

SUBMERGED TYPE MEMBRANE SEPARATION SYSTEM FOR ADVANCED SEWAGE AND WASTE WATER TREATMENT

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a submerged type membrane separation system, and more particularly, to a submerged type membrane separation system for advanced sewage and wastewater treatment, which enhances efficiency of the sewage and wastewater treatment.

Background of the Prior Art

Generally, a submerged type membrane separation system filters sewage and wastewater to filter out particles and purify the sewage and wastewater.

As shown in FIG. 1, in the submerged type membrane separation system, a grit bath 10 hinders introduced sewage and waste water (original water) from rapidly flowing, precipitates sands and small grits contained in the original water, and transfers the original water to screen bath 20 having a plurality of screens 21 to filter out coarse deleterious particles contained in the original water by each screen 21. The original water from which the coarse deleterious particles are filtered out is uniformly leaked from the flow control bath 30 installed outside the screen bath 20.

The flow control bath 30 has an original water pump 31 and a water level sensor 33. The original water pump 31 has a pumping power to leak out the original water in the flow control bath 30. The water level sensor 33 is connected to the original water pump 31 to control the original water pump 31 according to the water level of the original water and connected to a suction pump 90 to be described below.

Therefore, the water level sensor 33 senses the

water level of the introduced original water, that is, high or low and the original water pump 31 is operated/stopped according to a sensing signal of the water level sensor 33 so that the a predetermined amount of the original water is leaked from the flow control bath 30.

In other words, if the water level sensor 33 senses the water level of the original water in the flow control bath 30 and determines that the water level of the original water is high, in other words, if the original water is filled in the flow control bath 30 to some level, the original water pump 31 is operated to leak the original water out of the flow control bath 30. If the water level of the original water is low, the original water pump 31 is not operated and the water level of the flow control bath 30 gets higher due to the original water supplied from the screen bath 20.

Since a blower 32 is installed outside the flow control bath 30, air generated by the blower 32 flows into the flow control bath 30 and water flow phenomenon occurs in the original water.

The original water leaked out from the flow control bath 30 flows into a microfiltration screen 40 and passes through the microfiltration screen 40 to be filtered. That is, micro deleterious particles are filtered out from the original water. The original water is introduced into an aeration bath 50 and mixed with mixed liquor in the aeration bath 50. The mixed liquor is made of the original water and MLSS (hereinafter, referred to as mixed liquor suspended solid or MLSS).

Since a blower 52 that supplies air into the aeration bath 50 is installed outside the aeration bath 50, the water flow phenomenon occurs in the mixed liquor due to the air supplied from the blower 52 and the MLSS of the MLSS eats organic contaminant. Thus, the organic contaminant in the aeration bath 50 is eliminated.

A membrane separation aerobic bath 60 is installed outside the aeration bath 50. The mixed liquor in the aeration bath 50 flows into the membrane separation aerobic bath 60 through a flow path, that is, a sleeve formed between the aeration bath 50 and the membrane separation aerobic bath 60.

Since at least one separation membrane unit 61 is installed in the membrane separation aerobic bath 60, the mixed liquor introduced into the membrane separation aerobic bath 60 passes through the separation membrane unit 61 and floating materials are filtered out from the mixed liquor at the same time.

Since a suction pump 90 is installed outside the membrane separation aerobic bath 60 and connected to the separation membrane unit 61, the mixed liquor in the membrane separation aerobic bath 60 is introduced into the separation membrane unit 61 due to the sucking force of the suction pump 90 according to the operation of the suction pump 90. Then, the mixed liquor passes through the separation membrane unit 61 and floating materials are filtered out from the mixed liquor at the same time.

The separation membrane unit 61 is installed inside the membrane separation aerobic bath 60 and guided by guide rails (not shown) fixedly installed in the membrane separation aerobic bath 60 to be submerged in and taken out from the membrane separation aerobic bath 60. As shown in FIG. 2, the separation membrane unit 61 includes a separation membrane frame 65 and a diffuser 66. The separation membrane frame 65 has a plurality of membranes for taking floating material out from the mixed liquor. The diffuser 66 is installed on the lower portion of the separation membrane frame 65 and supplies the separation membrane frame 65 with air sent from the outside.

The separation membrane frame 65 includes a supporter 651, a pair of upper module supporters 652, a lower module supporter 653, an interconnection pipe 654,

a plurality of separation membranes 655 and a plurality of collecting pipes 656. The supporter 651 is formed of a plurality of angles coupled with each other in a rectangle to form an outline of the separation membrane frame 65. The upper module supporter 652 is formed as a hollow pipe coupled with an upper portion of the supporter 651. The lower module supporter 653 is formed as a channel coupled with a lower portion of the supporter 651. The interconnection pipe 654 is formed as a hollow pipe, coupled with the upper module supporter 652 and connected to a high pressure hose extended from the suction pump 90, and also has an outlet to discharge water collected in the upper module supporter 652. The plurality of separation membranes 655 are installed between the lower module supporter 653 and the pair of upper module supporters 652 and filters out the floating material from the mixed liquor introduced into the separation membrane unit 61. The plurality of collecting pipes 656 are connectively installed at both sides of each separation membrane 655 and coupled with the lower module supporter 653 and the pair of upper module supporters 652, and collects the water filtered through the separation membrane 655.

The diffuser 66 includes a diffusion pipe 661, a plurality of nozzles 662 and a plurality of holes 663. The diffusion pipe 661 has an air inlet to introduce air from the outside and is formed as hollow pipes coupled with each other in a rectangle to form a flow path of the air introduced through the air inlet. The plurality of nozzles 662 are coupled with the inside of the diffusion pipe 661 to supply each separation membrane 655 with air and cause water flow to occur by means of the supplied air. The plurality of holes 663 are formed on each nozzle 662 to vent air bubbles.

The separation membrane unit 61 causes the mixed liquor flows from the membrane separation aerobic bath 60

into the separation membrane frame 65 by means of the sucking force of the suction pump 90. The introduced mixed liquor passes through each separation membrane 655 and the floating material is filtered out from the mixed liquor at the same time. The treated water from which the floating material is filtered out is collected in each of the collecting pipes 656.

The treated water that was collected in each of the collecting pipes 656 due to the sucking force generated by the continuous operation of the suction pump 90 is introduced into the pair of upper module supporter 652 and discharged from the separation membrane unit 61 through the outlet of the interconnection pipe 654, and passes through the suction pump 90 to flow into a treatment tank 70.

The air generated by the blower 62 is sent to the diffusion pipe 661 of the diffuser 66 installed at the lower portion of the separation membrane frame 65. The introduced air is vented in the form of air bubbles through the holes 663 of the nozzles 662 of the diffusion pipe 661 to generate water flow and supplied to each separation membrane 655 of the separation membrane frame 65 at the same time.

Therefore, the floating material of the filtered mixed liquor falls on a surface of each separation membrane 655. Also, the water flow prevents the floating material of the mixed liquor from being attached to each separation membrane 655.

Here, the floating material filtered out by each of the separation membrane is prevented from falling from or being attached to the separation membrane to some extent by the air that the diffuser supplies to each separation membrane of the separation frame in the form of air bubbles to cause water flow. However, since the floating material cannot be completely removed, if the separation membrane is used for long time period, the floating

material is attached to the separation membrane.

Therefore, the inflow amount of the mixed liquor introduced into the separation membrane unit 61 is reduced and the floating material contained in the mixed liquor cannot be fully filtered out.

So, the separation membrane unit 61 is taken out from the membrane separation aerobic bath 60 and each of the separation membranes 655 of the separation membrane unit 61 is chemically cleaned using chemicals, that is, cleaning solution such as a sodium hypochlorite (NaOCl) used to clean, so that the floating material attached to the each of the separation membranes 655 is removed.

Meanwhile, since the MLSS is contained in the mixed liquor in the membrane separation aerobic bath 60, the MLSS removes organic contaminant contained in the mixed liquor. Therefore, clean treated water from which the organic contaminant and the floating material were removed by the MLSS and the separation membrane unit 61 respectively is introduced into the treatment tank 70 by the continuously operating suction pump 90.

The water level sensor 64 is installed in the membrane separation aerobic bath 60, and the water level sensor 64 is connected with the water level sensor 33 of the flow control bath 30 and the suction pump 90.

Thus, the water level sensor 64 senses the water level of the mixed liquor of the membrane separation aerobic bath 60 and sends the sensing signal of the water level to the water level sensor 33 and the suction pump 90. The water level sensor 64 operates or stops the original water pump 31 according to the sent sensing signal and the suction pump 90 operates and stops, so that the water level of the membrane separation aerobic bath 60 is maintained constant.

