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Gehr et al.

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(54) **METHOD FOR THE CARRYING OUT OF A FLOTATION, BLEACH AND/OR DISPERSION PROCESS SERVING FOR THE MANUFACTURE OF FIBER OR PAPER**

(76) Inventors: **Volker Gehr**, Baienfurt (DE); **Boris Reinholdt**, Waldburg (DE); **Harald Hess**, Grunkraut (DE); **Falk Albrecht**, Bad Wurzach (DE); **Herbert Britz**, Weingarten (DE); **Martin Kemper**, Weingarten (DE)

Correspondence Address:
skjerven morrillo macpherson LLP
Suite 700
25 Metro Drive
San Jose, CA 95110 (US)

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(57) **ABSTRACT**

In a method for the carrying out of a flotation, bleach and/or dispersion process serving for the manufacture of fiber or paper while using one or more method stages in which process steps defined by pre-settable chemical and physical routines are carried out and process optimizations are made in dependence on measured values and characteristic values formed therefrom, optionally while using state models, at least the measured values of at least one method stage, which relevantly affect the target values of the respective end product of the method, are detected online and/or the characteristic values determined from the measured values of at least one method stage are evaluated online and used directly or indirectly for the control or optimization of at least one process, with characteristic values being formed in dependence on the starting materials or raw materials and/or on the chemicals, auxiliary materials, energies and/or materials and emissions to be disposed of, which are added in at least one method stage.

**METHOD FOR THE CARRYING OUT OF A
FLOTATION, BLEACH AND/OR DISPERSION
PROCESS SERVING FOR THE MANUFACTURE
OF FIBER OR PAPER**

[0001] The invention relates to a method for the carrying out of a flotation, bleach and/or dispersion process serving for the manufacture of fiber or paper while using one or more method stages in which process steps defined by pre-settable chemical and physical routines are carried out and process optimizations are made in dependence on measured values and characteristic value formed therefrom, optionally while using state models.

[0002] In the manufacture of fiber or paper, the accepted stock, that is the pulp suspension, is separated from the reject, which is flotation foam which as a rule still contains small parts of the pulp suspension, by a respective flotation process. One or more so-called flotation cells can, for example, be used here and serve in particular for the removal of contaminants, in particular printing ink particles, from paper pulp suspensions, in particular suspensions of waste paper. Further typical contaminants are, for example, stickies (particularly sticky substances). In another known flotation method, microflotation, for example, filling materials and grain particles are regained from paper or cardboard machine sieve filtrates. In so-called de-inking flotation, printing inks and other hydrophobic (water-repelling) particles such as adhesive are removed from the waste paper suspension with the aid of air bubbles and suitable process chemicals.

[0003] Flotation is as a rule characterized by the fact that air and possible aids (e.g. soaps, surfactants) are added to the suspension and the air bubbles are given the opportunity to rise to the top in a reaction vessel with the adhering contaminants.

[0004] In the flotation of foams (primary overflows), the overflow rate can amount to up to 80% due to a high content of printing ink and ash. The overflow rate for suspensions also depends in particular on the respective portion of oil-based printing inks in addition to the ash content of the respective suspension, with suspensions with a high portion of oil-based printing inks resulting in particular with newspaper and magazine paper and such with a low portion of oil-based printing inks in particular in laser printing and office waste.

[0005] The parameters of influences which affect the flotation process can be divided into parameters which are based on the raw material and which cannot be influenced such as the kind of ink particle, ash content, etc. and into parameters which can be influenced by a technical process in the flotation such as reject volume, air content, bubble size, chemicals, etc.

[0006] It has been usual up to now to determine expedient values for these parameters by trials and then to maintain these until further notice. For instance, in particular the following rule strategies are usually used in the current flotation plants:

[0007] maintenance of a constant cell level, with a level or pressure transmitter in the cell influencing a control variable for the accepted stock flap of the flotation plant;

[0008] maintenance of a constant level in the foam pipe or in the foam channel, with a level or pressure transmitter in the foam channel or the foam pipe influencing a control variable for the accepted stock flap of the flotation plant;

[0009] maintenance of a constant level in the foam tank, with a level or pressure transmitter in the foam tank influencing a control variable for the accepted stock flap of the flotation plant;

[0010] maintenance of a constant difference between the inflow and the accepted stock volume flow, with the difference between the values obtained with an inductive flowmeter for the inflow or the flow respectively influencing a control variable for the accepted stock flap of the flotation plant.

[0011] In the latter case, it is therefore only provided—starting from a constant flow—that once a split is determined into the two fractions of accepted stock and reject, this is maintained, that is a pre-set volume flow is withdrawn as the reject.

