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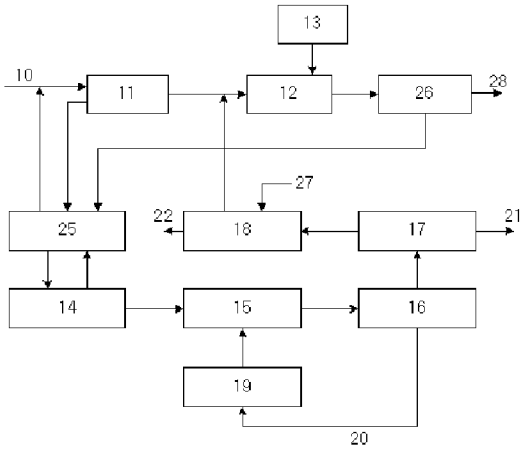
(54) **Title:** A DEVICE CAPABLE OF REMOVAL THE NITROGEN, PHOSPHORUS AND ETC. FROM SLUDGE

[Fig. 1]



(57) **Abstract:** Disclosed are an advanced apparatus and a method for treating sludge, which is constructed so that concentrated sludge is first desiccated with a desiccator in order to remove nutritional salt material such as nitrogen and phosphorus, which is included in foul water or wastewater sludge such as sewage, food waste, and livestock excretion, etc. thereby causing eutrophication; desiccated sludge is passed through a heat hydrolysis reactor to decompose a polymer formed spontaneously in the desiccated sludge and cell membrane of an organism; since microorganisms discharge absorbed phosphorus, at least one selected from magnesium, potassium, zinc, calcium carbonate, phosphoric acid and calcium is poured in order to remove phosphorus, nitrogen and various material contained in a solution generated during desiccation by crystallization into solid, and is passed through a crystallization reactor to crystallize into solid and then remove it; a remaining solution after crystallization is fed back to a step prior to the biological reactor or the digester.

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Description

A DEVICE CAPABLE OF REMOVAL THE NITROGEN, PHOSPHORUS AND ETC. FROM SLUDGE

Technical Field

[1] The present invention relates to an advanced apparatus and a method for treating sludge, which is constructed so that water contained in foul water or wastewater sludge is removed with a desiccator to lower the percentage of moisture content of the sludge in order to remove nutritional salt material such as nitrogen and phosphorus, which is mixed in foul water or wastewater purifying sludge, food waste, sewage and livestock excretion, etc. and becomes main cause of eutrophication; desiccated sludge is passed through a heat hydrolysis reactor to decompose a polymer formed spontaneously in the desiccated sludge and cell membrane of an organism; the resulting sludge is passed through a digester; the digested sludge is desiccated with a desiccator, and the resulting desiccated cake is treated by incinerating to a fertilizer, melting, carbonizing or solidifying; at least one selected from magnesium, potassium, zinc, calcium carbonate, phosphoric acid and calcium is poured in order to remove the nutritional salt material such as phosphorus and nitrogen contained in a solution generated during desiccation, and is passed through a crystallization reactor to crystallize into MAP or solid material and then remove it; a remaining solution is fed back to a step prior to the biological reactor.

[2]

Background Art

[3] General sewage, food waste and livestock excretion contain much phosphorus and nitrogen that contaminate a river or seawater through eutrophication. However, since there is not present an apparatus for treating sludge equipped with separate step for treating such phosphorus and nitrogen efficiently, there is a problem that sludge containing much phosphorus and nitrogen is discharged thereby contaminating a river or seawater seriously.

[4] In conventional advanced process for treating foul water or wastewater, some sludge sedimented at the bottom of a first sedimentation tank are transferred to a desiccator, a solution located at the top is transferred to a biological reactor that enhances proliferation of microorganisms by dissolving oxygen in air, and BOD is removed and phosphorus and nitrogen that greatly influences eutrophication are removed by action of microorganisms in the biological reactor. There is a problem that since sludge is

digested under a condition of interrupting oxygen supply in an anaerobic digester included in usual process for treating foul water or wastewater, phosphorus present in a solution through being discharged again by microorganisms that took it previously, and nitrogen added from sludge during digestion and desiccation steps are transferred to the biological reactor together with desiccated solution, and thus excess nitrogen and phosphorus are present in main step.