In other words, if the water level of the flow control bath 30 gets higher and the water level of the mixed liquor of the membrane separation aerobic bath 60

gets lower, the water level sensor 64 sends a sensing signal to the water level sensor 33 of the flow control bath 30, and the water level sensor 33 sends a signal to the original water pump 31 so as to operate the original water pump 31 to continuously leak out the original water from the flow control bath 30 and sends another signal to the suction pump 90 so as to stop the suction pump 90 to prevent the treated water from flowing from the membrane separation aerobic bath 60 into the treatment tank 70.

If the water level of the flow control bath 30 gets lower and the water level of the mixed liquor of the membrane separation aerobic bath 60 gets higher, the original water pump 31 is stopped by the water level sensor 33 that received a sensing signal from the water level sensor 64, and the suction pump 90 is operated, so that the treated water flows from the membrane separation aerobic bath 60 into the treatment tank 70.

The treated water introduced from the membrane separation aerobic bath 60 into the treatment tank 70 and disinfectant 71 added thereinto well mix in the treatment tank 70 by water flow phenomenon due to the air supplied from the blower 72, so that the treated water is disinfected.

A water level sensor 74 is installed outside the treatment tank 70 and the discharge pump 73 is installed inside the treatment tank 70. The water level sensor 74 senses the water level of the treated water in the treatment tank 70. According to the sensed result, if the water level is high, the water level sensor 74 operates the discharge pump 73 to leak out the treated water from the treatment tank 70 and If the water level is lower, the water level sensor 74 stops the discharge pump 73 so that the treated water is contained in the treatment tank 70.

Since at least one sludge transfer pump 63 is installed in the membrane separation aerobic bath 60, the

mixed liquor in the membrane separation aerobic bath 60 is introduced to the aeration bath 50 by the sludge transfer pump 63. Then, the introduced mixed liquor is mixed with the original water that passes through the microfiltration screen 40. Then, the organic contaminant is removed by the MLSS from the mixed liquor mixed with the original water. The mixed liquor without the organic contaminant is introduced into the membrane separation aerobic bath 60.

Here, the concentration of MLSS in the membrane separation aerobic bath 60 should be maintained a predetermined concentration. If the MLSS concentration exceed a proper concentration, (as a result of sampling) a line to the aeration bath 50 is cut and a line to a sludge thickening underflow bath 80 opened so that the mixed liquor transferred by the sludge transfer pump 63 does not flow into the aeration bath 50 but flows into the sludge thickening underflow bath 80.

Since the blower 82 is installed outside the sludge thickening underflow bath 80, water flow phenomenon occurs in the sludge thickening underflow bath 80 due to the air supplied intermittently from the blower 82. The sludge contained in the mixed liquor introduced into the sludge thickening underflow bath 80 is prevented from being settled on and stuck to the bottom of the sludge thickening underflow bath 80.

When the amount of the sludge in the sludge thickening underflow bath 80 gets larger, the sludge is transferred from the sludge thickening underflow bath 80 to the outside. The upper water in the sludge thickening underflow bath 80 is transferred to the flow control bath 30 installed outside of the sludge thickening underflow bath 80 through a sleeve 81.

The state described above is maintained while the submerged type membrane separation system is operated.

However, the submerged type membrane separation

system for advanced sewage and wastewater treatment is excellent at removing floating material and organic contaminant but is not enough to remove some kinds of nitrogen and phosphorus from the mixed liquor while the water quality standard of discharged water becomes stricter. Thus, the submerged type membrane separation system may discharge the treated water that does not meet the standard.

In other words, it is limited to remove nitrogen or phosphorus from the sewage and wastewater by only the separation membrane unit. Since the nitrogen is not completely removed, only nitrification occurs, that is, the nitrogen is transformed to be easy for MLSS in the water to absorb. In the case of the phosphorus, the MLSS but hardly absorbs the phosphorus, so that the phosphorus can hardly be removed.

Therefore, since the treated water containing nitrogen or phosphorus is discharged, either rivers or soils are contaminated and animals and plants are also contaminated. Then, it is harmful to the human being who eats them and natural environment is also destroyed.

Furthermore, to clean each separation membrane of the separation membrane unit, the separation membrane unit is taken out from the membrane separation aerobic bath and submerged into a bucket containing cleaning chemicals. Then, the separation membrane unit should be installed in the membrane separation aerobic bath again. Therefore, it is very inconvenient to work and an additional space is required to put out and clean the separation membrane unit.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in an effort to solve the above-described problems of the conventional arts.

An object of the present invention is to modify the

structure of a submerged type membrane separation system to prevent impurities from being concentrated therein and to enhance a treatment efficiency of the sewage and wastewater.

Another object of the present invention is to eliminate trephones such as nitrogen and phosphorus to cause eutrophication as well as various floating material and organic contaminants at the same time.

Another object of the present invention is to sense pressure difference of each separation membrane, supply the cleaning chemicals according to the pressure difference, clean the separation membrane and cause the submerged type membrane separation system to work.

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided a submerged type membrane separation system for filtering and treating sewage and wastewater, which comprises a grit bath, a screen bath, a flow control bath, a microfiltration screen, a treatment tank and a sludge thickening underflow bath, includes: an anaerobic bath installed outside of the microfiltration screen for receiving original water sent from the microfiltration screen, removing contaminants from mixed liquor mixed with the original water and dissolve phosphorus; a membrane separation aerobic bath installed outside the anaerobic bath, for removing contaminants and phosphorous material from the mixed liquor and having a separation membrane unit with a plurality of separation membrane for removing floating material; an oxygen-free bath installed outside the membrane separation aerobic bath, for separating and removing nitrogen (N_2) and oxygen (O_2) from nitrate nitrogen contained in the mixed liquor by denitrification, and transferring the mixed liquor to the microfiltration screen through a transfer pump and a transfer line; a distribution line connected to the

microfiltration screen, for transferring the original water from the microfiltration screen to the anaerobic bath and the oxygen-free bath according to a predetermined ratio; and a transfer line connected to the transfer pump in the oxygen-free bath, for transferring the mixed liquor from the oxygen-free bath to the microfiltration screen.

According to another embodiment of the present invention, a submerged type membrane separation system for filtering and treating sewage and wastewater, which comprises a grit bath, a screen bath, a flow control bath, a microfiltration screen, a treatment tank and a sludge thickening underflow bath, the system includes: a membrane separation aerobic bath installed outside of the microfiltration screen, for removing contaminants and phosphorous material from the mixed liquor and having a separation membrane unit with a plurality of separation membrane for removing floating material.

It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the present invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the present invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the present invention and together with the description serve to explain the principle of the present invention. In the drawings:

FIG. 1 illustrates a general submerged type membrane separation system;

FIG. 2 is a disassembled perspective view of a separation membrane unit of a conventional submerged type

membrane separation system;

FIG. 3 illustrates a submerged type membrane separation system for advanced sewage and wastewater treatment according to an embodiment of the present invention;

FIG. 4A illustrates that an additional phosphorus coagulating means is installed in a submerged type membrane separation system for advanced sewage and wastewater treatment according to an embodiment of the present invention;

FIG. 4B illustrates that a pump is added to a phosphorus coagulating means shown in FIG. 4A;

FIG. 5 illustrates that a separation membrane cleaner is added to a submerged type membrane separation system for advanced sewage and wastewater treatment according to an embodiment of the present invention;

FIG. 6 illustrates that a chemical injection pump is added to a separation membrane cleaner shown in FIG. 5;

FIG. 7 illustrates that a timer is substituted for contact differential pressure gauge in FIG. 6;

FIG. 8 is a disassembled perspective view of a separation membrane unit according to an embodiment of the present invention;

FIG. 9A is a perspective view of a lifting apparatus for lifting up a separation membrane unit according to an embodiment of the present invention;

FIG. 9B is a disassembled perspective view of a lifting apparatus for lifting up a separation membrane unit;

FIG. 9C is a front view illustrating that a lifting apparatus lifts up a separation membrane unit according to an embodiment of the present invention;

FIG. 9D is a perspective view illustrating that a lifting apparatus for lifting up a separation membrane unit couples with and removes from a holder of a separation membrane frame; and

FIG. 10 illustrates a submerged type membrane separation system for advanced sewage and wastewater treatment according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to a preferred embodiment of the present invention with reference to the accompanying drawings.