[0012] While such a flow regulation may be easy to carry out, it does leave the fluctuations which occur in practice out of consideration. With fluctuating raw materials, fluctuating volume inflows and/or fluctuating inflow consistencies, however, both the solid material loss and the quality of the accepted stock now change.

[0013] There is therefore a general need with respect to an optimum regulation, in particular of a flotation plant, for the maintenance of a constant quality (e.g. whiteness, brightness, specks of contaminant or ash content), the maintenance of a constant solid material loss and/or a minimization of the operating costs with a constant quality (for example by modifying the soap dosage and the solid material loss).

[0014] As regards in particular the regulation via flotation, bleach(es) and dispersion, the individual process steps, that is for example flotation, dispersion and bleaches, have previously been adjusted manually in an old stock treatment for optimization, with every process stage previously having been observed individually under the aspects of a mass optimization for the optimization. A corresponding optimization comprises, for example, the adjustment of a certain nominal whiteness or a certain loss amount (yield). A combination of a plurality of target values has, as a rule, not yet existed. It is in particular not available at present when a plurality of process steps running successively are present within one stock preparation.

[0015] There is therefore in particular also a need for an optimized regulation of a corresponding process module combination.

[0016] It is therefore generally the underlying object of the invention to provide an improved method of the kind initially mentioned with which the above-mentioned problems can be eliminated and the goals addressed achieved.

[0017] In accordance with a first aspect of the invention, this object is satisfied in that at least the measured values of at least one method stage, which relevantly affect the target values of the respective end product of the method, are detected online and/or in that the characteristic values determined from the measured values of at least one method stage are evaluated online and used directly or indirectly for the

control or optimization of at least one process, with characteristic values being formed in dependence on the starting material or raw materials and/or on the chemicals, auxiliary materials, energies and/or materials and emissions to be disposed of, which are added in at least one method stage.

[0018] Such a method can be used advantageously in particular in the regulation of a flotation plant, whereby this can be accordingly optimized in particular with respect to the maintenance of a constant quality (e.g. whiteness, brightness, specks of contaminant or ash content), the maintenance of a constant solid material loss and/or a minimization of operating costs with constant quality (e.g. by modification of the soap dosage and the solid material loss).

[0019] The determination of the characteristic values from the online measured values can in particular be carried out using mathematical or economic algorithms.

[0020] It is also of advantage, in particular in the carrying out of a flotation process, for values specific to the raw materials to be detected for the determination of at least some of the measured values and characteristic values.

[0021] In accordance with an expedient embodiment of the method of the invention, which can be in particular be used in the carrying out of a flotation process, at least one of the following values is preferably detected for the determination of at least some of the measured values and characteristic values: measurable parameters such as ash content, consistency, optical properties, specks of contaminant, printing ink residues, pH values, temperatures, flows, currents, powers, filling levels, use of auxiliary materials and/or stickies in the inflow, accepted stock and/or reject and/or values (characteristic values) calculated from the measurable parameters such as whiteness increase, reaction or throughflow times, specific work, solid material loss and/or ash loss and/or economic values such as cost of chemicals, of auxiliary materials, of water, of raw materials, of energy, of loss and/or of waste disposal which put the technological and economic values into relationship.

[0022] The values considered in the regulation can thus, for example, be divided up into four categories: technological, measurable parameters, technological characteristic values determined with the aid of calculation operations from the technological measured values, economic characteristic figures, which can, for example, be expressed in "DM of chemicals per point of whiteness gain".

[0023] In particular the maximization, minimization and/or maintaining constant of the production volumes, of the mechanical and/or optical properties and/or of the costs of the operating materials, raw materials and/or finished materials can be pre-set as the target values.

[0024] It is also of advantage, in particular when carrying out a flotation process for preferably at least one of the following parameters to be pre-set as the target values: constant quality of the respective end product of the method, constant solid material loss and/or minimum operating costs, in particular with a constant quality.

[0025] In accordance with a further embodiment, which can in particular again advantageously be used for the control or optimization of the flotation process, preferably at least one of the following process parameters is appropriately influenced: air content of the paper pulp suspension in

at least one method stage, in particular in a primary stage and/or in a secondary stage, bubble size, chemicals and/or the like.

[0026] It is also of advantage if in particular fluctuations due to the raw material in the characteristic values relevantly affecting the target values of the respective end product of the method are at least substantially compensated by a corresponding modification of at least one process parameter, with it being expedient if, in particular for the control or optimization of at least one process by appropriately influencing a plurality of process parameters, at least some of the characteristic values is evaluated or weighted and if the respective influencing of the process parameters takes place in dependence on the evaluated or weighted characteristic values.