[5]

Disclosure of Invention

Technical Problem

[6] An object of the present invention to be solved lies in providing a method that lowers the amount of sludge by passing through heat hydrolysis and digestion step before desiccating sludge of sewage or wastewater sludge, food waste and livestock excretion, etc.; produces methane gas as a by-product of the step; and removes efficiently nutrient salt material such as phosphorus and nitrogen that is included in sludge thereby causing eutrophication.

[7] Another object of the present invention to be solved lies in optimizing crystallization condition to remove efficiently nutrient salt material such as phosphorus and nitrogen that is included in foul water or wastewater such as sewage, food waste and livestock excretion thereby causing eutrophication.

[8] Another object of the present invention to be solved lies in providing a method that energy generated during the heat hydrolysis step is fed back to recycle, and methane gas generated in digester is used as energy to heat a boiler in order to supply energy necessary for heat hydrolysis or used for generating electricity.

[9]

Technical Solution

[10] In order to achieve the above objects, according to one aspect of the invention, there are provided an advanced apparatus and a method for treating sludge, which is constructed so that concentrated sludge is first desiccated with a desiccator in order to remove nutritional salt material such as nitrogen and phosphorus, which is included in foul water or wastewater sludge such as sewage, food waste, and livestock excretion, etc. thereby causing eutrophication; desiccated sludge is passed through a heat hydrolysis reactor to decompose a polymer formed spontaneously in the desiccated sludge and cell membrane of an organism; since microorganisms discharge absorbed phosphorus, at least one selected from magnesium, potassium, zinc, calcium carbonate,

phosphoric acid and calcium is poured in order to remove phosphorus, nitrogen and various material contained in a solution generated during desiccation by crystallization into solid, and is passed through a crystallization reactor to crystallize into solid and then remove it; a remaining solution after crystallization is fed back to a step prior to the biological reactor or the digester.

[11] According to another aspect of the invention, there are provided an advanced apparatus and a method for treating sludge, which is constructed so that the pouring amount of Mg^{2+} or Mg^{2+} and PO_4^{3-}, pH and reaction time, etc. are controlled, the pouring molar ratio of Mg^{2+}: NH_4^+: PO_4^{3-} is adjusted to 1.0 to 1.4: 0.8 to 1.0 to 1.4, and MAP crystallization reactor is maintained under pH of alkaline 9 to 12, thereby achieving rapid and efficient crystallization to remove efficiently nutrient salt material such as phosphorus and nitrogen that is included in foul water or wastewater such as sewage, food waste and livestock excretion thereby causing eutrophication.

[12] According to another aspect of the invention, there are provided an advanced apparatus and a method for treating sludge, which is constructed so that the pouring amount of Mg^{2+} or Mg^{2+} and PO_4^{3-} is controlled in optimum amount, thereby producing a fertilizer such as good MAP in the crystallization step efficiently in maximum.

[13]

Advantageous Effects

[14] The present invention has an effect of removing rapidly and efficiently nutrient salt material such as phosphorus and nitrogen that is included in foul water or wastewater such as sewage, food waste and livestock excretion thereby causing eutrophication, through performing multiple steps.

[15] Another effect of the present invention lies in optimizing conditions to remove efficiently nutrient salt material such as phosphorus and nitrogen that is included in foul water or wastewater such as sewage, food waste and livestock excretion thereby causing eutrophication; increasing the efficiency of removing the material by solidification; and using solidified good MAP, etc. as a fertilizer.

[16] Another effect of the present invention lies in feeding heat generated during the heat hydrolysis step back to recycle, and supplying energy necessary for heat hydrolysis by methane gas generated in digester or using such energy for generating electricity; thus saving energy and using energy efficiently.

[17]

Brief Description of the Drawings

[18] FIG. 1 illustrates a whole construction of an advanced apparatus for treating sludge according to the present invention.

[19] FIG. 2 illustrates another whole construction of an advanced apparatus for treating sludge according to the present invention.

