(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 020 862 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.05.2016 Bulletin 2016/20

(21) Application number: **14822321.7**

(22) Date of filing: **09.07.2014**

(51) Int Cl.:
D21H 21/04 $^{(2006.01)}$ ***D21H 21/02*** $^{(2006.01)}$

(86) International application number:
PCT/JP2014/068365

(87) International publication number:
WO 2015/005404 (15.01.2015 Gazette 2015/02)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **09.07.2013 JP 2013144051**
09.07.2013 JP 2013144052

(71) Applicant: **Kurita Water Industries Ltd.**
Nakano-ku, Tokyo 164-0001 (JP)

(72) Inventors:
- **KATSURA, Hiroki**
Tokyo 164-0001 (JP)
- **OGASAHARA, Hirotaka**
Tokyo 164-0001 (JP)
- **NINOMIYA, Seikichi**
Shikokuchuo-shi
Ehime 799-0402 (JP)
- **YAMAMOTO, Hiroaki**
Shikokuchuo-shi
Ehime 799-0402 (JP)

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

(54) SLIME CONTROL METHOD

(57) An efficient slime control method in a white water circulation line in a paper making process is provided. The present slime control method in a white water circulation line in a paper making process including the steps of: aerating with an oxygen-containing gas either one or both of a white water circulation line and the water feeding line for feeding water into the white water circulation line; and adding a slime control agent to at least one line of the white water circulation line and the water feeding line aerated with the oxygen-containing gas in the aerating step. Preferably, the step of measuring at least one selected from the group of measurement items consisting of the oxidation reduction potential, the sulfite ion concentration and the amount of dissolved oxygen in the white water circulation line is further included. Based on the measurement result obtained in the measurement step, the aeration rate in the aerating step and/or the amount of the slime control agent added in the adding step of the slime control agent may be regulated.

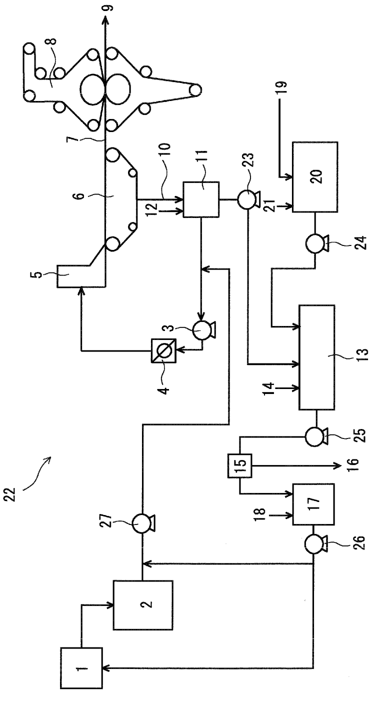


FIG. 1

EP 3 020 862 A1

Printed by Jouve, 75001 PARIS (FR)

Description

[TECHNICAL FIELD]

[0001] The present invention relates to a slime control method in a white water circulation line in a paper making process.

[BACKGROUND ART]

[0002] At present, paper is manufactured by paper making from a material slurry prepared by dispersing a pulp material in water. In this process, a large amount of a white water containing fine fibers and a filler is discharged from paper making machinery and the like. Although the white water has been used through circulation in the paper making process in light of effective utilization and recycling of water resources, the white water contains organic substances such as starch, sizing agents, latex and casein in a large amount; therefore, a condition suited for propagation of microorganisms such as bacteria and fungi can be provided. Thus, slime derived from the microorganisms is likely to be generated in a circulating water line, as well as on the surface of pipings and the equipment surface. Through contamination in the product, the slime leads to the deterioration of the quality of the product, and the production efficiency. Since the aforementioned fine fibers, starch and the like are concentrated in the white water circulation line during the operation, a part of the white water is discarded while fresh water is introduced thereinto. However, it is impossible to satisfactorily cope with the disadvantageous aspects described above by way of such an exchange of the white water.

[0003] In order to solve the problems as described above, an antimicrobial method was developed in which a slime control agent such as an organic antimicrobial agent is added to the white water circulation line (see Japanese Unexamined Patent Application, Publication No. 2003-164882). However, upon decay of the organic substances, the number of microorganism cells increases, and reductive substances such as hydrogen sulfide and mercaptan are generated in a large amount. On the other hand, since many of the slime control agents are oxidizing agents, these may react with sulfite ions derived from reductive substances prior to reacting with microorganisms, thereby leading to the consumption of a large quantity thereof is consumed before achieving a desired antimicrobial effect. Therefore, in order to sufficiently control the generation of slime, adding a large amount of the slime control agent including the amount of the slime control agent consumed by the reaction with the sulfite ions is required. In addition, the slime control agent is also comparatively expensive, and thus providing a more efficient slime control method, and a reduction in the amount thereof used have been desired.

[PRIOR ART DOCUMENTS]

[PATENT DOCUMENTS]

[0004] Patent Document 1: Japanese Unexamined Patent Application, Publication No. 2003-164882

[SUMMARY OF THE INVENTION]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

[0005] The present invention was made in view of the foregoing disadvantages, and an object of the invention is to provide an efficient slime control method in a white water circulation line in a paper making process.

[MEANS FOR SOLVING THE PROBLEMS]

[0006] In order to solve the foregoing problems, the present inventors have thoroughly investigated, and consequently found that the generation of slime can be efficiently controlled by: aerating a white water circulation line or a water feeding line for feeding water into the white water circulation line (hereinafter, may be also referred to as "water feeding line" or merely "water line") with an oxygen-containing gas; and then adding a slime control agent to the white water circulation line or the water feeding line aerated with the oxygen-containing gas. Accordingly, the present invention was accomplished.

[0007] According to an aspect of the invention made for solving the aforementioned problems, a slime control method in a white water circulation line in a paper making process includes the steps of: aerating with an oxygen-containing gas either one or both of the white water circulation line and the water feeding line for feeding water into the white water circulation line; and adding a slime control agent to at least one line of the white water circulation line and the water feeding line aerated with the oxygen-containing gas in the aerating step.

[0008] Through aerating with an oxygen-containing gas either one or both of a white water circulation line and a water feeding line for feeding water into the white water circulation line in the aerating step, the slime control method enables a significant decrease to be attained in the amount of the slime control agent added to the line aerated with the oxygen-containing gas. The basis for the advantage is presumed to result from lowering of the sulfite ion concentration in the white water circulation line, and the like, through oxidization of reductive substances by oxygen in the oxygen-containing gas, and a decrease in the solubility of the reductive substances such as hydrogen sulfide, which would result from dissolution of a large amount of the oxygen-containing gas in the white water circulation line.

[0009] It is preferred that the slime control method further includes the step of measuring at least one selected from the group of measurement items consisting of the oxidation reduction potential, the sulfite ion concentration and the amount of dissolved oxygen in the white water circulation line, and that the aeration rate in the aerating step and/or the amount of the slime control agent added in the adding step of the slime control agent is/are regulated, based on the measurement results obtained in the measurement step. By regulating the aeration rate and/or the amount of the slime control agent added, the generation of the slime can be controlled in a safer and more accurate manner.