[0027] In addition to the flotation process, the bleach and the dispersion process were also initially named for example.

[0028] In accordance with a further aspect of the invention, at least two method stages and/or at least two processes can be combined with one another and be put together to form a respective jointly controlled and jointly optimized module.

[0029] In particular an optimum regulation of a process module combination is also possible with such an embodiment.

[0030] In particular in the case of such a commonly controlled and commonly optimized module, a compressed or reduced number of characteristic values formed in a respective module can expediently be used for the control of one or more processes.

[0031] In accordance with a preferred practical embodiment of the method of the invention, at least some of the target and characteristic values are transformed to a uniform base by means of a computing unit. In particular the price per unit quantity can be selected as the uniform base.

[0032] In particular in the event of combined method stages and/or combined processes, preferably at least one of the following parameters is pre-set as the target values: constant optical properties (e.g. whiteness), constant ash quantity, minimum and/or constant specks of contaminant, minimum losses, minimum use of chemicals and/or minimum energy input.

[0033] At least some of the target values is advantageously weighted prior to their use for the control and optimization of the process(es), with it being of advantage if the weighting takes place via an evaluation in accordance with cost aspects and/or via the carrying out of a cost optimization.

[0034] In accordance with an advantageous embodiment of the method of the invention which can again be used in particular with combined method stages and/or combined processes, preferably at least one of the following values is detected for the determination of at least some of the measured values and characteristic values: consistencies, ash concentrations, filling levels, overflow quantities, residual amounts of printing ink, residual amounts of peroxide, temperatures, pH values, dispersing work, fiber dimensions, chemical doses, dwell times, optical properties, mechanical properties.

[0035] An electronic control and/or regulation device is preferably used to carry out the process. Such a control and/or regulation device then has the software required for the relevant process optimization.

[0036] The respectively verified technological process know how is expediently integrated into the control or regulation device.

[0037] In particular a cost optimization is preferably repeatedly carried out by means of the control and regulation device while taking the respective technological know-how into account. The relevant cycle time can lie, for example, in an order of magnitude of some seconds, for example in a range from around 3 to around 10 seconds. However, other cycle times are also possible depending on the respective circumstances.

[0038] In accordance with an expedient practical embodiment, the determination of at least some of the measured values and characteristic values is carried out via at least one sensor, in particular at least one sensor for the measurement of whiteness, online contamination, consistency, flow and/or level.

[0039] The invention is explained in more detail in the following with reference to embodiments.

[0040] A one-stage laboratory flotation cell of the kind described above can respectively be used, for example, as a trial machine for the optimization of the regulation of a flotation plant.

1st example

[0041] Raw material: 100% newspaper/magazine with 12% ash content (predominantly non-flammable paper filling materials).

[0042] The material is treated in a flotation cell such that the whiteness potential present is economically utilized, with a whiteness of, for example, 56% ISO resulting. For this purpose, as appropriate trials have shown, a foam overflow of, for example, around 8% has to be set, with this value being given in relation to the solid material, that is in "% oven dry". If the ash content of the raw material changes to 20%, for example by more magazines containing filling materials, then the overflow must be increased, for example, to 13% oven dry.

[0043] If, therefore, how the overflow quantity must be adjusted as a result of the ash content is stored in a process model, this adjustment can be constantly ideally matched to the raw material.

2nd example

[0044] Raw material: office waste.

[0045] The raw material should likewise again have an ash content of, for example, 12%. This can, however, reach the technically meaningful whiteness with an overflow, for example, of just 5% oven dry due to the different printing ink composition. As a consequence of the better, more expensive raw material, this is even higher at 72% ISO. If the ash content of the raw material changes to, for example, 20%, then the overflow is regulated to, for example, 8% oven dry.

[0046] The appropriate principle according to which fluctuations due to raw material are compensated by parameter

changes would, for example, also be able to be carried out with the other, previously named influencing values, with generally also any combinations of these influencing values being possible. In a combination, the individual target values, for example the demanded whiteness, low cost of chemicals, lowering of other process costs and/or the like, would expediently have to be evaluated.

[0047] Some embodiments are described in the following in particular for an optimum regulation of a process module combination, with the individual process steps being, for example, a flotation, dispersion and bleach(es), for example in waste paper treatment.