FIG. 3 illustrates a submerged type membrane separation system for advanced sewage and wastewater treatment according to an embodiment of the present invention. FIG. 4A illustrates that an additional phosphorus coagulating means is installed in the submerged type membrane separation system for advanced sewage and wastewater treatment according to an embodiment of the present invention. FIG. 4B illustrates that a pump is added to a phosphorus coagulating means shown in FIG. 4A. FIG. 5 illustrates that a separation membrane cleaner is added to a submerged type membrane separation system for advanced sewage and wastewater treatment according to an embodiment of the present invention. FIG. 6 illustrates that a chemical injection pump is added to a separation membrane cleaner shown in FIG. 5. FIG. 7 illustrates that a timer is substituted for contact differential pressure gauge in FIG. 6. FIG. 8 is a disassembled perspective view of a separation membrane unit according to an embodiment of the present invention. FIG. 9A is a perspective view of a lifting apparatus for lifting up a separation membrane unit according to an embodiment of the present invention. FIG. 9B is a disassembled perspective view of the lifting apparatus for lifting up a separation membrane unit. FIG. 9C is a front view illustrating that the lifting apparatus lifting up a separation membrane unit according to an embodiment of the present invention. FIG. 9D is a

perspective view illustrating that the lifting apparatus for lifting up a separation membrane unit couples with and removes from a holder of a separation membrane frame.

In the present invention, a grit bath 10 is installed to introduce the sewage and waste water (original water), prevent the original water from rapidly flowing, and precipitate sands or small grits contained in the original water. A screen bath 20 with a plurality of screens 21 is installed outside the grit bath 10 to filter out coarse deleterious particles contained the original.

A flow control bath 30 is installed outside the screen bath 20 to receive the original water without the coarse deleterious particles and leak out a predetermined amount of the original water. The flow control bath 30 has an original water pump 31, a water level sensor 33 and an water flow agitator 34. The original water pump 31 has a pumping power to leak out the original water in the flow control bath 30. The water level sensor 33 senses the water level of the original water. The water flow agitator 34 generates water flow to agitate the original water.

A microfiltration screen 40 is installed outside the flow control bath 30 to filter out micro deleterious particles from the original water sent from the flow control bath 30.

A distribution line 120 is connected to the microfiltration screen 40 and distributes the original water from the microfiltration screen 40 according to a predetermined ratio. An anaerobic bath 100 is installed outside the microfiltration screen 40, receives some of the original water sent through distribution line 120, and contains a mixed liquor without oxygen (O_2) so that the mixed liquor is mixed with the introduced original water and the MLSS of the mixed liquor removes the organic material and dissolves phosphorus.

The water flow agitator 101 is installed inside the anaerobic bath 100 to generate water flow so that the introduced original water is well mixed with the mixed liquor in the anaerobic bath 100 and the MLSS contained in the mixed liquor.

The membrane separation aerobic bath 60 is installed outside the anaerobic bath 100, that is, at a rear end of the anaerobic bath 100 shown in the drawings to allow the MLSS contained in the mixed liquor to eat contaminants (organic material, dissolved material, etc.) and phosphorous material (PO_4^{3-}), remove floating material and transform ammonia nitrogen ($\text{NH}_3\text{-N}$) and nitrous nitrogen ($\text{NO}_2\text{-N}$) contained in the mixed liquor into nitrate nitrogen ($\text{NO}_3\text{-N}$) due to nitrification with supplied air.

The water flow agitator 112 is installed in the oxygen-free bath 110 to generate water flow to well mix the mixed liquor sent from the membrane separation aerobic bath 60 and the original water introduced through the distribution line 120.

Meanwhile, a separation membrane unit 61 is installed in the membrane separation aerobic bath 60 to receive the mixed liquor from the membrane separation aerobic bath 60 by sucking force of the suction pump 90, filter out floating material from the mixed liquor, and transfer the treated water without the floating material through the suction line 91 to the treatment bath 70 by the suction pump 90.

In other words, when the separation membrane unit 61 filter out the floating material and MLSS from the mixed liquor, the mixed liquor is divided into solid (floating material and MLSS) and liquid. The solid is filtered out by the separation membrane unit 61 and removed from the treated water.

The separation membrane unit 61 is guided by a guide rail (not shown) fixedly installed in the membrane separation aerobic bath 60 to be inserted into or taken

out from the membrane separation aerobic bath 60.

At least one sludge transfer pump 63 is installed inside the membrane separation aerobic bath 60 to transform ammonia nitrogen ($\text{NH}_3\text{-N}$) and nitrous nitrogen ($\text{NO}_2\text{-N}$) contained in the introduced mixed liquor into nitrate nitrogen ($\text{NO}_3\text{-N}$) due to nitrification with air supplied into the membrane separation aerobic bath 60, that is, in aerobic state, and have pumping power to discharge the mixed liquor containing the transformed nitrate nitrogen out of the membrane separation aerobic bath 60, that is, to a sludge thickening underflow bath 80.

A water level sensor 64 installed inside the membrane separation aerobic bath 60 is connected to the water level sensor 33 and the suction pump 90 to sense the water level of the membrane separation aerobic bath 60 and the water level sensor 64 sends the sensing signal to the water level sensor 33 of the flow control bath 30 and the suction pump 90 so that the water level sensor 33 controls operation of the original pump 31 and operation of the suction pump 90 to maintain the water level of the membrane separation aerobic bath 60.

As shown in FIG. 8, the separation membrane unit 61 installed in the membrane separation aerobic bath 60, for filtering out floating material contained in the mixed liquor includes a separation membrane frame 65 and a diffuser 66. The separation membrane frame 65 has a plurality of membranes 655. The diffuser 66 supplies the membranes 655 with air sent from a blower 62 so as to detach floating material from the membranes 655.

The separation membrane frame 65 includes a supporter 651, a pair of upper module supporters 652, a lower module supporter 653, an interconnection pipe 654, a plurality of separation membranes 655 and a plurality of collecting pipes 656. The supporter 651 is formed of a plurality of angles coupled with each other in a

rectangle and forms an outline of the separation membrane frame 65. The upper module supporter 562 is formed as a hollow pipe coupled with an upper portion of the supporter 651. The lower module supporter 653 is formed as a channel coupled with a lower portion of the supporter 651. The interconnection pipe 654 is formed as a hollow pipe, coupled with the upper module supporter 652 and connected to a high pressure hose extended from the suction pump 90, and also has an outlet to discharge water collected in the upper module supporter 652. The plurality of separation membranes 655 are installed between the lower module supporter 653 and the pair of upper module supporters 652 and filters out the floating material from the mixed liquor introduced into the separation membrane unit 61. The plurality of collecting pipes 656 are connectively installed at both sides of each separation membrane 655 and coupled with the lower module supporter 653 and the pair of upper module supporters 652, and collects the water filtered through the separation membrane 655.

The diffuser 66 includes a diffusion pipe 661, a plurality of nozzles 662 and a plurality of holes 663. The diffusion pipe 661 has an air inlet to introduce air from the outside and is formed as hollow pipes coupled with each other in a rectangle to form a flow path of the air introduced through the air inlet. The plurality of nozzles 662 are coupled with the inside of the diffusion pipe 661 to supply each separation membrane 655 with air and cause water flow to occur by means of the supplied air. The plurality of holes 663 are formed on each nozzle 662 to vent air to form bubbles.

The lifting apparatus 160 is installed outside the membrane separation aerobic bath 60 to lift up the separation membrane unit 61 so as to take out and insert the separation membrane unit 61 from and into the membrane separation aerobic bath 60.

As shown in FIG. 8, holders 657 are coupled with both side of a top surface of the separation membrane frame 65. The holders 657 has at least one holding hole 658 of a predetermined size. The shape of the holding hole 658 can be various as polygon such as circle, rectangle, etc.

As shown in FIGs. 9A through 9D, the lifting apparatus 160 includes a lifting frame 170, a hook plate 180 and a lifting link units 190. The lifting frame 170 is located at a top surface of the separation membrane frame 65, and has a bottom surface thereof contacting the top surface of the separation membrane frame 65. The hook plate 180 is connected to a chain block 1 over the lifting frame 170 and connected to the lifting frame 170 through a plurality of chains 2, and moves up and down along with the lifting frame 170 by the chain block 1. The lifting link units 190 are rotatably coupled with both sides of the lifting frame 170, and latches with and removing from the holders 657 of the separation membrane frame 65 to lift up the separation membrane frame 65 according to rotation.

The holders 657 are coupled with both sides of the top surface of the separation membrane frame 65 by means of bolts. Each of the holders 657 has at least one holding hole 658 which a pair of pickup links 192 of pickup link unit 190 are inserted into and removed from so as to couple and remove the lifting 170 with and from the separation membrane frame 65.

As shown in FIG. 9A, the pickup frame has a plurality of "U"-shaped channels 171 coupled with each other in a rectangular form and upper and lower guide rollers 172 and 173 are coupled rotatably with upper and lower corners of the lifting 170 so that the lifting 170 guided by the guide rails can reciprocate smoothly.

As shown in FIG. 9A, the upper and lower guide rollers 172 and 173 corresponding to each other with

respect to the lifting frame 170 are installed to be perpendicular to each other, that is, crossed with each other as shown in the drawings so that the lifting frame 170 can reciprocate smoothly as the upper and lower guide rollers 172 and 173 contact inner surfaces of the guide rail. The inner surfaces are different from each other.