[20] Description of drawing reference numbers

[21] 11. sedimentation tank 12. biological reactor

[22] 13. microorganism 14. desiccator

[23] 15. heat hydrolysis reactor 16. digester

[24] 17. desiccator 18. crystallization reactor

[25] 19. boiler 20. methane gas

[26] 21. desiccated cake 22. crystallized product

[27] 23. control tank 24. heat recovery tank

[28] 25. concentration tank or desiccator

[29] 26. sedimentation tank 27. crystallization material

[30] 28. disinfection-discharge

[31]

Best Mode for Carrying Out the Invention

[32] The present invention relates to an advanced apparatus and a method for treating sludge, which is designed and manufactured so that in order to remove nutritional salt material such as nitrogen and phosphorus, which is included in foul water or wastewater sludge thereby causing eutrophication, foul water or wastewater is sedimented in a first sedimentation tank and sedimented product is concentrated; the foul water or wastewater solution at the top is transferred to a biological reactor and microorganisms are poured thereto for microorganisms to remove a nutrient material and phosphorus and nitrogen that are eutriphication material; a solution containing sludge treated biologically is transferred to a second sedimentation tank, and supernatant is disinfected and then discharged, and sedimented product is concentrated together with the sediment of the first sedimentation tank by employing a concentration tank or a desiccator; concentrated sludge is desiccated with a first desiccator to lower the amount of sludge and then desiccated sludge is passed through a heat hydrolysis reactor to decompose a polymer formed spontaneously in the sludge flock and cell membrane of an organism simultaneously, thereby discharging phosphorus and nitrogen contained by microorganisms in some extent; phosphorus and nitrogen contained by microorganisms are discharged on digestion in an anaerobic digester properly controlling supply of nutrient source, temperature and pH; digested sludge is

desiccated with a desiccator; desiccated sludge is transferred to a crystallization reactor that a crystallization material is poured to form MAP or various crystallized material in order to remove nutrient salt material such as phosphorus and nitrogen, and at least one crystallized material selected from magnesium, potassium, zinc, calcium carbonate, phosphoric acid and calcium is poured to remove by crystallization; and a remaining solution after crystallization is fed back to a step prior to the biological reactor or the digester thereby being removed again through advanced treatment process.

[33] Since the solution passed through the desiccator 17 contains phosphorus and nitrogen, crystallization reactor 18 is set next to the second desiccator 17 in order to remove phosphorus and nitrogen efficiently through a step for crystallizing them into MAP. Crystallization material 27 of Mg^{2+} or Mg^{2+} and PO_4^{3-} is poured into the crystallization reactor 18 in a certain quantity to crystallize into MAP($Mg^{2+}NH_4^{+}PO_4^{3-}$), and then the crystallized product is discharged outside to store at a reservoir 22 for crystallized products for use as good fertilizer. An aqueous solution remaining after crystallization step is recycled to a step prior to the biological reactor 12 or the digester to remove again sludge, phosphorus and nitrogen. These steps are repeated in certain times.

[34] Since the crystallization reactor 18 depends greatly on the pouring amount of Mg^{2+} or Mg^{2+} and PO_4^{3-}, pH and reaction time, etc., optimum reaction condition must be satisfied in order to achieve efficient crystallization reaction. In order to achieve efficient reaction in the crystallization reactor 18, when the pouring molar ratio of Mg^{2+}: NH_4^{+}: PO_4^{3-} is adjusted to 1.0 to 1.4: 0.8 to 1.0 to 1.4, and crystallization reactor is maintained under pH of alkaline 9 to 12, crystallization efficiency becomes greatly high thereby achieving efficient crystallization and elevating treatment speed due to rapid reaction.

[35] Further, the present invention also relates to an advanced method for treating sludge wherein biological reaction step is performed so that phosphorus and nitrogen are removed by employing microorganisms; desiccation step is performed to lower the percentage of moisture content of the sludge in which microorganisms containing phosphorus and nitrogen are included; desiccated sludge resulting from desiccation step is subjected to heat hydrolysis step to decompose a polymer present in a solution; the resulting product is transferred to an anaerobic digester and subjected to digestion step to digest organic sludge; the sludge after digestion step is subjected to desiccation, and thus nitrogen and phosphorus present in some microorganisms are incinerated, carbonized, melted, or solidified to a fertilizer as desiccated cakes having the