[0010] It is preferred that the aeration rate in the aerating step and/or the amount of the slime control agent added in the adding step of the slime control agent are/is regulated such that in the white water circulation line: the oxidation reduction potential is no less than -150 mV; the sulfite ion concentration is no greater than 2.0 mg SO_3^-/L; and/or the amount of dissolved oxygen is no less than 1 mg/L. The generation of the slime can be more effectively controlled by such an adjustment.

[0011] It is preferred that an aeration tank having a diffuser tube on the bottom thereof is used for the aerating in the aerating step, and that the aeration rate by the diffuser tube with respect to 1 m^2 of the unit bottom area of the aeration tank is no less than 0.5 m^3/hour and no greater than 10 m^3/hour. By thus adjusting the aeration rate, the decrease in the amount of the slime control agent can be further facilitated.

[EFFECTS OF THE INVENTION]

[0012] According to the present invention, an efficient slime control method in a white water circulation line in a paper making process can be provided. In addition, a decrease in the amount of the slime control agent used is also enabled.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0013] FIG. 1 shows a view illustrating one embodiment of the paper making process according to the present invention.

[DESCRIPTION OF EMBODIMENTS]

Slime Control Method

[0014] The slime control method is a slime control method in a white water circulation line in a paper making process, the method including the steps of: aerating with an oxygen-containing gas either one or both of the white water circulation line and a water feeding line for feeding water into the white water circulation line; and adding a slime control agent to at least one line of the white water from the circulation line and the water feeding line aerated with the oxygen-containing gas in the aerating step.

[0015] In addition, it is preferred that the slime control method further includes the step of measuring at least one selected from the group of measurement items consisting of the oxidation reduction potential, the sulfite ion concentration and the amount of dissolved oxygen in the white water circulation line.

[0016] Hereinafter, the slime control method will be described in detail.

White Water Circulation Line

[0017] The slime control method is used in the white water circulation line in the paper making process. As referred to herein, the term "white water" means an aqueous solution discharged in a large amount from paper making machinery and the like in a paper making process for paper manufacture. The white water contains: fine fibers derived from a raw material pulp generally employed in paper making; other agent for paper manufacture; and the like. The term "white water circulation line" as referred to means the stream line of the white water used through circulation in a paper making process. The term "water feeding line for feeding water into the white water circulation line" as referred to means a water line for use in adjusting the concentration and the like of the pulp slurry and/or the white water in the white water circulation line. Although the water line is not particularly limited, for example, soft water, hard water and the like for use in paper manufacture may be involved, and also a small amount of any agent for paper manufacture may be contained within a range not leading to impairment of the effects of the present invention. In addition, the white water circulation line may pass via a solid-liquid separator, and the separated solid content may be either discharged out from the line, or recovered into the material system.

[0018] The raw material pulp used for the paper making is not particularly limited, and is exemplified by chemical pulps such as a hardwood (Laubholz) bleached Kraft pulp (LBKP), a softwood (Nadelholz) bleached Kraft pulp (NBKP), a Laubholz unbleached Kraft pulp (LUKP) and a Nadelholz unbleached Kraft pulp (NUKP), mechanical wood pulps such as a ground pulp (GP), a thermomechanical wood pulp (TMP), a chemithermomechanical wood pulp (CTMP) and a refiner mechanical wood pulp (RMP), waste paper pulps recycled from waste cardboard paper, waste liner paper, waste magazine paper, waste newspaper, waste chi-ken-shi paper, etc., a waste high-quality white paper pulp, a de-inked pulp, and the liked.

[0019] Also, the agent for paper manufacture is not particularly limited, and for example, a surfactant, a wax, a sizing agent, a filler, a rust-preventive agent, a conductive agent, a defoaming agent, a dispersant, a viscosity adjusting agent, a flocculant, coagulant, a paper strength enhancer, a process yield improver, a paper dust detachment-preventing agent, bulking agent, and the like.

Aerating Step

[0020] In this step, either one or both of the white water circulation line and the water line is aerated with an oxygen-containing gas. By increasing the amount of oxygen in the white water circulation line, or maintaining the amount so as to exceed a certain level, a decrease in the amount of the slime control agent added in the paper making process, as well as efficient control of the generation of slime can be contemplated, as compared with the absence of the aerating step. Furthermore, when the water line is aerated with the oxygen-containing gas in this step, the generation of the slime in the entirety of the white water circulation line can be readily controlled as compared with a large amount of the white water in the white water circulation line, through efficiently aerating a comparatively small amount of the water line.

[0021] Although the reason for achieving the effects described above through aerating either one or both of the white water circulation line and the water line is not necessarily clarified, the reason may be presumed, for example, as in the following. Specifically, since many of the slime control agents serve as an oxidizing agent, these would react with the sulfite ions derived from reductive substances such as hydrogen sulfide from microorganisms, and mercaptan prior to reacting with the microorganisms, a large quantity of the slime control agent would be consumed before achieving a desired antimicrobial effect. However, oxidization of the sulfite ions to give harmless sulfate ions, etc., is enabled by way of oxidization of the sulfite ions with oxygen in the oxygen-containing gas. In addition, dissolution of a large amount of the oxygen-containing gas in the white water circulation line enables the partial pressure of the reductive substances such as hydrogen sulfide to be lowered, whereby the solubility of the reductive substances can be decreased. As a result, the amount of the slime control agent added can be decreased while the sulfite ion concentration in the white water circulation line is lowered. Moreover, it is presumed that the generation of the slime can be efficiently controlled without need of an excess amount of the slime control agent.

[0022] In addition, by decreasing the amount of the slime control agent added, it is also possible to control the change in color tone of the paper resulting from use of a large amount of the slime control agent, and negative influences on the paper quality involving e.g., deterioration of the dye. Furthermore, the whole area in the white water circulation line can be maintained clean during a continuous operation time period, thereby enabling the operation time period to be prolonged.

[0023] The aerating is carried out with the oxygen-containing gas. The oxygen-containing gas is not particularly limited, and is exemplified by an oxygen gas alone, a gas mixture containing oxygen such as the air, and the like. Of these, in light of availability, the gas mixture is preferred, and the air is more preferred. A gas other than oxygen in the gas mixture may be exemplified by a well-known gas such as nitrogen and carbon dioxide. The oxygen-containing gas may be used either alone, or two or more types thereof may be used in combination.

[0024] The aerating procedure is not particularly limited as long as either one or both of the white water circulation line and the water line can be supplied with the oxygen-containing gas, and use of a diffuser tube, a stir or the like may be involved. Of these, since the aerating can be stably and continuously carried out, use of a diffuser tube is preferred. Specifically, finely bubbling upwards from the bottom so as to increase the contact efficiency between the white water or the water with the oxygen-containing gas enables the aerating to be more efficiently executed. The diffuser tube is not particularly limited, and is exemplified by those provided with openings having a diameter of no less than 1 mm and no greater than 5 mm with each interval of no less than 5 cm and no greater than 50 cm, and the like. Either one, or a plurality of diffuser tubes may be used.

