the accepted flow passing along flowpath 13 is carried out using a two-stage process, one of these stages being via and the other of these stages being via a hydrostatic dewatering process. Preferably, the first stage is via a gravity dewatering apparatus in the form of an inclined screw thickener 15 which receives the accepted flow from the Separplast machine 11. Such a thickener 15 has a slow mechanical movement which drains the liquid from the fibres using gravity so that the fibres are effectively 'squeezed' together. There is, therefore, a reduction in volume of the fibrous material passing through the machine as it rises through the machine from its lower inlet to an upper outlet 16. Liquid draining from

the stock is filtered prior to egressing from the thickener 15 via a bottom outlet 17. The liquid egressing from the outlet 17 is also reintroduced into the process at the initial pulping stage.

[0021] As in EP2112272, the screw thickener 15 is also modified to increase the quantity of fine usable fibres in the accepted flow that would otherwise be lost in the liquid draining from the fibrous material rising through the thickener 15. These modifications involve altering the filters which are used to filter the liquid egressing from the outlet 17 so that the size of the filter holes is reduced from a diameter of 2.0 mm to a diameter of 1.25 mm. In addition, the speed of rotation of the screw within the thickener 15 is reduced by approximately 20% over the speed in a conventional screw thickener of this type. This reduces the fibre content of the filtered liquid egressing from the outlet 17 from approximately 600 parts per million to around 200 parts per million.

[0022] The flow issuing from the upper outlet 16 is then subjected to a second thickening stage, preferably via hydrostatic dewatering apparatus in the form of a disk thickening apparatus 18. The advantage of such an apparatus 18 is that it combines a large filter surface with a relatively small volume and is capable of achieving rapid thickening of a fiber suspension by raising the dry solids content up to between 4 % and 5% inclusive, which is a high capacity. In such an apparatus, a plurality of rotatable filter disks 19 is mounted on a rotor 20 and axially spaced. The disks 19 are adapted to be partially submerged in the flow to be thickened, which is retained in a sump 21 beneath the rotor 20. Each filter disk 19 includes a plurality of filter sections (not shown) communicating with filtrate discharge ducts (not shown) located at the periphery of the disks 19. Through the central opening of the filter disks extends a collecting trough 22 for solid material which is deposited on the filter sections during thickening and is caused to fall into the trough 22. Typically, spray and/or jet means (not shown) are provided to cause the material to fall into the trough 22 and to washing particulate material off the filter sections. Hence, the apparatus operates via a hydrostatic dewatering process wherein the disks pass through a static sump of the liquor to be thickened. The thickened flow collected in the trough 22 runs out of the apparatus 18 and is then reintroduced into the stock being processed in the main processing plant via a screening bath 23.

[0023] The rejects in the flowpath 14 may also be treated to separate them from the liquid with which they are mixed on egress from the Separplast 11. This can take place substantially as described in EP2112272 with the material in the flowpath 14 being fed to a second inclined screw thickener 24 and thence to a compactor press 25. The output from the compactor press 25 is collected in a bin 26, the contents of which can then be directly disposed of by either dumping or incineration.

[0024] The improvements described herein to the method and apparatus of EP2112272 enables virtually all pollutants, especially colloidal pollutants, to be removed from the plant thereby improving the quality of the paper being produced. Also, the fact that the stock being used is not diluted when the flow is reintroduced into it from the screening bath 23 enables the plant to be used to make paper with superior characteristics as such stock can withstand the processes used in such paper production.

Claims

1. A method for the integrated cleaning of a paper-pulp processing plant including one or more high density cleaners comprising the steps of
supplying the rejected flow (10) from one of said high density cleaners to a screening centrifugal separator (11);
screening out contaminants in the separator (11) using a screen hole size of less than 3.5 mm; and
thickening any fibrous material accepted by the separator (11) and returning same to stock being processed in the processing plant;
characterized in that
thickening of the fibrous material accepted by the separator (11) is via a two-stage process (15, 18).

2. A method as claimed in Claim 1, **characterised in that** one stage of said two-stage process is via a hydrostatic dewatering process (18)

3. A method as claimed in Claim 1 or Claim 2, **characterised in that** one stage of the two-stage process is via a gravity dewatering process (15).

4. A method as claimed in any of Claims 1 to 3, **characterised in that** the first stage of the two stage thickening process is via a gravity dewatering process (15) and the second stage is via a hydrostatic dewatering process (18).

5. A method as claimed in any of Claims 1 to 4, **characterised in that** the dry solids content of the fibrous material accepted by the separator (11) is raised up to between 4% and 5% inclusive by the two-stage thickening process.

6. A method as claimed in any of Claims 1 to 5, **characterised in that** the contaminants in the separator (11) are screened using a screen hole size of approximately 1.8 mm.

7. A method as claimed in any of Clams 1 to 6, comprising the additional step of recovering liquid (B) from any material (A) rejected by the separator (11) prior to disposing of said material.

8. A paper-pulp processing plant including one or more high density cleaners and incorporating apparatus

for the integrated cleaning of same, said apparatus comprising
a screening centrifugal separator (11) set up to receive the rejected flow (10) from one of said high density cleaners and adapted to screen out contaminants from the rejected flow using a screen hole size of less than 3.5 mm;
a first thickener (15, 18) for thickening fibrous material accepted by the separator (11);
characterised in that
a second thickener (18, 15) is provided for thickening the fibrous material output by the first thickener prior to return of said fibrous material to stock being processed in the processing plant.