percentage of moisture content below 70% together with microorganisms; since the solution discharged during desiccation contains much phosphorus and nitrogen because microorganisms alive in the digestion step discharge phosphorus and nitrogen during digestion in an anaerobic digester, the solution is transferred to crystallization reactor 18 to remove phosphorus and nitrogen present in the solution, and Mg^{2+} or Mg^{2+} and PO_4^{3-} is poured into the crystallization reactor in a certain quantity to crystallize, and then the MAP converted to solid is transferred to a reservoir 22 for crystallized products for use as good fertilizer; a solution generated during crystallization step is recycled to a step prior to the biological reactor or the digester to remove phosphorus and nitrogen again.

[36]

Mode for the Invention

[37] Embodiments of the present invention will be described based on the drawings. FIG. 1 depicts a whole construction of an advanced apparatus for treating sludge according to the present invention. FIG. 2 depicts another whole construction of an advanced apparatus for treating sludge according to the present invention.

[38] In an embodiment of the present invention and another embodiment thereof, desiccator 14, 17 is made up of one selected from a belt press, a filter press, and a desiccator and a centrifuge employing air pressure.

[39] A solution exited on concentration or desiccation is fed back to any step of prior end to retreat, or is purified and then disinfected to discharge.

[40] Hereinafter, construction elements according to the present invention are described in more detail. In general, since phosphorus and nitrogen are present in the amount of about hundreds to thousands mg per one liter in usual sludge contained in sewage sludge, food waste and livestock excretion, etc., the usual sludge greatly influences eutrophication of a river and a seawater. In particular, significantly high concentrations of phosphorus and nitrogen are contained in pig excretion.

[41] The biological reactor 12 is constructed so that microorganisms may eat out BOD load material, which is nutrient source contained in foul water or wastewater inlet 10, and phosphorus and nitrogen, which are eutrophication sources. Phosphorus gone into a microorganism is partly removed together with the microorganism during desiccation with a desiccator 17; however, since a usual apparatus for treating sludge discharges phosphorus, which microorganisms contain, during a digestion step in an anaerobic digester 16, and thus phosphorus and nitrogen are present together with nitrogen added from microorganisms in a solution exited from the desiccator 17 during a step for

treating desiccated cake 21.

[42] Since the solution passed through the desiccator 17 contains phosphorus and nitrogen, crystallization reactor 18 is set next to the second desiccator 17 in order to remove phosphorus and nitrogen efficiently through a step for crystallizing them into MAP. Crystallization material 27 of Mg^{2+} or Mg^{2+} and PO_4^{3-} is poured into the crystallization reactor 18 in a certain quantity to crystallize into MAP($Mg^{2+}NH_4^{+}PO_4^{3-}$), and then the crystallized product is discharged outside to store at a reservoir 22 for crystallized products for use as good fertilizer. An aqueous solution remaining after crystallization step is recycled to a step prior to the biological reactor 12 or the digester to remove again sludge, phosphorus and nitrogen. These steps are repeated in certain times.

[43] An advanced apparatus for treating foul water or wastewater sludge can be constructed by further including a usual incineration apparatus for incinerating cake desiccated with the desiccator 17, or a high temperature melt processing apparatus for melt processing the cake.

[44] An advanced apparatus for treating foul water or wastewater sludge can be constructed by further including an apparatus selected from a usual sludge solidifying apparatus for solidifying the cake desiccated with the desiccator 17 in order to use as a cover soil material, a usual sludge carbonizing apparatus for carbonizing in order to recycle as an industrial material, and a usual sludge dryer for drying in order to use as a fuel.

[45] In the apparatus according to the present invention, a step for incinerating or melting the cake desiccated with the desiccator can be further included, and a step selected from a step for solidifying the desiccated cake in order to use as a cover soil material, a step for carbonizing in order to recycle the cake as an industrial material, and a step for drying the cake in order to use as a fuel can be further included.