[0025] The place where the aerating is executed in the white water circulation line or in the water line is not particularly limited, and for example, the place may be in the piping, in the water channel, in the aeration tank, or the like. Of these, since the aerating can be more efficiently executed on a large scale, use of the aeration tank is preferred, and use of an aeration tank having a diffuser tube on the bottom thereof is more preferred. The shape of the aeration tank is not particularly limited, and the shape may be, for example, a box-shape, a cylindrical shape, an elliptic cylindrical shape, a cone-shape, or the like. Also, either only one, or a plurality of aeration tanks may be provided.

[0026] The aeration rate by the diffuser tube is not particularly limited, and the aeration rate with respect to 1 m^2 of the unit bottom area of the aeration tank is preferably no less than 0.5 m^3/hour and no greater than 10 m^3/hour, more preferably no less than 0.5 m^3/hour and no greater than 8 m^3/hour. When the aeration rate falls within the above range, the white water circulation line or the water line aerated with the oxygen-containing gas tends to be sufficiently supplied with oxygen. When the aeration rate is greater than the upper limit, an equipment on a larger scale may be necessary. When the aeration rate is less than the lower limit, the aerating may be insufficient.

[0027] Also, the aeration time period with the oxygen-containing gas is not particularly limited, and is typically no less than 3 min and no greater than 30 days, and preferably no less than 4 min and no greater than 20 days. When the aeration time period falls within the above range, the white water circulation line or the water line aerated with the oxygen-containing gas tends to be sufficiently supplied with oxygen. When the aeration time period is greater than the upper limit, the manufacturing cost may increase. When the aeration rate is less than the lower limit, the aerating may be insufficient. Further, the aerating may be carried out either continuously, or several times intermittently.

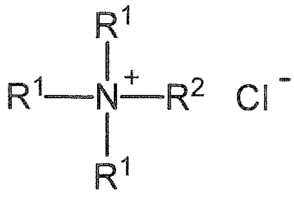
[0028] In an exemplary aerating procedure, an aeration tank having a diffuser tube on the bottom thereof is used in the aerating in the aerating step, with the aeration rate by the diffuser tube with respect to 1 m^2 of the unit bottom area of the aeration tank being no less than 0.5 m^3/hour and no greater than 10 m^3/hour.

Adding Step of Slime Control Agent

[0029] In this step, the slime control agent is added to at least one line of the white water circulation line and the water line aerated with the oxygen-containing gas in the aerating step. By adding the slime control agent to at least one line of the white water circulation line and the water line aerated with the oxygen-containing gas in the aerating step, the number of bacteria in the white water circulation line can be further decreased as compared with the case in which the aerating is not carried out, and as a result, the generation of the slime can be further controlled. In addition, the slime control agent also enables the degradation of organic substances such as starch contained in the white water to be inhibited, whereby the generation of the slime can be controlled.

[0030] The slime control agent is not particularly limited, and is exemplified by an organic antimicrobial agent, an inorganic antimicrobial agent, and the like.

[0031] The organic antimicrobial agent is not particularly limited, and examples of the organic antimicrobial agent include methylene bisthiocyanate, 5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazolin-3-one, 4,5-dichloro-2-n-octylisothiazolin-3-one, 1,2-benzoisothiazolin-3-one, 2-n-octylisothiazolin-3-one, sodium dimethyldithiocarbamate, 2,2-dibromo-3-nitrilopropionamide, 2-bromo-2-bromomethylglutaronitrile, 2-bromo-2-nitropropane-1,3-diol, 2,2-dibromo-2-nitroethanol, 1,1-dibromo-1-nitro-2-propanol, 1,1-dibromo-1-nitro-2-acetoxyethane, 1,1-dibromo-1-nitro-2-acetoxypropane, 2-bromo-2-nitro-1,3-diacetoxypropane, tribromonitromethane, β-bromo-β-nitrostyrene, 5-bromo-5-nitro-1,3-dioxane, 5-bromo-2-methyl-5-nitro-1,3-dioxane, 1,2-bis(bromoacetoxy)ethane, 1,2-bis(bromoacetoxy)propane, 1,4-bis(bromoacetoxy)-2-butene, methylene bisbromoacetate, benzyl bromoacetate, N-bromoacetamide, 2-bromoacetamide, dichloroglyoxime, α-chlorobenzaldoxime, α-chlorobenzaldoxime acetate, 2-(p-hydroxyphenyl)glyoxylohydroximoylchloride, triiodoallyl alcohol, 5-chloro-2,4,6-trifluoroisophthalonitrile, 2,4,5,6-tetrachloroisophthalonitrile, 3,3,4,4-tetrachlorotetrahydrothiophene-1,1-dioxide, 4,5-dichloro-1,2-dithiol-3-one, hexabromodimethyl sulfone, glutaraldehyde, orthophthalaldehyde, dichlorophen, a quaternary ammonium salt represented by the general formula (1), and the like.



$$R^1-\overset{\displaystyle R^1}{\underset{\displaystyle R^1}{\overset{+}{N}}}-R^2\quad Cl^- \qquad (1)$$

[0032] In the above formula (1), R^1 represents a linear or branched alkyl group having 1 to 18 carbon atoms, and three R^1s may be the same or different; and R^2 represents a linear or branched alkyl group having 8 to 18 carbon atoms, a benzyl group or a hydroxyethyl group.

[0033] Of these, 2,2-dibromo-3-nitrilopropionamide, and 2,2-dibromo-2-nitroethanol are preferred since a more superior antimicrobial effect is expected.

[0034] The inorganic antimicrobial agent is not particularly limited, and examples of the inorganic antimicrobial agent include hypochlorites such as sodium hypochlorite, potassium hypochlorite, calcium hypochlorite and barium hypochlorite, chlorine dioxide, chlorinated isocyanuric acid, a chlorine-bound compound, and the like.

[0035] Of these, sodium hypochlorite and a chlorine-bound compound are preferred due to having appropriate oxidizability, and having low reactivity with dissolved organic substances.

[0036] The chlorine-bound compound may be typically produced by reacting a chlorine donor that releases free chlorine with any one of ammonia, an ammonium salt and an organic nitrogen compound in an adequate condition. The chlorine donor is not particularly limited, and for example, sodium hypochlorite may be used. Examples of the ammonium salt include ammonium halides such as ammonium chloride and ammonium bromide, ammonium sulfate, ammonium nitrate, and the like. As the organic amine, for example, sulfamic acid, urea or the like may be also used. Alternatively, a compound which generates hypochlorous acid and/or hypobromous acid in water may be also acceptable, and examples of the compound include chlorine, chlorine dioxide, highly bleaching powder, hypochlorous acid, sodium hypochlorite, potassium hypochlorite, calcium hypochlorite, ammonium hypochlorite, magnesium hypochlorite, hypobromous acid, sodium hypobromite, potassium hypobromite, calcium hypobromite, ammonium hypobromite, magnesium hypobromite, chlorinated and/or brominated hydantoins, chlorinated and/or brominated isocyanuric acid, and sodium salts and potassium salts thereof, and the like.

[0037] Although the chlorine-bound compound can be produced in accordance with a well-known process, "Fuzzicide (trade name)" (manufactured by Kurita Water Industries Ltd.) may be commercially available. "Fuzzicide" is a 1:1 reaction product (molar ratio) of ammonium bromide and sodium hypochlorite.