The lifting frame 170 has a plurality of coupling holes 171a so as to be selectively coupled with I-bolt 3 and reduce friction between the lifting frame 170 and the water in the membrane separation aerobic bath 60 when the lifting frame 170 is submerged in the water of the membrane separation aerobic bath 60. The I-bolt 3 coupled with a coupling hole 171a of the coupling holes 171a is coupled with the chain 2.

The hook plate 180 has a plurality of coupling holes 180a so as to be coupled with I-bolt 3. The I-bolt 3 coupled with a coupling hole 180a on bottom of the hook plate 180 is coupled with each chain 2 coupled with the lifting frame 170.

In other words, an end of the chain 2 is coupled with each I-bolt 3 of the lifting frame 170 and the other end of the chain 2 is coupled with each I-bolt 3 of the hook plate 180.

The top surface of the hook plate 180 is coupled with a hook 181 to be coupled with link 1a of the chain block 1 so as to lift up the hook plate 180 and the lifting frame 170.

As shown in FIG. 9A and 9B, the lifting link units 190 include rotation shafts 191, pairs of lifting links 192, a tension chain 193 and a connection member 194. The rotation shafts 191 are coupled rotatably with both sides of the lifting frame 170. The pairs of lifting links 192 are coupled with both sides of each rotation shaft 191, rotate with respect to the rotation shaft 191 in order to lift up the separation membrane frame 65, and couple with and remove from the holder 657 of the

separation membrane frame 65. The tension chain 193 is connected to any one lifting 192 of each pair of lifting links 192 coupled with the rotation shaft 191, move along force transmitted from the outside and control the rotation of each pair of lifting links 192. The connection member 194 between the pair of lifting links 192 connects the pair of lifting links 192 to each other to rotate the lifting links 192 at the same time according to moving of the tension chain so as to couple a pair of lifting links 192 and remove with and from the holders 657 of the separation membrane frame 65.

At both ends of the rotation shafts 191, bearings 195 are coupled with an inner surface of the lifting frame 170, that is, are installed on the sides of the longer channels 171 so that each rotation shaft 191 rotates well.

The tension chain 193 has ends connected to each one lifting 192 of each pair of lifting links 192 and a predetermined portion connected to finger stop (not shown) of the membrane separation aerobic bath 60. Therefore, the pairs of lifting links 192 are rotated in an arrow direction as shown in FIG. 9D according to control such as drawing and releasing the tension chain 193 outside the membrane separation aerobic bath 60.

Meanwhile, as shown in FIG. 9D, when external force is applied and the tension chain 193 is drawn, the pairs of lifting links 192 are removed (depicted by a solid line) from each holding hole 658 of each holder 657. The pairs of lifting links 192 has weight center at lower portion thereof so that the pairs of lifting links 192 are rotated with respect to the rotation shafts 191 due to weight thereof and coupled (dotted line) with each holding hole 658 of each holder 657 when external force is removed.

The lifting frame 170 and the lifting link unit 190 submerged into the membrane separation aerobic bath 60,

that is, components of the separation frame lifting apparatus are made of stainless that is light and is not be rusted by water.

The oxygen-free bath 110 is installed outside the membrane separation aerobic bath 60, that is, at the rear end of the membrane separation aerobic bath 60 shown in the drawings to contain mixture of the mixed liquor sent from the membrane separation aerobic bath 60 and the original water sent through the distribution line 120 from the micro filtration screen 40.

The water flow agitator 112 is installed inside the oxygen-free bath 110 to generate water flow to well mix the mixed liquor sent from the membrane separation aerobic bath 60 and the mixed liquor in the oxygen-free bath 110 and to promote denitrification of the mixed liquors. The transfer pump 111 is installed inside the oxygen-free bath 110. The transfer pump 111 has a pumping force to transfer mixed liquor from the oxygen-free bath 110 to the microfiltration screen 40.

A transfer line 160 is connected to the transfer pump 111 and forms a flow path of the mixed liquor to transfer the mixed liquor from the oxygen-free bath 110 to the microfiltration screen 40.

The mixed liquor transferred to the microfiltration screen 40 through the transfer line 160 passes through the microfiltration screen 40 along with the original water sent from the flow control bath 30 and micro deleterious particles of the mixed liquor are filtered out one more time. Then, the mixed liquor is transferred to the anaerobic bath 100 and the oxygen-free bath 110.

A phosphorus coagulating means 140 is installed outside the membrane separation aerobic bath 60, and reacts with and coagulates phosphorous material (PO_4^{3-}) contained in mixed liquor in the membrane separation aerobic bath 60 so as to remove the phosphorous material (PO_4^{3-}).

As shown in FIG. 4A, a coagulation agent tank 141 is installed outside the membrane separation aerobic bath 60 and contains the coagulation agent that reacts with phosphorous material contained in the mixed liquor in the membrane separation aerobic bath 60 to coagulate the phosphorous material so as to remove the phosphorous material (PO_4^{3-}) in the mixed liquor. The tank 141 transfers the coagulation agent to the membrane separation aerobic bath 60 so that the coagulation agent reacts with the mixed liquor in the membrane separation aerobic bath 60. A coagulation agent flow line 142 is connected to the coagulation agent tank 141 and forms a flow path of the coagulation agent to supply and cut the coagulation agent to the membrane separation aerobic bath 60.

As the phosphorous material (PO_4^{3-}) is coagulated by the coagulation agent transferred from the coagulation agent tank 141 to the membrane separation aerobic bath 60, the coagulated phosphorous material and the coagulation agent are solidified. The coagulation agent is FeCl_3 or $\text{Al}_2(\text{SO}_4)_3$ that are apt to coagulate with phosphorous material. The coagulation agent may be anything that can coagulate with phosphorus besides the above-mentioned material.

An open/close valve 143 is installed at a predetermined location of the coagulation agent flow line, and opens and closes the supply path of the coagulation agent from the coagulation agent tank 141 to the membrane separation aerobic bath 60 through the coagulation agent flow line 142 in the manner of gravity flow.

As shown in FIG. 4B, a coagulation agent pump 144 is installed at the coagulation agent flow line 142 and forcibly pumps the coagulation agent from the coagulation agent tank 141 to the membrane separation aerobic bath 60.

Meanwhile, a separation membrane cleaner 150 is installed outside the membrane separation aerobic bath 60, senses a differential pressure caused by floating material filtered out by each separation membrane 655 of the separation membrane unit 65, and cleans each separation membrane 655 using cleaning chemical by the differential pressure.

The separation membrane cleaner 150 manually and automatically supplies the cleaning chemical to each separation membrane 655 of the separation membrane unit 61.

As shown in FIG. 5, the separation membrane cleaner 150 that manually supplies the cleaning chemical to each separation membrane 655 includes a cleaning chemical tank 151, a cleaning chemical supply line 152 and a contact differential pressure gauge 153. The cleaning chemical tank 151 is installed outside the membrane separation aerobic bath 60, and contains the cleaning chemical to supply the cleaning chemical to each separation membrane 655 of the separation membrane unit 61 of the membrane separation aerobic bath 60. The cleaning chemical supply line 152 is connected to the cleaning chemical tank 151 and has an end connected to a suction line 91 to form a flow path of the cleaning chemical. The contact differential pressure gauge 153 is installed at a predetermined portion of the suction line 91 connected to the separation membrane unit 61, senses differential pressure caused by 655 at each separation membrane according to a amount of floating material filtered out by each separation membrane 655, that is, a amount of the separation membrane 655 that is blocked when the mixed liquor passes through each separation membrane 655 of the separation membrane unit 65, and controls the operation of the suction pump 90 according to the differential pressure. The contact differential pressure gauge 153 stop the operation of the suction pump 90 when the

differential pressure of the separation membrane 655 is high, and operates the suction pump 90 when the differential pressure of the separation membrane 655 is low.

Usually, sodium hypochlorite (NaOCl) is used as the cleaning chemical and the cleaning chemical is made by mix crude liquid of sodium hypochlorite with water to dilute sodium hypochlorite to a predetermined concentration.

A first motor valve 154 is connected to the contact differential pressure gauge 153 and installed at the suction line 91, and opens and closes according to the sensing signal of the contact differential pressure gauge 153 so as to control that the treated water is introduced from the separation membrane unit 61 to the suction pump 90. A second motor valve 155 is connected to the contact differential pressure gauge 153 and installed at the cleaning chemical supply line 152, and opens and closes according to the sensing signal of the contact differential pressure gauge 153 so as to control supplying the cleaning chemical from the cleaning chemical tank 151 to each separation membrane 655 of the separation membrane unit 61.