[46] The crystallization step can enhance crystallization efficiency and reaction speed when a crystal core is poured in proper quantity. An example of the crystal core includes pre-crystallized struvite sludge. Struvite sludge is a crystallized body bound in molar ratio of Mg^{2+}: NH_4^{+}: PO_4^{3-} = 1:1:1, and is in general said as Struvite or MAP. The form of its solid state is present as two types, i.e., $MgNH_4PO_4$ (MAP) or $MgNH_4PO_4 \cdot H_2O$(MAP Hydrate). The MAP is used as a fertilizer for gardening, a seedling, a golf course and various soils.

[47] Mg can be poured in the state of MgO, MgOH or $MgSO_4 \cdot H_2O$. In order to increase crystallinity, PO_4^{3-} can be poured using KH_2PO_4.

[48] The apparatus is constructed so that its desiccation efficiency can be elevated through hydrolyzing microorganism cells contained in sludge and chain-form polymers by heating them for 30 minutes to one hour under the condition of the inside temperature of the heat hydrolysis reactor 15 at 150℃ to 250℃, and the pressure at 3 to 12 bars; then digesting the resulting product in the digester 16; and then desiccating the product with the desiccator 17. The apparatus can be constructed so that it has preheating pretreatment step before desiccated sludge is transferred to heat hydrolysis reaction 15 by setting control tank 23 after lowering the percentage of moisture content with the desiccator 14.

[49] Energy can be saved by constructing the apparatus so that since the heat hydrolysis reactor 15 requires heat of 150℃ to 250℃ and the digester next to the reactor 15 must be maintained below 40℃, a heat recovery tank 24 is set between the heat hydrolysis reactor and the digester in order to recycle the heat of the heat hydrolysis reactor 15, and the recovered heat can be employed in maintaining the preheating pretreatment step of the at least one control tank 23 and/or the digester 16 at a constant temperature. Since the heat hydrolysis reactor 15 discharges, in some extent, phosphorus and nitrogen which microorganisms absorbed during heat hydrolysis reaction, phosphorus and nitrogen are present in the sludge.

[50] The digester 16 according to the present invention can be constructed so that the sludge having a temperature of 35℃ to 40℃ suitable to moderate temperature digestion produces a fatty acid or a volatile acid by microorganisms such as bacteria contained in the sludge with employing nutrients and energy sources which the sludge has; produced fatty acid lowers the quantity and odor of the sludge through a step for generating carbon dioxide (CO_2) and methane gas (CH_4); and the methane gas generated as a by-product is supplied as energy required to a boiler 19 for heating the heat hydrolysis reactor 15 or used as an energy source of generating electricity or heating.

[51] The apparatus according to the present invention can be constructed so that a means for controlling feed of nutrient source to sludge, temperature and pH properly is included in order to effect digestion efficiently at the digester 16, equilibrium can be achieved on forming an acid and methane gas through such control, and a digestion sludge as an end product consists of volatile and non-volatile particles, and thus if desiccated, can increase the percentage of desiccation while not emitting special odor.

[52] The present invention can be designed and manufactured so that the sludge heat-hydrolyzed in the heat hydrolysis reactor 15 without performing digestion step

employing the digester is passed through a desiccator, and some sludge are treated as desiccated cakes, and the solution generated during desiccation is transferred to the crystallization reactor 18 to crystallize and then remove phosphorus and nitrogen contained in the solution.

[53] Another advanced apparatus for treating sludge according to the present invention can be designed and manufactured so that the sludge heat-hydrolyzed in the heat hydrolysis reactor 15 is transferred to the crystallization reactor 18 to crystallize and then remove phosphorus and nitrogen contained in the solution, MAP converted to solid by crystallization reaction in the crystallization reactor 18 is transferred to a reservoir 22 for crystallized product to store and use as good fertilizer, the solution generated in crystallization step is transferred to the digester to digest, and then desiccated with a desiccator to form desiccated cake and remaining solution is fed back to prior step.

[54] Another advanced apparatus for treating sludge according to the present invention can be designed and manufactured so that the solution generated in crystallization step is fed back to the digester, and the sludge passed through crystallization step and digestion step is desiccated to form sludge cake and remaining solution is fed back to prior step.

[55] An advanced apparatus for treating usual sludge contained in sewage, food waste and livestock excretion according to the present invention can include a thermometer, a pressure gauge, a common sensor for detecting the quantity of stored sludge and other necessary sensors required in each step so that each step can be controlled efficiently and automatically.