[0038] The slime control agent may be used either alone, or two or more types thereof may be used in combination. Also, the slime control agent may be added once, or may be divided into aliquots and added several times.

[0039] The adding procedure of the slime control agent to the white water circulation line or the water line is not particularly limited, and the slime control agent may be directly added, or the slime control agent may be dissolved or dispersed in a solvent for use as a solution or dispersion. The solvent is not particularly limited, and is exemplified by water, an organic solvent, a mixed solvent thereof, and the like.

[0040] The organic solvent is not particularly limited, and examples of the organic solvent include:

amides such as dimethylformamide and dimethylacetamide;
glycols such as ethylene glycol, propylene glycol, diethylene glycol, dipropylene glycol and polyethylene glycol;
glycol ethers such as methylcellosolve, phenylcellosolve, diethylene glycol monomethyl ether and dipropylene glycol monomethyl ether;
glycol esters such as diethylene glycol monoethyl ether acetate, ethylene glycol diacetate and 2,2,4-trimethyl-1,3-pentanediol diisobutyrate;
alcohols having 8 or less carbon atoms;
esters such as methyl acetate, ethyl acetate, butyl acetate, dimethyl maleate, diethyl adipate, ethyl lactate, methyl glutarate, dimethyl succinate, dimethyl phthalate, 1,2-dibutoxyethane, 3-methoxybutyl acetate, 2-ethoxyethyl acetate and propylene carbonate;
ketones such as acetone, methyl ethyl ketone, methyl isobutyl ketone and isophorone;
aromatic solvents such as toluene, xylene and 1,2-dimethyl-4-ethylbenzene;
dimethyl sulfoxide, dioxane, N-methylpyrrolidone; and the like.

[0041] Of these, water and diethylene glycol monomethyl ether are preferred since a more superior dispersibility and/or solubility can be ensured.

[0042] The concentration of the slime control agent in the solution is not particularly limited, and is typically no less than 1% by mass and no greater than 40% by mass, and preferably no less than 2% by mass and no greater than 30% by mass. When the concentration falls within this range, the slime control agent tends to be sufficiently dispersed or dissolved in the solvent. When the concentration is greater than the upper limit, the slime control agent can not be sufficiently dispersed or dissolved. When the concentration is less than the lower limit, the solvent may be required in a great amount.

[0043] The amount of the slime control agent added to the white water circulation line or the water line (the amount added to one of the white water circulation line and the water line when the slime control agent is added to both of the lines) is not particularly limited, and in terms of the solid content equivalent, the amount is typically no less than 0.1 mg/L and no greater than 1,000 mg/L, and preferably no less than 1 mg/L and no greater than 100 mg/L. When the amount falls within this range, the generation of the slime tends to be capable of being sufficiently controlled. When the amount is greater than the upper limit, the manufacturing cost may be increased. When the amount is less than the lower limit, controlling the generation of the slime may fail.

[0044] The time period from the start of the aerating treatment until the adding of the slime control agent is not particularly limited, and this time period is preferably no less than 0 min and no greater than 30 min. When the time period from the start of the aerating treatment until the adding of the slime control agent is greater than 30 min, the bacteria and the like are activated and propagated again, whereby reductive substances may increase.

[0045] FIG. 1 shows a view illustrating one embodiment of the paper making process according to the present invention. Procedures of aerating with the oxygen-containing gas either one or both of the white water circulation line and the water line, and further adding the slime control agent to at least one line of the white water circulation line and the water line aerated with the oxygen-containing gas in the aerating step will be described below with references to specific examples. It is to be noted that in the following, a case in which the white water circulation line is aerated with the oxygen-containing gas, and the slime control agent is added to this white water circulation line (first method), and a case in which the water line is aerated with the oxygen-containing gas, and the slime control agent is added to this water line (second method) are each described.

First Method

[0046] First, in the case where a white water circulation line 22 is aerated with the oxygen-containing gas, and the slime control agent is added to this white water circulation line 22, a white water 10 is aerated with the oxygen-containing gas in an aeration tank 17 and/or the like. Next, a raw material pulp slurry in a machine tank 2 is mixed with the white water 10 from the aeration tank 17. Thereafter, a slime control agent 18 and the like are added to the white water 10, and transferred to an inlet 5 via a screen 4 by way of a fan pump 3. The raw material pulp slurry transferred to the inlet 5 is fed to a wire part 6 and is dewatered. The dewatered wet sheet 7 is transferred from a press part 8 to a dryer part 9. The white water 10 separated in the wire part 6 is reserved in a white water silo 11, and a part thereof is again charged into the aeration tank 17 and the like, followed by aerating in a similar manner to that described above.

[0047] Alternatively, in a case where the white water circulation line 22 is aerated with the oxygen-containing gas, and the slime control agent is added to this white water circulation line 22, a water line 19 for feeding into the white water circulation line 22 may be provided with an aeration tank 20 to carry out the aerating, and the slime control agent 21 may be added to the water line 19 (second aerating step, and second adding step of the slime control agent).

[0048] The procedures of the aerating and adding in the water line 19 are not particularly limited, and the aerating and the adding may be carried out in a similar manner to, for example, the aerating procedure and the adding procedure in the white water circulation line 22.

Second Method

[0049] On the other hand, in the case where the water line 19 is aerated with the oxygen-containing gas, and the slime control agent is added to this water line 19, the water line 19 for feeding into the white water circulation line 22 is aerated with the oxygen-containing gas in an aeration tank 20 having a diffuser tube on the bottom thereof. After mixing the water line 19 and the white water 10 from the white water silo 11, the mixture is combined with the raw material pulp slurry in the machine tank 2. Next, the slime control agent 21 is added to the aeration tank 20, and transferred to the inlet 5 via the screen 4 by way of the fan pump 3. The raw material pulp slurry transferred to the inlet 5 is fed to the wire part 6 and is dewatered. The dewatered wet sheet 7 is transferred from the press part 8 to the dryer part 9. The white water 10 separated in the wire part 6 is reserved in the white water silo 11 to permit circulation of the white water 10.

[0050] Alternatively, in a case where the water line 19 is aerated with the oxygen-containing gas, and the slime control agent is added to this water line 19, aerating with the oxygen-containing gas, and/or the adding the slime control agent 18, etc., in the aeration tank 17 and the like are/is preferred.

[0051] In other words, it is preferred that the step of aerating the white water circulation line 22 with the oxygen-containing gas (second aerating step) is further included. By also aerating the white water circulation line 22 with the oxygen-containing gas, the generation of the slime can be further controlled synergistically.

[0052] In addition, it is preferred that the step of adding a slime control agent to the white water circulation line 22 (second adding step of the slime control agent) is further included. By thus aerating also the white water circulation line 22 with the oxygen-containing gas, the generation of the slime can be even more controlled synergistically.

[0053] The procedures of the aerating and the adding in the white water circulation line 22 are not particularly limited, and the aerating and the adding may be carried out in a similar manner to, for example, the aerating procedure and the adding procedure in the water line 19.