In other words, when the treated water is introduced from the separation membrane unit 61 to the suction pump 90, that is, treatment bath 70, the first motor valve 154 is opened and the second motor valve 155 is closed due to the sensing signal from the contact differential pressure gauge 153 so as to introduce the treated water to the treatment bath 70 through suction line 91. When the cleaning chemical is supplied from the cleaning chemical tank 151 to the separation membrane unit 61, the first motor valve 154 is closed and the second motor valve 155 is opened so as to supply the cleaning chemical to the separation membrane unit 61 through the cleaning chemical supply line 152.

A level switch 156 is installed inside the cleaning chemical tank 151 to sense water level of the cleaning chemical and control the first motor valve 154 and the second motor valve 155 to open and close according to the water level of the cleaning chemical.

Meanwhile, as shown in FIG. 6, a chemical injection pump 157 is installed at the cleaning chemical supply line 152, and has pumping force to forcedly pump the cleaning chemical supplied from the cleaning chemical tank 151 to each separation membrane 655 of the separation membrane unit 61.

In other words, in order to supply the cleaning chemical to the separation membrane unit 51 in the manner of gravity flow as shown in FIG. 5, the chemical injection pump 157 is not installed. In order to forcedly pump the cleaning chemical to smoothly supply the cleaning chemical, the chemical injection pump 157 should be installed at the cleaning chemical supply line 152 as shown in FIG. 6. The installation of the cleaning chemical tank 151 can be modified according to location, space, design and purpose and effects of a pump.

Meanwhile, as shown in FIG. 7, a timer 158 may be installed at the suction line 91 instead of the contact differential pressure gauge 153, and repeatedly open and close the first motor valve 154 and the second motor valve 155 for a predetermined period. In other words, the timer 158 alternatively opens and closes the suction line 91 and the cleaning chemical supply line 152. Thus, when the treated water flows through the suction line 91, the cleaning chemical does not flow through the cleaning chemical supply line 152. To the contrary, when the cleaning chemical flows through the cleaning chemical supply line 152, the treated water does not flow through the suction line 91. As described above, since the first motor valve 154 and the second motor valve 155 are alternatively opened and closed according to the

operation of the timer 158, thereby controlling that the treated water and the cleaning chemical flow to the suction line 91 and the cleaning chemical supply line 152.

A PLC program substituting for the contact differential pressure gauge 153 or a timer 158 may be installed at the suction line 91 to periodically open and close the first motor valve 154 and the second motor valve 155.

Here, any one of the contact differential pressure gauge 153, the timer 158 and the PLC program can be used according to the purpose and application of the submerged type membrane separation system for advanced sewage and wastewater treatment and an order of the user.

In an embodiment of the present invention of the submerged type membrane separation system for advanced sewage and wastewater treatment, all, some or none of the phosphorus coagulating means 140, the separation membrane cleaner 150 and the lifting apparatus 160 can be installed variously according to the purpose and application of the submerged type membrane separation system for advanced sewage and wastewater treatment, installation space and an order of the user.

FIG. 10 illustrates the submerged type membrane separation system for advanced sewage and wastewater treatment according to another embodiment of the present invention. It is made by removing the anaerobic bath 100 and the oxygen-free bath 110 from the first embodiment of the submerged type membrane separation system for advanced sewage and wastewater treatment. The submerged type membrane separation system for advanced sewage and wastewater treatment according to another embodiment of the present invention includes a grit bath 10, a screen bath 20, a flow control bath 30 and a microfiltration screen 40, a membrane separation aerobic bath 60, and a transfer pump 63. The membrane separation aerobic bath

60 is installed to receive the original water that passed through the microfiltration screen 40 through the distribution line 120, and removes contaminants (organic material, dissolved material, etc.), floating material, phosphorous material, ammonia nitrogen and nitrous nitrogen from the original water. The membrane separation aerobic bath 60 has the separation membrane unit 61 and the sludge transfer pump 63.

The treatment bath 70 is installed to receive the clean treated water that passed through the separation membrane unit 61. The suction line 91 is installed to connect the separation membrane unit 61 of the membrane separation aerobic bath 60 to the treatment bath 70. The suction pump 90 is installed at suction line 91 to generate sucking force.

A sludge thickening underflow bath 80 is installed inside the membrane separation aerobic bath 60 to contain sludge pumped by the transfer pump 63.

The present invention works as follows.

The original water is introduced into the grit bath 10. The sands and small grits contained in the original water are precipitated. The original water is transferred to the screen bath 20 and passes through each of the screens 21 and coarse deleterious particles are filtered out. The original water without the coarse deleterious particle flows into the flow control bath 30. If the water level sensor 33 of the flow control bath 30 senses the water level of the introduced original water, the original water pump 31 is operated/stopped according to a sensing signal of the water level sensor 33 so that a predetermined amount of the original water is leaked from the flow control bath 30 to the outside or not.

Here, since the water flow agitator 34 is installed in the flow control bath 30, the water flow agitator 34 generates water flow in the original water in the flow control bath 30 and agitate the original water.

Meanwhile, the original water leaked out from the flow control bath 30 passes through the microfiltration screen 40 and micro deleterious particles are filtered out. The original water without micro deleterious particles is introduced into the distribution line 120.

Some of the original water flowing through the distribution line 120 is introduced into the anaerobic bath 100 and the remaining original water is introduced into oxygen-free bath 110. The original water flowing through the distribution line 120 is introduced to anaerobic bath 100 and the oxygen-free bath 110.

The original water introduced into the anaerobic bath 100 is mixed with the mixed liquor with MLSS contained in the anaerobic bath 100. The mixed liquor and the original water are well mixed with each other due to water flow caused by the water flow agitator 101 in the anaerobic bath 100.

The mixed liquor in the aerobic bath 100 has MLSS and the MLSS eats and removes the contaminants (organic material, dissolved material, etc.) and floating material. The phosphorous material (PO_4^{3-}) contained in the original water is dissolved under anaerobic condition.

Meanwhile, to maintain a proper concentration of MLSS in the mixed liquor in the anaerobic bath 100, the mixed liquor in the oxygen-free bath 110 is introduced into the anaerobic bath 100 through the transfer line 130 by the pumping force of the transfer pump 111 installed in the oxygen-free bath 110. Therefore, the mixed liquor in the anaerobic bath 100 is maintained to have a proper MLSS concentration.

Here, the mixed liquor transferred from the oxygen-free bath 110 to anaerobic bath 100 through the transfer line 130 passes through the microfiltration screen 40 one more time. The transferred mixed liquor is introduced into the anaerobic bath 100 without deleterious

particles.

The organic contaminant is removed in the anaerobic bath and the mixed liquor from which phosphorous material is dissolved is introduced into the membrane separation aerobic bath 60. The mixed liquor in the membrane separation aerobic bath 60 contains contaminants (organic material, solved material, etc.), floating material, phosphorous material (PO_4^{3-}), ammonia nitrogen ($\text{NH}_3\text{-N}$) and nitrous nitrogen ($\text{NO}_2\text{-N}$).

The contaminants (organic material, solved material, etc.) are food for the MLSS, and are consumed and removed by the MLSS's eating. The floating material is filtered out when the mixed liquor penetrates the separation membrane unit 61 installed in the membrane separation aerobic bath 60.

The ammonia nitrogen ($\text{NH}_3\text{-N}$) and the nitrous nitrogen ($\text{NO}_2\text{-N}$) are nitrified by the air sent from the blower 62 for supplying air to the membrane separation aerobic bath 60 and are transformed into the nitrate nitrogen ($\text{NO}_3\text{-N}$).

The phosphorous material (PO_4^{3-}) contained in the mixed liquor in the membrane separation aerobic bath 60 is overeaten by the MLSS in the mixed liquor and removed into water.

Here, when the mixed liquor in the membrane separation aerobic bath 60 contains a lot of phosphorous material and the phosphorous material is not properly treated, phosphorus coagulation agent is injected into the membrane separation aerobic bath 60 to react with and solidify the phosphorous material (PO_4^{3-}).

To inject the phosphorus coagulation agent, as shown in FIG. 4A, an additional phosphorus coagulating means 140 is installed.

In other words, since the phosphorous material usually exists in the form of PO_4^{3-} in the mixed liquor in the membrane separation aerobic bath 60, in order to coagulate the phosphorous material, the coagulation agent

contained in the coagulation agent tank 141 installed outside the membrane separation aerobic bath 60 should be supplied into the membrane separation aerobic bath 60.

To do this, the open/close valve 143 installed in the coagulation agent flow line 142 connected to the coagulation agent tank 141 is opened and the coagulation agent flows along the coagulation agent flow line 142 and the coagulation agent is injected into the membrane separation aerobic bath 60 in the way of gravity flow.

Then, the phosphorous material reacts with the coagulation agent and they are solidified. The coagulated phosphorous material is precipitated on bottom of the membrane separation aerobic bath 60.