[56] An advanced apparatus for treating foul water or wastewater sludge according to the present invention can include an apparatus control unit with a built-in PLC or micro-processor and memory, and control program in order to control efficiently engaged with valves and various sensors equipped to perform the multiple steps smoothly. The apparatus is constructed so that the apparatus control unit can be worked manually or automatically if needed engaged with a control button to work each step manually if needed, a pump to transfer sludge to necessary step according to the order, and valves that are set to a pipe, i.e., a side of a pipe to which sludge is transferred, and thus are opened and shut manually or automatically if needed.

[57] The apparatus control unit includes a display panel for user's convenience, and a means for monitoring whether each step is normally worked engaged with various sensors, or inputting a value required in control of each step, thereby setting and

storing it.

[58] A sedimentation tank, a biological reactor, a desiccator, a heat hydrolysis reactor, a digester and a crystallization reactor that are employed in the advance apparatus for treating sludge according to the present invention can be equipped with multiple numbers in parallel, or with omitting unnecessary apparatus. The apparatus consists of biological reaction step, desiccation step, heat hydrolysis step, digestion step and crystallization step of the advanced method for treating sludge according to the present invention, but can include further intermediate steps if needed. For example, sedimentation step employing a sedimentation tank to sediment sludge and control step by equipping with a control tank for preheating pretreatment prior to heat hydrolysis step can be further included, and some steps can be omitted if needed.

[59]

Industrial Applicability

[60] The present invention can provide an advanced apparatus and method for treating sludge that includes a biological reactor, a desiccator, a heat hydrolysis reactor, a digester and a crystallization reactor, and discharges nutritional salt material such as phosphorus and nitrogen contained in foul water or wastewater, etc. thereby causing eutrophication after removing the material by elevating the removing efficiency through optimization of conditions and solidification, and thus prevents eutrophication of a river and seawater and can use solidified MAP as good fertilizer, and can feed back the heat generated during heat hydrolysis step to recycle, and can provide energy required in heat hydrolysis by methane gas generated in the digester or can use in generating electricity to save energy and use it efficiently, and thus industrial applicability according to the present invention is very high.

[61]

Claims

[1] An advanced apparatus for treating foul water or wastewater sludge containing sewage sludge, food waste and livestock excretion including:
a desiccator to lower the percentage of moisture content of the sludge transferred from a sludge concentration tank;
a heat hydrolysis reactor to heat-hydrolyze a polymer and a microorganism cell membrane formed in microorganism flock of desiccated sludge to decompose at a constant temperature and pressure;
a digester to digest anaerobically the sludge in which the polymer is decomposed at lowered temperature easy to digest;
a desiccator to treat the anaerobically digested sludge to form desiccated cake by lowering the percentage of moisture content of the sludge;
a crystallization reactor to crystallize and then remove phosphorus and nitrogen in a solution generated in desiccation with the desiccator; and
an apparatus for incinerating or melting the cake desiccated with the desiccator.

[2] An advanced apparatus for treating foul water or wastewater sludge containing sewage, food waste and livestock excretion including:
a biological reactor manufactured so that nutrient, phosphorus and nitrogen contained in foul water or wastewater transferred from a sedimentation place are removed by pouring microorganisms;
a desiccator to lower the percentage of moisture content of the sludge transferred from the biological reactor;
a heat hydrolysis reactor to heat-hydrolyze a polymer and a microorganism cell membrane formed in microorganism flock of desiccated sludge to decompose at a constant temperature and pressure;
a digester to digest anaerobically the sludge in which the polymer is decomposed at suitable temperature easy to digest;
a desiccator to treat the anaerobically digested sludge to form desiccated cake by lowering the percentage of moisture content of the sludge;
a crystallization reactor to crystallize and then remove phosphorus and nitrogen in a solution generated in desiccation with the desiccator; and
an apparatus for incinerating or melting the cake desiccated with the desiccator.