9. A plant as claimed in Claim 8, **characterised in that** the either first thickener or the second thickener comprises a disk thickener (18)

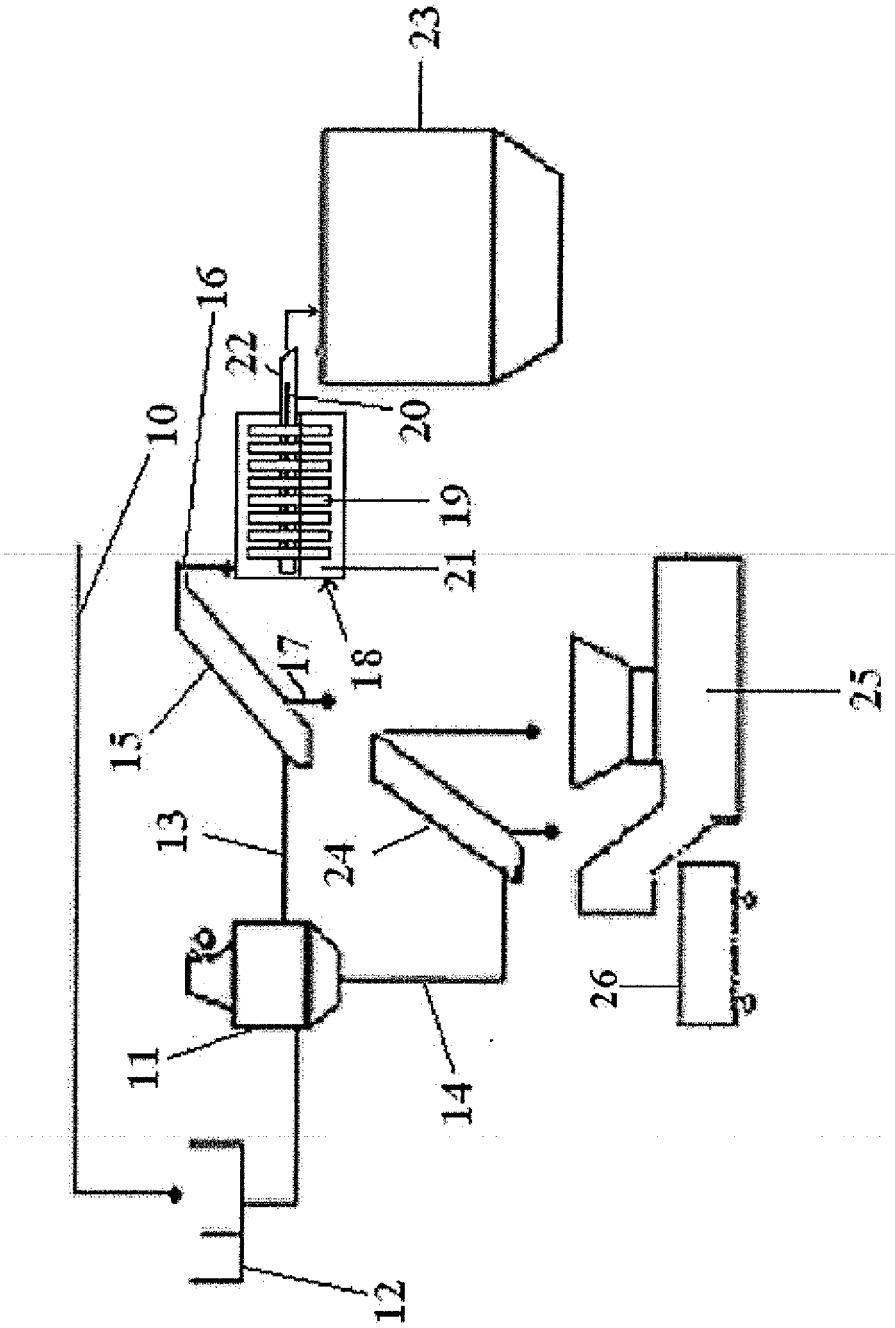
10. A plant as claimed in Claim 8 or Claim 9, **characterised in that** the first thickener or the second thickener comprises an inclined screw thickener (15).

11. A plant as claimed in any of Claims 8 to 10, **characterised in that** the first thickener comprises an inclined screw thickener (15) and the second thickener comprises a disk thickener (18).

12. A plant as claimed in Claim 10 or Claim 11, **characterised in that** the inclined screw thickener (15) comprises liquid filtering holes with a diameter less than 2.00 mm.

13. A plant as claimed in any of Claims 8 to 12, **characterised in that** the screening centrifugal separator (11) is adapted to screen out contaminants from the rejected flow using a screen hole size of approximately 1.8 mm.

14. A plant as claimed in any of Claims 8 to 13, **characterised in that** it comprises means for recovering liquid (B) from any material (A) rejected by the separator (11) prior to disposal of said material.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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 4207

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	EP 2 112 272 A1 (IND TECHNOLOGY & SERVICES LLC [US]) 28 October 2009 (2009-10-28) * abstract * * paragraph [0018] - paragraph [0019] * * figures * -----	1-14	INV. D21D5/02 D21D5/24 D21F1/74
Y	DE 10 2008 008762 A1 (VOITH PATENT GMBH [DE]) 13 August 2009 (2009-08-13) * paragraphs [0006], [0008], [0012] * -----	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

D21D
D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 July 2010	Pregetter, Mario

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 15 4207

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02-07-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2112272 A1	28-10-2009	US 2009272504 A1	05-11-2009
DE 102008008762 A1	13-08-2009	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2112272 A **[0002] [0004] [0019] [0021] [0023] [0024]**