At this time, if the phosphorous material in the mixed liquor of the membrane separation aerobic bath 60 is coagulated and solidified to some extent, the coagulation agent open/close valve 143 is closed to prevent the coagulation agent from flowing from the coagulant agent tank 141 into the membrane separation aerobic bath 60.

Here, if the submerged type membrane separation system is used for a long time period, the concentration of the membrane separation aerobic bath 60, that is, the concentrations of coagulated phosphorous material and MLSS are increased. To maintain constant concentration (5,000 ~ 12,000 mg/l) of the membrane separation aerobic bath 60, the sludge transfer pump 63 installed in the membrane separation aerobic bath 60 is operated to transfer the mixed liquor containing the coagulated and solidified phosphorous material and sludge from the membrane separation aerobic bath 60 to the sludge thickening underflow bath 80.

The coagulation agent for coagulating the phosphorous material is FeCl_3 or $\text{Al}_2(\text{SO}_4)_3$ that are apt to coagulate phosphorous material. The coagulation agent may be anything that can coagulate phosphorus besides the

above-mentioned material.

Meanwhile, as shown in FIG. 4B, a coagulation agent pump 144 is installed at the coagulation agent flow line 142 to forcibly pump the coagulation agent from the coagulation agent tank 141 to the membrane separation aerobic bath 60 so that the coagulation agent reacts with the phosphorous material rapidly to solidify the phosphorous material.

In other words, when the coagulation agent open/close valve 143 is opened and the coagulation agent pump 144 is operated so as to supply coagulation agent into the membrane separation aerobic bath 60, the coagulation agent in the coagulation agent tank 141 is forcibly supplied to the membrane separation aerobic bath 60 due to pumping force of the coagulation agent pump and reacts with the phosphorous material to coagulate the phosphorous material. If the phosphorous material is fully coagulated, the coagulation agent pump 144 is stopped and the coagulation agent open/close valve 143 is closed and the coagulation agent is prevented from flowing from the coagulation agent tank 141 to the membrane separation aerobic bath 60.

Meanwhile, ammonia nitrogen ($\text{NH}_3\text{-N}$) and nitrous nitrogen ($\text{NO}_2\text{-N}$) are nitrified and transformed into nitrate nitrogen ($\text{NO}_3\text{-N}$) in the membrane separation aerobic bath 60. The mixed liquor containing nitrate nitrogen ($\text{NO}_3\text{-N}$) is introduced into the oxygen-free bath 110.

The mixed liquor introduced into the oxygen-free bath 110 is mixed with the original water that is discharged from the microfiltration screen 40 through the distribution line 120. As the denitrification occurs due to denitrification microbe in the oxygen-free bath 110, the nitrogen (N_2) and the oxygen (O_2) are separated from the nitrate nitrogen contained in the mixed liquor and the nitrogen (N_2) and the oxygen (O_2) is discharged into

air.

Here, the organic carbon source necessary for activating the denitrification microbe is supplied from organic material in the original water introduced through the distribution line 120.

The mixed liquor introduced from the membrane separation aerobic bath 60 is mixed well with the original water introduced through the distribution line 120 by the water flow agitator 112 installed in the oxygen-free bath 110. Also, the sludge contained in the mixed liquor in the oxygen-free bath 110 by pumping of the transfer pump 111 installed the oxygen-free bath 110 is transferred along with the mixed liquor to the microfiltration screen 40 through the transfer line 130.

The mixed liquor sent to the microfiltration screen 40 passes through the microfiltration screen 40 along with the original water and micro deleterious particles are filtered out. The mixed liquor is introduced into the anaerobic bath 100 and an oxygen-free bath 110 at a predetermined ratio.

Meanwhile, the floating material in the membrane separation aerobic bath 60 is filtered out by at least one separation membrane unit 61 installed in the membrane separation aerobic bath 60. In other words, since the suction pump 90 connected to the separation membrane unit 61 is installed outside the membrane separation aerobic bath 60, the mixed liquor in the membrane separation aerobic bath 60 is introduced into the separation membrane unit 61 by the sucking force caused by the sucking pump 90, and passes through the separation membrane unit 61 so that the floating material is filtered out.

More detailed description will be made. The mixed liquor in the membrane separation aerobic bath 60 is introduced into the separation membrane frame 65 of the separation membrane unit 61 by the sucking force of the

suction pump 90. The introduced mixed liquor passes through each separation membrane 655 of the separation membrane frame 65 and the floating material is filtered out. The treated water without the floating material is collected into each collection pipe 656.

The treated water collected to each of the collection pipe by a sucking force generated by continuous operation of the suction pump 90 is introduced into a pair of upper module supporter 652, and flows from the separation membrane unit 61 through the outlet of the interconnection pipe 654. Then, the treated water passes the suction pump 90 and is introduced into the treatment bath 70.

Then, air generated by the blower 62 is introduced into the diffusion pipe 661 of the diffuser 66 installed at the lower portion of the separation membrane frame 65. The introduced air is vented through holes of the nozzle 662 of the diffusion pipe 661 to form air bubble and is supplied to the separation membrane 655 of the separation membrane frame 65.

Therefore, the floating material of the mixed liquor filtered out on each separation membrane 655 falls and the floating material of the mixed liquor is prevented from being attached to the separation membrane 655.

Here, the floating material of the mixed liquor filtered out on each separation membrane 655 is prevented from falling or being attached to the separation membrane 655 to some extent due to the air supplied from the diffuser in the form of air bubbles to generate the water flow to each separation membrane 655 of the separation membrane frame 65. However, it is not fully removed. If the separation membrane 655 is used for a long time period, the floating material is attached to the separation membrane 655.

so, the inflow amount of the mixed liquor introduced into the separation membrane unit 61 is reduced and the

floating material contained in the mixed liquor cannot be fully filtered out.

Therefore, The separation membrane unit 61 is taken out from the membrane separation aerobic bath 60 and each of the separation membranes 655 of the separation membrane unit 61 is chemically cleaned using chemicals, that is, cleaning solution such as a sodium hypochlorite (NaOCl) used to clean, so that the floating material filtered out on the each of the separation membranes 655 is removed.

Here, in order to lift the separation membrane unit 61 up from the membrane separation aerobic bath 60, an additional lifting apparatus 160 is necessary.

As shown in FIGs. 9A to 9D, each I-bolt 3 is coupled with a plurality of coupling holes 171a selected among the coupling holes 171a and is coupled with an end of the chain 2.

At the same time, a link 1a of the chain block 1 is coupled with a hook 181 coupled with the top surface of the hook plate 180. Each I-bolt 3 is coupled with each of the coupling holes 180a of the coupled hook plate 180 and is coupled with the other end of the chain 2. The lifting frame 170 and the hook plate 180 are connected to each other through each chain 2.

In this state, since the chain block 1 is operated (positive direction), the hook plate 180 is lifted up over the membrane separation aerobic bath 60 and each chain 2 connected to the hook plate 180 becomes taut. Accordingly, the lifting frame 170 is also lifted up along with the hook plate 180.

Then, if the lifting apparatus 160 is moved to be positioned over the separation membrane unit 61 in the membrane separation aerobic bath 60 and the chain block 1 is operated in reverse, the hook plate 180 and the lifting frame 170 are lifted down.

When the bottom of the lifting frame 170 are lifted

down meets the top surface of the separation membrane unit 61, the chain block 1 is stopped.

At this time, since the tension chain 193 is loose outside the membrane separation aerobic bath 60, a predetermined position of the tension chain 193 is drawn and loosened, pairs of lifting link 192 are rotated by the tension chain 192 with respect to a rotation shaft 191 and coupled with each holder 657 coupled with both upper sides of the separation membrane 61 by coupling bolts.

In other words, the pairs of the lifting links 192 are rotated to the inner side of the lifting frame 170 by the drawn tension chain 193 as shown by a solid line of FIG. 9D. the pairs of the lifting links 192 are rotated to the outer side of the lifting frame 170 by the loosened tension chain 193 as shown by a dotted line of FIG. 9D. So, the lifting links 192 are inserted into and coupled with the holding holes 658 of the holders 657.

Here, since the pairs of the lifting links 192 have a gravity center at lower portion thereof and the pairs of the lifting link 192 are rotated to the outer side of the lifting frame 170 by the loosened tension chain 193, the pairs of lifting links 192 are inserted into and coupled with the holding hole 658 of the holder 657 coupled with both sides of the top surface of the separation membrane 61.

As described above, the pairs of lifting links 192 are coupled with the holders 657 of the separation membrane unit 61. In the condition described above, if the chain block 1 is operated in positive direction to lift the lifting frame 170, the separation membrane unit 61 is lifted up along with the lifting frame 170.