Measurement Step

[0054] It is preferred that the slime control method further includes the step of measuring at least one selected from the group of measurement items consisting of the oxidation reduction potential, the sulfite ion concentration and the amount of dissolved oxygen in the white water circulation line. By controlling the aeration rate in the aerating step and/or the amount of the slime control agent added in the adding step of the slime control agent, based on the measurement results obtained in the measurement step, the generation of the slime can be controlled in a safer and more accurate manner.

[0055] Specifically, it is preferred that the aeration rate in the aerating step and/or the amount of the slime control agent added in the adding step of the slime control agent is adjusted such that in the white water circulation line: the oxidation reduction potential is no less than -150 mV; the sulfite ion concentration is no greater than 2.0 mg SO_3^-/L;

and/or the amount of dissolved oxygen is no less than 1 mg/L. The generation of the slime can be more effectively controlled by such an adjustment.

[0056] The oxidation reduction potential is adjusted to be preferably no less than -150 mV, and more preferably no less than -100 mV and no greater than 500 mV. When oxygen in the line is consumed along with increasing contamination with microorganisms, the oxidation reduction potential is likely to be lowered; however, when the oxidation reduction potential falls within the above range, the amount of oxygen in the white water circulation line would be sufficient, whereby the generation of the slime tends to be effectively controlled. When the oxidation reduction potential is greater than the upper limit, the amount of oxygen in the white water circulation line may be unnecessarily excessive. When the oxidation reduction potential is less than the lower limit, the control of the generation of the slime may fail.

[0057] The measuring method of the oxidation reduction potential is not particularly limited, and is exemplified by potentiometry, potentiometric titration, and the like.

[0058] The sulfite ion concentration is adjusted to be preferably no greater than 2.0 mg SO_3^-/L, and more preferably no greater than 1.5 mg SO_3^-/L. When the sulfite ion concentration falls within the above range, the sulfite ion concentration in the white water circulation line tends to be sufficiently lowered. When the sulfite ion concentration is greater than the upper limit, the reductive substances may not be sufficiently decreased.

[0059] The sulfite ion concentration may be measured according to JIS K 0102: 2008.

[0060] The amount of dissolved oxygen is adjusted to be preferably no less than 1 mg/L, and more preferably no less than 5 mg/L and no greater than 100 mg/L. When the amount of dissolved oxygen falls within the above range, the amount of oxygen in the white water circulation line would be sufficient, whereby the generation of the slime tends to be effectively controlled. When the amount of dissolved oxygen is greater than the upper limit, the amount of oxygen in the white water circulation line may be unnecessarily excessive. When the amount of dissolved oxygen is less than the lower limit, the control of the generation of the slime may fail. The amount of dissolved oxygen may be measured by using a dissolved oxygen meter.

[0061] Furthermore, the viable cell number is not particularly limited, and is typically no greater than 1×10^7 CFU/mL, and preferably no greater than 1×10^6 CFU/mL. When the viable cell number is greater than the upper limit, the control of the generation of the slime may fail.

[0062] The viable cell number is measured by a colony counting method in which water from a cooling water line which should be prevented from rotting is employed as a microorganism source, and determines the number of colonies formed from a certain amount of the water to designate the viable cell number. Alternatively, the viable cell number may be also determined according to an absorbance/ turbidity measuring method, a weight measuring method, or the like.

[0063] The colony counting method is not particularly limited, and is exemplified by a plate culture method, a capillary method, a membrane filter method and the like.

[0064] The sterilization rate is not particularly limited, and is typically no less than 99.5%, and preferably no less than 99.9%. When the sterilization rate is less than the lower limit, the control of the generation of the slime may fail.

[0065] The measurement step may be also carried out by measuring other parameter. The other parameter is not particularly limited, and is exemplified by markers such as the amount of calcium ion, electric conductivity, glucose concentration, starch concentration, pH and turbidity.

Others

[0066] Other conditions of the steps involving e.g., the temperature, the pressure, the time period and the equipment in each step are not particularly limited, and may be appropriately predetermined according to the material and the like used. The number of substeps of each step is not also particularly limit, and either one substep, or multiple substeps may be carried out. Quantitative determination or qualitative determination of the material and the product may be carried out in accordance with a well-known method such as NMR, IR, an element analysis or mass spectrometry. Moreover, the material used may be alone, or a plurality of types of material may be used in combination.

[0067] According to the present invention, generation of slime in a white water circulation line in a paper making process can be sufficiently and conveniently controlled. Therefore, the slime control method can be suitably used in a paper making process in paper manufacture. Moreover, in a paper making process, recycling or a decrease in the amount of the slime control agent used, a decrease in the amount of fresh water used, diminishing of a wastewater treatment, and the like may be also contemplated.

EXAMPLES

[0068] Hereinafter, the embodiment of the present invention will be explained in detail by way of Examples, but the present invention is not in any way limited to these Examples. It is to be noted that in Examples and Comparative Examples, measurements were conducted in accordance with the following methods.

Oxidation Reduction Potential (ORP)

[0069] The oxidation reduction potential (mV) was measured by using an oxidation reduction potential meter (manufactured by Toko Kagaku CO., LTD.) through use of potentiometry.

Sulfite Ion Concentration

[0070] The sulfite ion concentration (mg SO_3^-/L) was measured according to JIS K 0102:2008. Specifically, an appropriate amount of a sample was charged into a volumetric flask, and thereto were added a pararosaniline solution, a formaldehyde solution and a mercury chloride solution to allow for color development. After leaving to stand for 20 min, colorimetry at 572 nm was conducted using a blank solution separately prepared similarly as a control. Thus, the sulfite ion concentration was determined.

Amount of Dissolved Oxygen

[0071] The amount of dissolved oxygen (mg/L) was measured using a diaphragm electrode type dissolved oxygen meter (manufactured by Orbisphere, Inc.,).

Viable Cell Number

[0072] The viable cell number (CFU/mL) was measured by: diluting a test water; mixing well a certain amount of the same with a nutrition-containing agar medium; plate-culturing the mixture for 1 day; and thereafter counting the number of colonies produced.

Sterilization Rate

[0073] The sterilization rate (%) was calculated by using the following formula:

sterilization rate (%)= ((viable cell number before the treatment) - (viable cell number after the treatment))/(viable cell number before the treatment) x 100.

Sterilization Effect

[0074] The sterilization effect was determined according to the following evaluation criteria.

A: sterilization rate being no less than 99.9%
B: sterilization rate being no less than 99.5% and less than 99.9%
C: sterilization rate being no less than 90% and less than 99.5%
D: sterilization rate being less than 90%

Slime Control Effect

[0075] The slime control effect was determined according to the following evaluation criteria.

A: no adhesion of slime found
B: the thickness of the slime being less than 0.1 mm
C: the thickness of the slime being no less than 0.1 mm and less than 0.5 mm
D: the thickness of the slime being no less than 0.5 mm

Preparation A

[0076] A 12% sodium hypochlorite was prepared to give a preparation A.

Preparation B

[0077] Ammonium bromide was reacted with sodium hypochlorite at a molar ratio of 1:1 to give a preparation B.

Preparation C

[0078] 2,2-Dibromo-3-nitrilopropionamide (DBNPA) in an amount of 20 parts by mass was blended with 80 parts by mass of diethylene glycol monomethyl ether to give a preparation C.