[0048] To achieve the relevant goals, the respective parameters can be converted in particular to a uniform base (cost per quantity). The goals to be achieved can, for example, be the following:

- [0049] constant optical properties (e.g. whiteness)
- [0050] constant ash content
- [0051] minimum and/or constant specks of contaminant
- [0052] minimum losses
- [0053] minimum use of chemicals
- [0054] minimum energy input.

[0055] A weighting of the targets is carried out, for example, via the evaluation in accordance with cost aspects and via the carrying out of a cost optimization.

[0056] For example, the know-how described further below can be verified in the relevant plant and integrated in the regulation, with the regulation constantly carrying out a cost optimization taking the technological know-how into account, for example according to a cycle time of around 3 up to around 10 seconds.

[0057] The detection of the individual parameters can take place using commercial sensors (e.g. sensors for the measurement of whiteness, online-specks of contaminant, consistency, flow and/or level) and/or in combination with special sensors or sensors to be newly developed.

[0058] With respect to the losses, raw material costs per quantity and waste disposal costs per quantity can be given, for example. Defined costs per quantity result therefrom for each percentage point. An as a rule nonlinear dependence of losses on whiteness limited in its variation results for the flotation.

[0059] The further possible machines include, for example, washers.

[0060] Costs for hydrogen peroxide, caustic soda, water glass and/or the like have to be taken into account, for example, in the costs for the relevant bleaching chemicals. The respective loss costs can in turn be determined from the respective costs per quantity and the relevant loss percentage points. The same also applies, for example, in connection with any sodium dithionite used.

[0061] The gain in whiteness in the individual bleaching stages is not proportional to the bleaching chemical quantities used. The bleaching potential of fibers is limited. Printing inks and ash (anorganic constituents) cannot be bleached. These rather maintain a certain graying level.

[0062] If one considers, for example, the dispersing energy and if one assumes, for example, a circulation temperature of 45° C. and a dispersion temperature of 80° C., then the temperature in the heating coil must be increased by, for example, 35° C. For this purpose, for example with 25% consistency (dependent on consistency!), around 0.3 tonnes of saturated steam are, for example, consumed per tonne of pulp. Starting from the respective saturated steam costs per quantity, the specific saturated steam costs then result for the saturated steam consumption present.

[0063] The specific energy of the dispersion amounts, for example, to around 80 kWh/t. The relevant costs per quantity result from the respective kWh price. The more specific energy is used in the dispersion, the smaller (less visible) the specks of contaminant become. If, however, a lot of specks of contaminant are present in the inflow, then the graying (whiteness loss) is also stronger. It is also possible that these particles are not removed at high printing ink concentrations, but are rubbed even deeper into the pulp.

[0064] The possible parameters include, for example, the following:

- [0065] consistency
- [0066] ash concentration
- [0067] filling levels
- [0068] overflow quantities
- [0069] residual amounts of printing ink
- [0070] residual amounts of peroxide
- [0071] pH values
- [0072] dispersing work
- [0073] fiber dimensions
- [0074] chemical doses
- [0075] dwell times
- [0076] optical properties
- [0077] mechanical properties

1st EXAMPLE

[0078] A respective comparison for a raw material is made here.

[0079] The flotation 1 is run with different losses, whereby a larger loss of whiteness results in the dispersing means in the event of low losses since more printing inks are present. The subsequent bleach results in both cases in the same increase in whiteness. More losses are naturally run in the flotation 2 from the material which was run with a higher yield in flotation 1. Nevertheless, not all printing inks can be removed since the dispersing means has kneaded these into the material in part. The whiteness deficit can only be compensated by an additional reductive bleach.

2nd EXAMPLE

[0080] Two different raw materials are compared here.

[0081] Although the flotation 1 works with the same losses, the difference in whiteness is maintained. The more printing inks in the dispersing means results in a clear loss of whiteness. Double the quantity of bleaching chemicals is

therefore dosed in the bleach 1. A further matching takes place in the flotation 2. The reductive bleach is omitted since the points of whiteness reached here are not necessary in order to achieve the target whiteness and are more difficult to achieve cost-wise than with the oxidative bleach.

1. A method for the carrying out of a flotation, bleach and/or dispersion process serving for the manufacture of fiber or paper while using one or more method stages in which process steps defined by pre-settable chemical and physical routines are carried out and process optimizations are made in dependence on measured values and characteristic values formed therefrom, optionally while using state models, characterized in that at least the measured values of at least one method stage, which relevantly affect the target values of the respective end product of the method, are detected online; and/or in that the characteristic values determined from the measured values of at least one method stage are evaluated online and used directly or indirectly for the control or optimization of at least one process, with characteristic values being formed in dependence on the starting materials or raw materials and/or from the chemicals, auxiliary materials, energies and/or materials and emissions to be disposed of, which are added in at least one method stage.