The separation membrane unit 61 is guided by guide rails to get out of the guide rails due to the lifting frame 170 that is moving up. If the lifting frame 170 is lifted up higher, the separation membrane unit 61 is

taken out from the membrane separation aerobic bath 60.

Here, the separation membrane unit 61 and the lifting frame 170 are guided by guide rails having the shape of "L" to move. In other words, since the upper and lower guide rollers 172 and 173 are perpendicularly coupled with each other, the upper and lower guide rollers 172 and 173 contact different inner surfaces of the vertically standing guide rail, respectively. The upper and lower guide rollers 172 and 173 rotate well along different inner surfaces of the guide rail due to the lifting frame 170 that is moving up. The lifting frame 170 reciprocates well.

Therefore, the lifting frame 170 and the separation membrane unit 61 can be taken out along the guide rail without fluctuation by the guide rail and the upper and lower guide rollers 172 and 173.

The separation membrane unit 61 that got out of the guide rail and was taken out from the membrane separation aerobic bath 60 is brought to the space or the place for repair and cleaning outside the membrane separation aerobic bath 60. The chain block 1 is operated in reverse and the separation membrane unit 61 is placed on the floor.

Then, the separation membrane unit 61 is repaired or cleaned. Otherwise, the separation membrane unit 61 is submerged into the bucket containing cleaning chemical such as sodium hypochlorite (NaOCl) so that the separation membranes 655 of the separation membrane unit 61 are chemically cleaned and the floating material filtered out on the separation membrane 655 is removed.

If the separation membrane unit 61 is completely repaired and cleaned and the separation membrane unit 61 is completely cleaned, the separation membrane unit 61 is inserted into the membrane separation aerobic bath 60 in the manner described above by the chain block 1 and the lifting frame 170 to perform its own functions.

In other words, if the separation membrane unit 61 is completely inserted into the guide rail in the membrane separation aerobic bath 60, the lifting apparatus 160 should be taken out from the membrane separation aerobic bath 60.

To do this, a pair of lifting links 192 coupled with holder 657 of the separation membrane unit 61 should be removed from the holding hole 658 of the holder 657. In other words, if a tension chain 193 coupled with a pair of lifting links 192 is drawn outside the membrane separation aerobic bath 60, a pair of the lifting links 192 are rotated to the inner side of the lifting frame 170 with respect to a rotation shaft 191 as shown by a solid line of FIG. 9D. a pair of lifting link 192 are removed from the holding hole 658 of the holder 657.

Then, if the chain block 1 is operated in positive direction, the hook plate 180 is lifted up and the lifting frame 170 removed from the separation membrane unit 61 is also lifted up.

Then, under the condition that the separation membrane unit 61 is positioned in the guide rail installed fixedly in the membrane separation aerobic bath 60, if the submerged type membrane separation activated sludge system is operated, contaminants of the sewage and wastewater are filtered out by the separation membrane unit 61 and the sewage and wastewater is cleaned.

Here, the operation of the lifting apparatus 160 will be described in brief. According the operation of the chain block 1, the lifting frame 170 is reciprocated up and down. As the tension chain 193 is drawn and loosened, the pairs of the lifting links 192 are rotated to be coupled with or removed from a holder 637 of the separation membrane unit 61. So, the lifting frame 170 and the separation membrane unit 61 are coupled with or removed from each other. Accordingly, the separation membrane unit 61 is taken out from or inserted into the

membrane separation aerobic bath 60 by the lifting frame 170.

As described above, the separation membrane unit 61 may be taken out from the membrane separation aerobic bath 60 and the separation membranes 655 are cleaned. Also, as shown in FIG. 5, the cleaning chemical may be automatically supplied to each separation membrane 655 of the separation membrane unit 61.

In other words, as shown in FIG. 5, if the floating material filtered out by the separation membrane 655 makes the contamination of the separation membranes 655 worse and the separation membranes 655 is blockaded, the contact differential pressure gauge 153 senses the differential pressure due to the blockade.

According to the sensed differential pressure, the contact differential pressure gauge 153 controls the open/close of the first motor valve 154 of a suction line 91 and the second motor valve 155 of cleaning chemical supply line 152.

In other words, when the sensed differential pressure sensed by the contact differential pressure gauge 153 does not exceed a predetermined differential pressure, the second motor valve 155 is closed and the first motor valve 154 is opened. Due to the sucking force of the suction pump 90, the mixed liquor is introduced into the separation membrane unit 61 and the cleaned treated water flows through the suction line 91 and is introduced into the treatment tank 70.

When the sensed differential pressure sensed by the contact differential pressure gauge 153 exceeds the predetermined differential pressure, the separation membranes 655 should be cleaned so that floating material can be removed from the surface of the separation membrane 655.

In order to clean the separation membranes 655, the first motor valve 154 is closed and the second motor

valve 155 is opened according to the sensing signal sent by the contact differential pressure gauge 153. The suction pump 90 and the blower 62 are both stopped.

Therefore, the treated water is prevented from flowing into the suction line 91 and the opened second motor valve 155 allows the clean chemical to flow from the cleaning chemical tank installed outside the membrane separation aerobic bath 60 through the clean chemical supply line 152, pass the opened second motor valve 155, and be supplied to separation membrane unit 61.

The cleaning chemical supplied to the separation membrane unit 61 passes through the upper module supporters 652 of the separation membrane frame 65 and the collecting pipe 656 and transferred to the separation membrane 655. The floating material attached to the surface of each separation membrane 655 falls and is removed due to the supplied cleaning chemical so that each of the separation membranes 655 is cleaned.

Meanwhile, the cleaning chemical is supplied from the cleaning chemical tank 151 to the separation membrane unit 61 by the second open/close motor valve 155 in a gravity flow way, or the chemical injection pump 157 can be installed at the cleaning chemical supply line 120 as shown in FIG. 6 to forcibly supply the cleaning chemical to the separation membrane unit 61 by the pumping force of the chemical injection pump 157. This can be variously selected depending on a product specification, a work object and effect or the like.

If the cleaning of each separation membrane 655 is completed or if the cleaning chemical is at a low water level within the cleaning chemical tank 151 as described above, the second motor valve 155 is closed to block the cleaning chemical supply line 152 and at the same time, the first motor valve 154 is opened to open the suction line 91. Therefore, while the suction line 90 and the blower 62 are operated, the submerged type membrane

separation system for the advanced sewage and wastewater treatment is normally operated to treat the sewage and wastewater thereby generating the clean treated water.

Herein, opening and closing the first and second motor valves 154 and 155 using the low water level of the cleaning chemical tank 151 are accomplished by the level switch 156 installed within the cleaning chemical tank 151. Since the level switch 156 is installed inside the cleaning chemical tank 151, the level switch 156 senses the water level of the cleaning chemical within the cleaning chemical tank 151.

In other words, if the cleaning chemical is supplied to each separation membrane 655 from the cleaning chemical tank 151 so as to clean each separation membrane 655 thereby causing the water level of the cleaning chemical to be lowered within the cleaning chemical tank 151, this lowered water level is sensed by the level switch 156 such that the sensing signal is not only transmitted to the first and second motor valves 154 and 155 to open and close the first and second motor valves 154 and 155, but also the sensing signal is transmitted to the suction line 90 and the blower 62 to control the suction line 90 and the blower 62 to operate or not.

Herein, the cleaning chemical is supplied to each separation membrane 655 of the separation membrane unit 61 in the manner of the gravity flow as in FIG. 5, or is forcibly supplied using the chemical injection pump 157 installed at the cleaning chemical supply line 152 as shown in FIG. 6. This can be variously installed according to an object and a use of the submerged type membrane separation system for the advanced sewage and wastewater, or according to a specification requested by a user.

In the meanwhile, the differential pressure generated from each separation membrane 655 of the separation membrane unit 61 can be sensed using the

contact differential pressure gauge 153 as shown in FIGs. 5 and 6. Or, instead of the contact differential pressure gauge 153, the timer 158 and the programmed PLC program can be installed to periodically open and close the first and second motor valves 154 and 155 during a predetermined time as in FIG. 7. Any one of the contact differential pressure gauge 153, the timer 158 and the programmed PLC program can be selected and used according to the object or the use of the submerged type membrane separation system for the advanced sewage and waste treatment and according to the request of a user.

As described above, the mixed liquor within the separation membrane unit 61 passes through each separation membrane 655 by the sucking force of the suction pipe 90 to be produced as the clean treated water without the floating material. The treated water is collected and flowed into the collecting pipe 656 of the separation membrane unit 61 by the continuously operating suction pump 90, and then is introduced into a pair of upper module supporters 652 of the separation membrane frame 65 to be discharged to an external of the separation membrane unit 61 through the interconnection pipe 654 connected to the upper module supporter 652. Accordingly, while the discharged water flows into the suction line 91 connected with the interconnection pipe 654, it passes through the suction pipe 90 to be introduced into the treatment tank 70.