Preparation D

[0079] 2,2-Dibromo-2-nitroethanol (DBNE) in an amount of 20 parts by mass was blended with 80 parts by mass of diethylene glycol monomethyl ether to give a preparation D.

Example 1, and Comparative Example 13

[0080] Using a white water collected from paper making machinery, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured. Before the treatment, the oxidation reduction potential of the white water was -388 mV; the sulfite ion concentration was 8.8 mg SO_3^-/L; the amount of dissolved oxygen was less than 0.1 mg/L; and the viable cell number was 3.8 x 10^8 CFU/mL. The white water collected from the paper making machinery was taken in a volume of 2 L, and was aerated with the air at a flow rate of 300 mL/min (corresponding to 1 m^3/hour with respect to a unit bottom area of 1 m^2) for 5 min by using a diffuser tube. Thereafter, a slime control agent was added thereto such that a concentration in terms of the active ingredient concentration was attained, and 10 min later, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured (Example 1). Furthermore, in a similar manner to Example 1 except that the slime control agent (preparation) was not added, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured (Comparative Example 13). The sterilization rate of Example 1 was calculated from the viable cell number before the treatment and the viable cell number in Example 1. In addition, the sterilization effect was evaluated.

Examples 2 to 12

[0081] The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen, the viable cell number and the sterilization rate were measured in a similar manner to Example 1 except that the type and the concentration of the slime control agent (preparation) added were as shown in Table 1.

Comparative Example 1

[0082] The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen, the viable cell number and the sterilization rate were measured in a similar manner to Example 1 except that the aerating treatment was not carried out, and that the type and the concentration of the slime control agent (preparation) added were as shown in Table 1 (Comparative Example 1). The sterilization rate of Comparative Example 1 was calculated from the viable cell number before the treatment and the viable cell number in Comparative Example 1. In addition, the sterilization effect was evaluated.

Comparative Examples 2 to 12

[0083] In a similar manner to Comparative Example 1 except that the type and the concentration of the slime control agent (preparation) added were as shown in Table 1, The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen, the viable cell number and the sterilization rate were measured . In addition, the sterilization effect was evaluated.

[0084]

Table 1

	Preparation		Aerating treatment	ORP	Sulfite ion concentration	Dissolved oxygen	Viable cell number	Sterilization rate	Sterilization effect
	type	concentration added							
		(mg/L)		(mV)	(mg SO_3^-/L)	(mg/L)	(CFU/mL)	(%)	
Example 1	preparation A	20	done	-88	1.2	5.2	8.6. E+05	99.8	B
Example 2		40	done	12	0	5.8	1.0 E-05	100.0	A
Example 3		100	done	104	0	5.4	3.1 E+04	100.0	A
Example 4	preparation B	20	done	27	0	5.6	3.6 E+04	100.0	A
Example 5		40	done	210	0	5.5	5.8 E+03	100.0	A
Example 6		100	done	288	0	5.1	2.4 E+03	100.0	A
Example 7	preparation C	20	done	-33	1.1	5.2	7.1 E+04	100.0	A
Example 8		40	done	31	0	5.8	5.9 E+03	100.0	A
Example 9		100	done	92	0	5.4	3.1 E+03	100.0	A
Example 10	preparation D	20	done	-46	1.1	5.3	1.1 E+05	100.0	A
Example 11		40	done	2	0	5.7	8.7 E+03	100.0	A
Example 12		100	done	57	0	5.2	4.2 E+03	100.0	A
Comparative Example 1	preparation A	20	not done	-366	8.3	<0.1	3.7 E+08	2.6	D
Comparative Example 2		40	not done	-298	7.9	<0.1	6.4 E+07	83.2	D
Comparative Example 3		100	not done	-115	5.3	<0.1	2.9 E+06	99.2	C

(continued)

	Preparation		Aerating treatment	ORP	Sulfite ion concentration	Dissolved oxygen	Viable cell number	Sterilization rate	Sterilization effect
	type	concentration added							
		(mg/L)		(mV)	(mg SO_3^-/L)	(mg/L)	(CFU/mL)	(%)	
Comparative Example 4	preparation B	20	not done	-168	2.4	<0.1	4.1 E+06	98.9	C
Comparative Example 5		40	not done	21	0	<0.1	2.3 E+06	99.4	C
Comparative Example 6		100	not done	97	0	<0.1	2.3 E+06	99.4	C
Comparative Example 7	preparation C	20	not done	-326	5.6	<0.1	6.6 E+07	82.6	D
Comparative Example 8		40	not done	-274	4.8	<0.1	3.2 E+06	99.2	C
Comparative Example 9		100	not done	-196	3.2	<0.1	3.0 E+06	99.2	C
Comparative Example 10	preparation D	20	not done	-333	6.2	<0.1	6.7 E+07	82.4	D
Comparative Example 11		40	not done	-290	5.1	<0.1	1.0 E+07	97.4	C
Comparative Example 12		100	not done	-216	3.5	<0.1	2.4 E+06	99.4	C
Comparative Example 13	untreated	0	done	-167	2.8	5.4	3.8 E+08	-	-

[0085] Using a white water collected from a paper making machinery, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured (measurement step). Before the treatment, the oxidation reduction potential of the white water was -361 mV; the sulfite ion concentration was 8.8 mg SO_3^-/L; the amount of dissolved oxygen was less than 0.1 mg/L; and the viable cell number was 4.0 x 10^8 CFU/mL. Using a white water collected from a paper making machinery, in an aeration tank having a diffuser tube on the bottom thereof, the white water was aerated with the air by using a diffuser tube provided with openings having a diameter of 2 mm with each interval of 10 cm, at an aeration rate of 5 m^3/hour with respect to the unit area of 1 m^2 (aerating step). A raw material pulp slurry from a machine tank, which had been prepared using a Laubholz bleached Kraft pulp and a de-inked pulp as raw material pulps, was mixed with the white water from the aeration tank. The preparation A was added to the white water at a rate of 100 mg/L (adding step of the slime control agent), and the raw material pulp slurry was transferred to an inlet via a screen by way of a fan pump. The raw material pulp slurry transferred to the inlet was fed to a wire part and was dewatered. The dewatered wet sheet was transferred from a press part to a dryer part. The white water separated in the wire part was reserved in a white water silo, and a part thereof was again charged into the aeration tank, followed by aerating in a similar manner to that described above (white water circulation line). Fourteen days later, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number of the white water were measured (Example 13). In addition, the amount of the slime adhered in the piping of the white water circulation line was visually observed. On the other hand, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured in a similar manner to Example 13 except that the slime control agent (Preparation) was not added (Comparative Example 18). The sterilization rate of Example 13 was calculated from the viable cell number before the treatment and the viable cell number in Example 13.

Examples 14 to 16

[0086] The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen, the viable cell number and the sterilization rate were measured in a similar manner to Example 13 except that the type and the concentration of the slime control agent (preparation) added were as shown in Table 2. In addition, the amount of the slime adhered in the piping of the white water circulation line was visually observed.