[3] An advanced apparatus for treating foul water or wastewater sludge containing sewage sludge, food waste and livestock excretion including:

a desiccator to lower the percentage of moisture content of the sludge transferred from a sludge concentration tank;
a heat hydrolysis reactor to heat-hydrolyze a polymer and a microorganism cell membrane formed in microorganism flock of desiccated sludge to decompose at a constant temperature and pressure;
a digester to digest anaerobically the sludge in which the polymer is decomposed at lowered temperature easy to digest;
a desiccator to treat the anaerobically digested sludge to form desiccated cake by lowering the percentage of moisture content of the sludge;
a crystallization reactor to crystallize and then remove phosphorus and nitrogen in a solution generated in desiccation with the desiccator;
an apparatus for incinerating or melting the cake desiccated with the desiccator; and
a means for discharging the crystallized product resulting from the crystallization reactor outside and storing at a reservoir for crystallized product to use as a fertilizer, and feeding a solution remaining after reaction back to a step prior to digester.

[4] The apparatus according to any of claims 1 to 3, wherein the crystallization reactor is poured simultaneously with a certain quantity of magnesium or magnesium and phosphoric acid to form MAP crystallized product, and is poured with an alkali aqueous solution to maintain pH at 9 to 12.

[5] The apparatus according to any of claims 1 to 3, further including an apparatus selected from a sludge solidifying apparatus for solidifying the cake desiccated with the desiccator in order to use as a cover soil material, a sludge carbonizing apparatus for carbonizing in order to recycle as an industrial material, and a sludge dryer for drying in order to use as a fuel.

[6] An advanced method for treating foul water or wastewater sludge containing sewage, food waste and livestock excretion comprising:
desiccating to lower the percentage of moisture content of the sludge containing microorganisms that absorbed phosphorus and nitrogen after step of biological reaction;
heat-hydrolyzing to decompose a polymer and a microorganism cell membrane formed in microorganism flock of the sludge after transferring the desiccated sludge to a heat hydrolysis reactor;
digesting after transferring the sludge passed through the heat hydrolysis step to

an anaerobic digester;
desiccating to treat the sludge passed through the digestion step to form desiccated cake having low percentage of moisture content;
transferring phosphorus and nitrogen contained in solution remained, after desiccating phosphorus and nitrogen which microorganisms discharge during the anaerobic digestion step to form desiccated cake, to MAP crystallization reactor to crystallize them into solid and then remove them; and
incinerating or melting the cake desiccated with the desiccator.

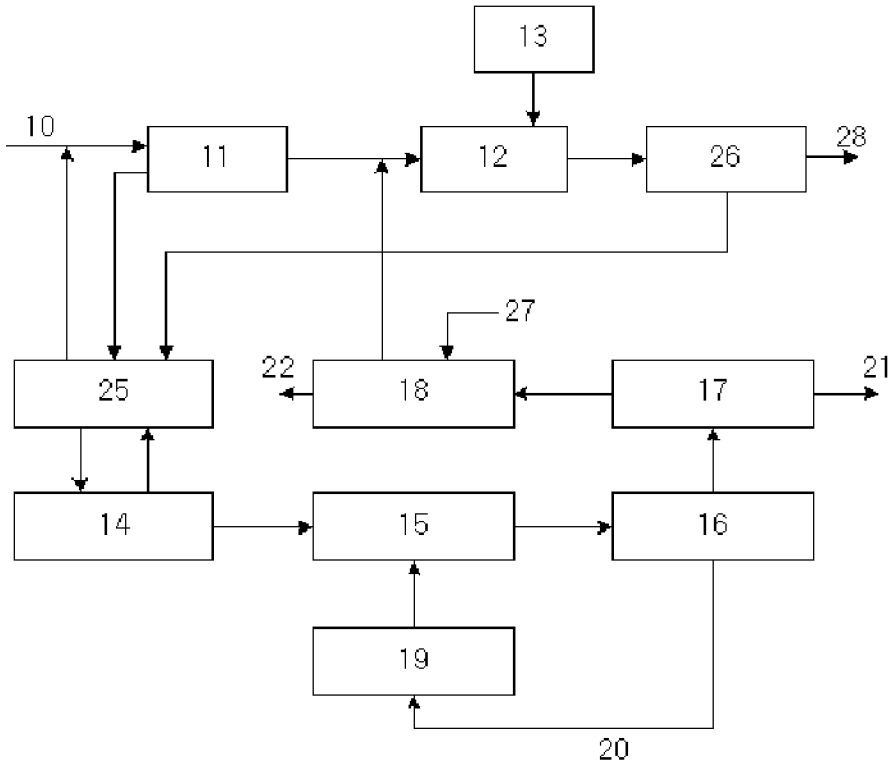
[7] An advanced method for treating foul water or wastewater sludge containing sewage, food waste and livestock excretion comprising:
desiccating to lower the percentage of moisture content of the sludge containing microorganisms that absorbed phosphorus and nitrogen after step of biological reaction;
heat-hydrolyzing to decompose a polymer and a microorganism cell membrane formed in microorganism flock of the sludge after transferring the desiccated sludge to a heat hydrolysis reactor;
digesting after transferring the sludge passed through the heat hydrolysis step to an anaerobic digester;
desiccating to treat the sludge passed through the digestion step to form desiccated cake having low percentage of moisture content;
transferring phosphorus and nitrogen contained in solution remained, after desiccating phosphorus and nitrogen which microorganisms discharge during the anaerobic digestion step to form desiccated cake, to MAP crystallization reactor to crystallize them into MAP;
transferring MAP generated during the crystallization step to a reservoir for a crystallized product in order to use as a fertilizer, and feeding a solution resulting from the crystallization step back to a step prior to the biological reaction step or the digestion step; and
incinerating or melting the cake desiccated with the desiccator.