2. A method in accordance with claim 1, characterized in that the determination of the characteristic values from the online measured values is carried out using mathematical or economic algorithms.

3. A method in accordance with claim 1, characterized in that, in particular when carrying out a flotation process, values specific to the raw material are detected for the determination of at least some of the measured values and characteristic values.

4. A method in accordance with claim 1, characterized in that, in particular when carrying out a flotation process, at least one of the following values is preferably detected for the determination of at least some of the measured values and characteristic values: measurable parameters such as ash content, consistency, optical properties, specks of contaminant, printing ink residues, pH values, temperatures, flows, currents, powers, filling levels, use of auxiliary materials and/or stickies in the inflow, accepted stock and/or reject and/or values (characteristic values) calculated from the measurable parameters such as whiteness increase, reaction or throughflow times, specific work, solid material loss and/or ash loss and/or economic values such as cost of chemicals, of auxiliary materials, of water, of raw materials, of energy, of loss and/or of waste disposal which put the technological and economic values into relationship.

5. A method in accordance with claim 1, characterized in that the maximization, minimization and/or maintaining constant of the production volumes, of the mechanical and/or optical properties and/or of the costs of the operating materials, raw materials and/or finished materials can be pre-set as the target values.

6. A method in accordance with claim 1, characterized in that, in particular when carrying out a flotation process, preferably at least one of the following values is pre-set as the target values: constant quality of the respective end product of the method, constant solid material loss and/or minimum operating costs, in particular with a constant quality.

7. A method in accordance with claim 1, characterized in that, in particular for the control or optimization of the

flotation process, preferably at least one of the following process parameters is appropriately influenced: air content of the paper pulp suspension in at least one method stage, in particular in a primary stage and/or in a secondary stage, overflow volume flow in at least one method stage, in particular in a primary stage and/or in a secondary stage, bubble size, chemicals and/or the like.

8. A method in accordance with claim 1, characterized in that in particular fluctuations due to the raw material in the characteristics values relevantly affecting the target values of the respective end product of the method are at least substantially compensated by an appropriate modification of at least one process parameters

9. A method in accordance with claim 8, characterized in that, in particular for the control or optimization of at least one process by appropriately influencing a plurality of process parameters, at least some of the characteristic values are evaluated or weighted and the respective influencing of the process parameters takes place in dependence on the evaluated or weighted characteristic values.

10. A method in accordance with claim 1, characterized in that at least two method stages and/or at least two processes are combined with one another and put together to form a respective jointly controlled and jointly optimized module.

11. A method in accordance with claim 10, characterized in that a compressed or reduced number of characteristic values formed in a respective module is used for the control of one or more processes.

12. A method in accordance with claim 1, characterized in that at least some of the target and characteristic values are transformed to a uniform base by means of a computing unit.

13. A method in accordance with claim 12, characterized in that the price per unit quantity is selected as the uniform base.

14. A method in accordance with claim 1, characterized in that, in particular with combined method stages and/or combined processes, preferably at least one of the following parameters is preset as the target values: constant optical

properties, constant ash quantity, minimum and/or constant specks of contaminant, minimum losses, minimum use of chemicals and/or minimum energy input.

15. A method in accordance with claim 1, characterized in that at least some of the target values is weighted prior to their use for the control and optimization of the process(es).

16. A method in accordance with claim 15, characterized in that the weighting takes place via an evaluation in accordance with cost aspects and/or via the carrying out of a cost optimization.

17. A method in accordance with claim 1, characterized in that in particular with combined method stages and/or combined processes, preferably at least one of the following values is used for the determination of at least some of the measured values and characteristic values: consistencies, ash concentrations, filling levels, overflow quantities, residual amounts of printing ink, residual amounts of peroxide, temperatures, pH values, dispersing work, fiber dimensions, chemical doses, dwell times, optical properties, mechanical properties.

18. A method in accordance with claim 1, characterized in that an electronic control and/or regulation device is used to carry out the process.

19. A method in accordance with claim 1, characterized in that the respectively verified technological process know how is integrated into the control or regulation device.

20. A method in accordance with claim 1, characterized in that in particular a cost optimization is repeatedly carried out by means of the control and regulation device while taking the respective technological know-how into account.

21. A method in accordance with claim 1, characterized in that the determination of at least some of the measured values and characteristic values is carried out via at least one sensor, in particular at least one sensor for the measurement of whiteness, online contamination, consistency, flow and/or level.

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