Comparative Examples 14 to 17

[0087] The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured in a similar manner to Example 13 except that the aerating treatment was not carried out and that the type and the concentration of the slime control agent (preparation) added were as shown in Table 2 (Comparative Examples 14 to 17). The amount of the slime adhered in the piping of the white water circulation line was visually observed. The sterilization rates of Comparative Examples 14 to 17 were calculated, respectively, from the viable cell number before the treatment and the viable cell numbers in Comparative Examples 14 to 17.

[0088]

Table 2

	Preparation		Aerating treatment	ORP	Sulfite ion concentration	Dissolved oxygen	Viable cell number	Sterilization rate	Slime control effect
	type	concentration added							
		(mg/L)		(mV)	(mg SO_3^-/L)	(mg/L)	(CFU/mL)	(%)	
Example 13	preparation A	100	done	55	0	5.6	7.4 E+05	99.8	B
Example 14	preparation B	20	done	22	0	5.4	4.4 E+03	100.0	A
Example 15	preparation C	40	done	7	0	5.5	6.9 E+03	100.0	A
Example 16	preparation D	40	done	-18	0	5.3	1.0 E+04	100.0	A
Comparative Example 14	preparation A	100	not done	-82	5.6	<0.1	3.4 E+07	91.5	C
Comparative Example 15	preparation B	20	not done	-133	3.3	<0.1	8.1 E+06	98.0	C
Comparative Example 16	preparation C	40	not done	-246	5.1	<0.1	6.2 E+06	98.5	C
Comparative Example 17	preparation D	40	not done	-268	5.2	<0.1	1.2 E+07	97.0	C
Comparative Example 18	untreated	0	done	-195	3	5.1	4.0 E+08	0.0	D

Example 17, and Comparative Example 23

[0089] Using a white water collected from a paper making machinery, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured (measurement step). Before the treatment, the oxidation reduction potential of the white water was -387 mV; the sulfite ion concentration was 9.0 mg SO_3^-/L; the amount of dissolved oxygen was less than 0.1 mg/L; and the viable cell number was 4.1 x 10^8 CFU/mL. In an aeration tank having a diffuser tube on the bottom thereof, a water feeding line for feeding water into the white water circulation line was aerated with the air by using a diffuser tube provided with openings having a diameter of 2 mm with each interval of 10 cm, at an aeration rate of 2 m^3/hour with respect to the unit area of 1 m^2 (aerating step). After mixing the water line and the white water from the white water silo, a raw material pulp slurry from a machine tank, which had been prepared using a Laubholz bleached Kraft pulp and a de-inked pulp as raw material pulps, was mixed with the resulting white water. The preparation A was added to the aeration tank at a rate of 100 mg/L (adding step of the slime control agent), and the raw material pulp slurry was transferred to an inlet via a screen by way of a fan pump. The raw material pulp slurry transferred to the inlet was fed to a wire part and was dewatered. The dewatered wet sheet was transferred from a press part to a dryer part. The white water separated in the wire part was reserved in a white water silo, and the white water was circulated (white water circulation line). Fourteen days later, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number of the white water were measured. In addition, the amount of the slime adhered in the piping of the white water circulation line was visually observed (Example 17). On the other hand, the oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured in a similar manner to Example 17 except that the slime control agent (Preparation) was not added (Comparative Example 23). The sterilization rate of Example 17 was calculated from the viable cell number before the treatment and the viable cell number in Example 17.

Examples 18 to 24, Comparative Example 24

[0090] The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen, the viable cell number and the sterilization rate were measured in a similar manner to Example 17 except that the aeration rate, and the type and the concentration of the slime control agent (preparation) added were as shown in Table 3. In addition, the amount of the slime adhered in the piping of the white water circulation line was visually observed.

Comparative Examples 19 to 22

[0091] The oxidation reduction potential, the sulfite ion concentration, the amount of dissolved oxygen and the viable cell number were measured in a similar manner to Example 17 except that the aerating treatment was not carried out and that the type and the concentration of the slime control agent (preparation) added were as shown in Table 3. In addition, the amount of the slime adhered in the piping of the white water circulation line was visually observed. Without carrying out the aerating treatment, the sterilization rates of Comparative Examples 19 to 22 were calculated, respectively, from the viable cell number before the treatment and the viable cell numbers in Comparative Examples 19 to 22.

[0092]

Table 3

	Reparation		Aerating treatment of water feeding line		ORP	Sulfite ion concentration	Dissolved oxygen	Viable cell number	Sterilization rate	Slime control effect
	type	concentration added	aerating treatment	aeration rate						
		(mg/L)		(m^3/m^2/hour	(mV)	(mg SO_3^-/L)	(mg/L)	(CFU/mL)	(%)	
Example 17	preparation A	100	done	2	8	0.1	3.6	8.8. E+05	99.8	B
Example 18		100	done	5	32	<0.1	4.8	6.8. E+05	99.8	3
Example 19	preparation B	20	done	2	2	<0.1	3.9	6.0. E+03	100.0	A
Example 20		20	done	5	28	<0.1	5.2	4.2. E+03	100.0	A
Example 21	preparation C	40	done	2	-8	0.2	3.6	1.0. E+04	100.0	A
Example 22		4C	done	5	5	<0.1	5.1	5.1. E+03	100.0	A
Example 23	preparation D	40	done	2	-42	0.2	3.2	2.2. E+04	100.0	A
Example 24		40	done	5	-31	<0.1	5.1	1.2. E+04	100.0	A
Comparative Example 19	preparation A	100	not done	-	-106	5.8	<0.1	6.6 E+07	83.9	D
Comparative Example 20	preparation B	20	not done	-	-141	3.6	<0.1	1.0 E+07	97.6	C
Comparative Example 21	preparation C	40	not done	-	-250	4.9	<0.1	1.2 E+07	97.1	C
Comparative Example 22	preparation D	40	not done	-	-272	5.3	<0.1	2.6 E+07	93.7	C
Comparative Example 23	untreated	0	done	2	-227	4	3.8	3.9. E+08	4.9	D
Comparative Example 24		0	done	5	-192	3.3	4.9	3.9. E+08	4.9	D

[0093] From Tables 1 to 3, it is proven that the sterilization effect and the slime control effect were improved in Examples, as compared with Comparative Example. It is to be noted that in Tables 1 to 3, the expression "a E+b" in connection with the viable cell number means "a x 10^b".

[INDUSTRIAL APPLICABILITY]

[0094] According to the present invention, generation of slime in a white water circulation line in a paper making process can be sufficiently and conveniently controlled. Therefore, the slime control method can be suitably used in a paper making process in paper manufacture.

[EXPLANATION OF THE REFERENCE SYMBOLS]

[0095]

1 material production step
2 machine tank
3 fan pump
4 screen
5 inlet
6 wire part
7 wet sheet
8 press part
9 dryer part
10 white water
11 white water silo
12 slime control agent
13 aeration tank
14 slime control agent
15 solid-liquid separator
16 solid content being discharged or recovered to material system
17 aeration tank
18 slime control agent
19 water line for feeding water into white water circulation line
20 aeration tank
21 slime control agent
22 white water circulation line
23 fan pump
24 fan pump
25 fan pump
26 fan pump

Claims

1. A slime control method in a white water circulation line in a paper making process, the method comprising:

   aerating with an oxygen-containing gas either one or both of the white water circulation line and a water feeding line for feeding water into the white water circulation line; and
   adding a slime control agent to at least one line of the white water circulation line and the water feeding line aerated with the oxygen-containing gas in the aerating.