[8] The method according to claims 6 or 7, wherein in the crystallization step, a certain quantity of magnesium or magnesium and phosphoric acid is poured simultaneously to form MAP crystallized product, and an alkali aqueous solution is poured to maintain pH at 9 to 12.

[9] The method according to claims 6 or 7, further including a step selected from a step for solidifying the cake desiccated with the desiccator in order to use as a

cover soil material, a step for carbonizing in order to recycle as an industrial material, and a step for drying in order to use as a fuel.

[Fig. 1]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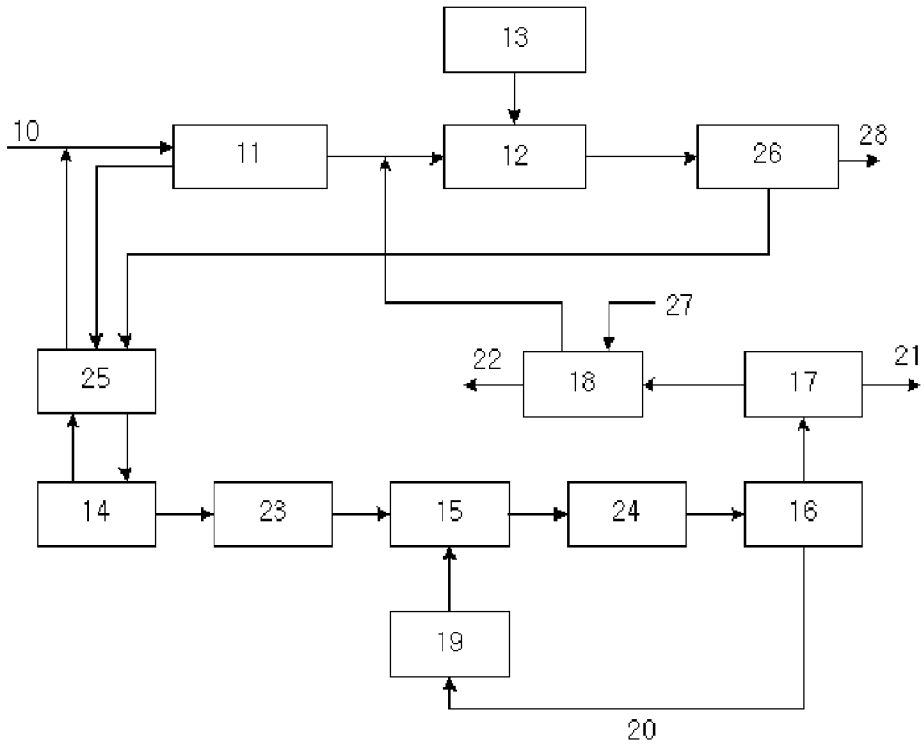
[Fig. 2]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