2. The slime control method according to claim 1, further comprising measuring at least one selected from the group of measurement items consisting of an oxidation reduction potential, a sulfite ion concentration and an amount of dissolved oxygen in the white water circulation line, wherein
   an aeration rate in the aerating and/or an amount of the slime control agent added are/is regulated, based on a measurement result obtained in the measuring.

3. The slime control method according to claim 2, wherein the aeration rate in the aerating and/or the amount of the

slime control agent added are/is regulated such that in the white water circulation line: the oxidation reduction potential is no less than -150 mV; the sulfite ion concentration is no greater than 2.0 mg SO_3^-/L; and/or the amount of dissolved oxygen is no less than 1 mg/L.

4. The slime control method according to any one of claims 1 to 3, wherein an aeration tank having a diffuser tube on a bottom thereof is used for the aerating, and an aeration rate by the diffuser tube with respect to 1 m^2 of a unit bottom area of the aeration tank is no less than 0.5 m^3/hour and no greater than 10 m^3/hour.

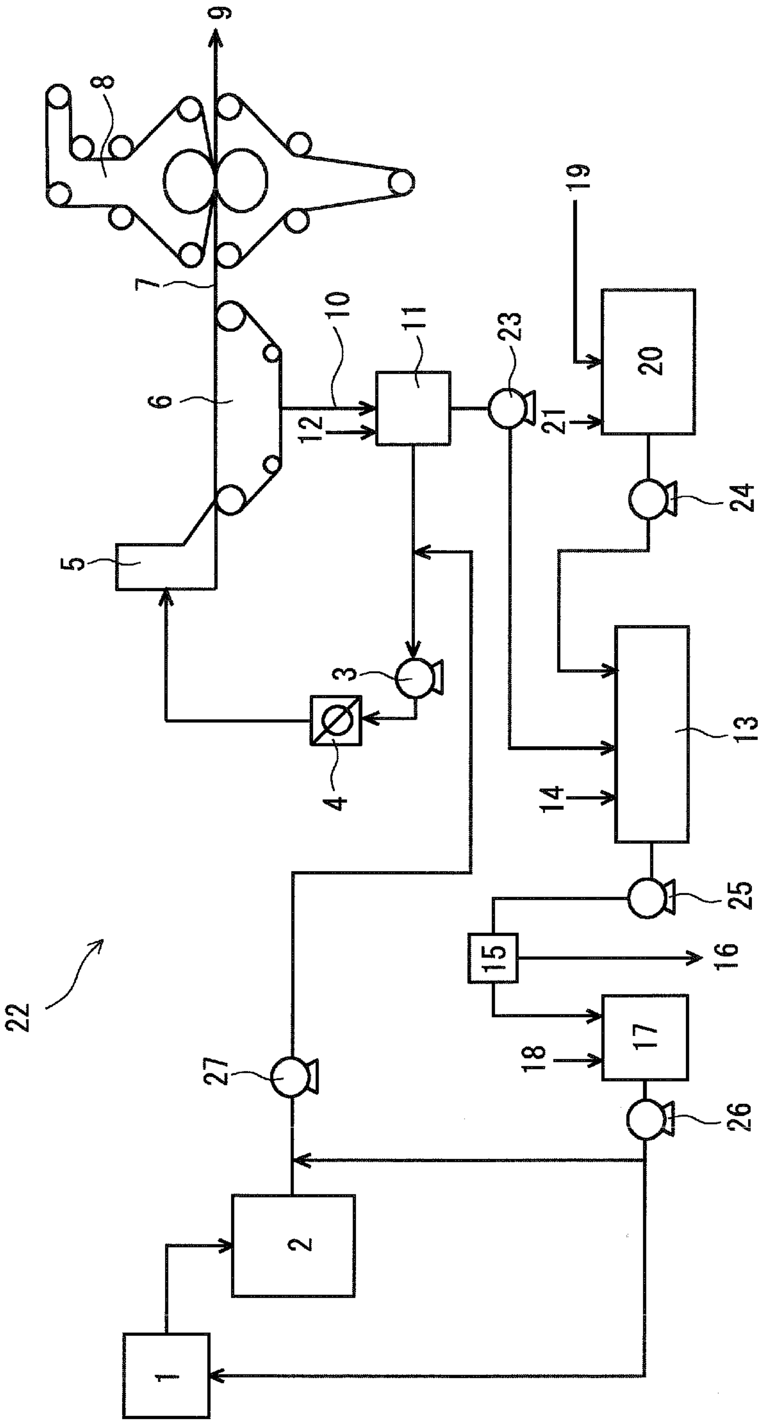


FIG. 1

INTERNATIONAL SEARCH REPORT	International application No. PCT/JP2014/068365

A. CLASSIFICATION OF SUBJECT MATTER

D21H21/04(2006.01)i, *D21H21/02*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D21B1/00-1/38, D21C1/00-11/14, D21D1/00-99/00, D21F1/00-13/12, D21G1/00-9/00, D21H11/00-27/42, D21J1/00-7/00, C02F1/70-1/78

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2014
Kokai Jitsuyo Shinan Koho	1971-2014	Toroku Jitsuyo Shinan Koho	1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2006/137183 A1 (HSP Hanbai Kabushiki Kaisha), 28 December 2006 (28.12.2006), paragraphs [0005] to [0007] & JP 5231804 B & US 2009/0114353 A1 & CN 101208477 A	1-4
Y	JP 2003-164882 A (Kurita Water Industries Ltd.), 10 June 2003 (10.06.2003), claim 3; paragraphs [0004] to [0006] (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier application or patent but published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 02 October, 2014 (02.10.14)	Date of mailing of the international search report 14 October, 2014 (14.10.14)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/068365

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-326150 A (Kurita Water Industries Ltd.), 18 November 2003 (18.11.2003), claim 1; paragraphs [0002] to [0010], [0013], [0016], [0030] (Family: none)	1-4
Y	JP 2004-275795 A (Kurita Water Industries Ltd.), 07 October 2004 (07.10.2004), claim 1; paragraphs [0002], [0005], [0007] (Family: none)	1-4
Y	JP 2008-194609 A (JFE Steel Corp.), 28 August 2008 (28.08.2008), claim 1; paragraphs [0006] to [0008], [0011], [0013] (Family: none)	1-4
Y	JP 2011-226043 A (Kurita Water Industries Ltd.), 10 November 2011 (10.11.2011), claim 3; paragraphs [0004], [0029] (Family: none)	2-4
Y	JP 2009-241018 A (Somar Corp.), 22 October 2009 (22.10.2009), claims; paragraph [0020] (Family: none)	2-4
A	JP 2000-256993 A (Hakuto Co., Ltd.), 19 September 2000 (19.09.2000), claims (Family: none)	1-4
P,A	JP 2013-240770 A (Kurita Water Industries Ltd.), 05 December 2013 (05.12.2013), claims (Family: none)	1-4

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2003164882 A **[0003] [0004]**