Further, the water level sensor 64 is installed at the membrane separation aerobic bath 60. The water level sensor 64 is connected with the water level sensor 33 of the flow control bath, and also is connected with the suction pipe 90.

Therefore, the water level sensor 64 senses the water level of the mixed liquor of the membrane separation aerobic bath 60 such that the sensing signal is transmitted to the water level sensor 33 and the

suction pump 90. The water level sensor 64 operates and stops the original water pump 31 according to the transmitted sensing signal. Also, as the suction pump 90 operates and stops, the water level of the membrane aerobic bath 60 is constantly maintained.

In other words, if the water level of the flow control bath 30 is at a high level and the water level of the mixed liquor within the membrane separation aerobic bath 60 is at a low level, the water level sensor 64 transmits the sensing signal to the water level sensor 33 of the flow control bath 30. As the water level sensor 33 transmits the sensing signal to the original water pump 31 to operate the original water pump 31, the original water continues to flow out from the flow control bath 30. At the same time, as the water level sensor 33 transmits the sensing signal to the suction pump 90 to stop the operation of the suction pump 90, the treated water is prevented from flowing from the membrane separation aerobic bath 60 to the treatment tank 70.

Additionally, if the water level of the flow control bath 30 is at the low level and the water level of the mixed liquor of the membrane separation aerobic bath 60 is at the high level, the original water pump 31 is not only stopped by the water level sensor 33 receiving the sensing signal from the water level sensor 64, but also the suction pump 90 is operated thereby allowing the treated water to flow from the membrane separation aerobic bath 60 into the treated tank 70.

The phosphor agglomerator 140, the separation membrane cleaner 150, the lifting apparatus 160 and the like can be all installed, or only some of them can be installed or not.

As described above, the present invention has effects in that a structure of the submerged type membrane separation system for the advanced sewage and waste water treatment is modified, that is, the anaerobic

bath, the membrane separation aerobic bath and the oxygen-free bath are installed and also, the original water is distributed to the anaerobic bath and the oxygen-free bath at the microfiltration screen and the mixed liquor is transferred from the oxygen-free bath to the fine filtration screen such that micro deleterious particles are once more filtered thereby preventing the deleterious particles within the system from being thickened, and also enhancing the treatment efficiency of the sewage and waste water by the system.

In other words, the present invention has effects of concurrently eliminating various floating materials and contaminants (the organic material, the dissolved material and the like), and also nitrogen and phosphor as the trephones causing an occurrence of the eutrophication.

Further, the present invention has an effect in that the phosphor agglomerater for agglomerating the phosphorous material is provided at the external of the membrane separation aerobic bath such that as the phosphorous material contained in the mixed liquor of the membrane separation aerobic bath is agglomerated by the aggregating agent supplied from the phosphor agglomerater, the phosphorous material is a little more smoothly eliminated from the mixed liquor of the membrane separation aerobic bath thereby enhancing the efficiency of the submerged type membrane separation system for the advanced sewage and waste water treatment.

Additionally, the present invention also has an effect in that the separation membrane cleaner for supplying the cleaning chemical is provided at the external of the membrane separation aerobic bath such that in case that the blockade phenomenon is caused by the floating material at each separation membrane, the differential pressure of each separation membrane is sensed such that the separation membrane cleaner supplies

the cleaning chemical to each separation membrane of the separation membrane unit to clean each separation membrane thereby smoothly managing the submerged type membrane separation system for the advanced sewage and waste water treatment.

The present invention also has an effect in that as the generation of the treated water at the separation membrane unit, the cleaning of each separation membrane and the like are automatically performed as described above, there is no need for a regular check or monitor thereby not only reducing a time and human power loss and improving the work efficiency but also improving an entire efficiency of the submerged type membrane separation system for the advanced sewage and waste water treatment.

The above effects not only improve the efficiency of the submerged type membrane separation system for the advanced sewage and wastewater treatment, but also improve a consumer's reliability for the product.

The foregoing embodiment is merely exemplary and is not to be construed as limiting the present invention. The present teachings can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.

Claims

1. A submerged type membrane separation system for filtering and treating sewage and wastewater, which comprises a grit bath, a screen bath, a flow control bath, a microfiltration screen, a treatment tank and a sludge thickening underflow bath, the system comprising:

an anaerobic bath installed outside of the microfiltration screen for receiving original water sent from the microfiltration screen, removing contaminants from mixed liquor mixed with the original water and dissolve phosphorus;

a membrane separation aerobic bath installed outside the anaerobic bath, for removing contaminants and phosphorous material from the mixed liquor and having a separation membrane unit with a plurality of separation membrane for removing floating material;

an oxygen-free bath installed outside the membrane separation aerobic bath, for separating and removing nitrogen (N_2) and oxygen (O_2) from nitrate nitrogen contained in the mixed liquor by denitrification, and transferring the mixed liquor to the microfiltration screen through a transfer pump and a transfer line;

a distribution line connected to the microfiltration screen, for transferring the original water from the microfiltration screen to the anaerobic bath and the oxygen-free bath according to a predetermined ratio; and

a transfer line connected to the transfer pump in the oxygen-free bath, for transferring the mixed liquor from the oxygen-free bath to the microfiltration screen.

2. The system of claim 1, further comprising:

a phosphorus coagulating means outside the membrane separation aerobic bath, for reacting with phosphorous material contained in mixed liquor in the membrane separation aerobic bath to coagulate the phosphorous

material.

3. The system of claim 2, wherein the phosphorus coagulating means comprises:

- a coagulation agent tank installed outside the membrane separation aerobic bath, for containing coagulation agent to react with phosphorous material contained in mixed liquor in the membrane separation aerobic bath to coagulate the phosphorous material;

- a coagulation agent flow line connected to the coagulation agent tank, for forming a flow path of the coagulation agent to supply the coagulation agent to the membrane separation aerobic bath; and

- a coagulation agent open/close valve installed at a predetermined location of the coagulation agent flow line, for opening and closing to supply and cut the coagulation agent to and from the membrane separation aerobic bath.

4. The system of claim 3, further comprising:

- a coagulation agent pump installed at the coagulation agent flow line, for pumping the coagulation agent from the coagulation agent tank to the membrane separation aerobic bath.

5. The system of claim 1, further comprising:

- a separation membrane cleaner installed outside the membrane separation aerobic bath, for sensing differential pressure by floating material filtered out by each separation membrane of the separation membrane unit, and cleaning each separation membrane by cleaning chemical.

6. The system of claim 5, wherein the separation membrane cleaner comprises:

- a cleaning chemical tank installed outside the

membrane separation aerobic bath, for containing the cleaning chemical to supply the cleaning chemical to the separation membrane unit of the membrane separation aerobic bath;

a cleaning chemical supply line connected to the cleaning chemical tank and having an end connected to a suction line for forming a flow path of the cleaning chemical;

a contact differential pressure gauge installed at the suction line connected to the separation membrane unit, for sensing differential pressure caused by the mixed liquor passing through the separation membrane at each separation membrane, and controlling operation of a suction pump according to the sensed differential pressure;

a first motor valve connected to the contact differential pressure gauge and installed at the suction line, for opening and closing according to the sensing signal of the contact differential pressure gauge so as to control the transferring a treated water from the suction pump to the separation membrane unit;

a second motor valve connected to the contact differential pressure gauge and installed at the cleaning chemical supply line, for opening and closing according to the sensing signal of the contact differential pressure gauge so as to control supplying the cleaning chemical from the cleaning chemical tank to the separation membrane unit; and

a level switch installed inside the cleaning chemical tank, for sensing water level of the cleaning chemical and controlling the first motor valve and the second motor valve to open and close according to the water level of the cleaning chemical.

7. The system of claim 6, further comprising:
a timer substituting for the contact differential

pressure gauge and installed at the suction line, for repeatedly opening and closing the first motor valve and the second motor valve for a predetermined period.

8. The system of claim 6, further comprising:

a PLC program substituting for the contact differential pressure gauge and installed at the suction line, for periodically opening and closing the first motor valve and the second motor valve.

9. The system of claim 6, further comprising:

a chemical injection pump installed at the cleaning chemical supply line, for pumping the cleaning chemical from the cleaning chemical tank to the separation membrane unit.

10. The system of claim 1, further comprising:

a separation membrane unit lifting apparatus installed outside the membrane separation aerobic bath, for lifting up the separation membrane unit so as to take out and insert the separation membrane unit from and into the separation membrane unit.

11. The system of claim 1, wherein the separation membrane unit lifting apparatus comprises:

a lifting frame located at a top surface of the separation membrane unit, and having a guide roller at each corner of upper portion and lower portion to move forth and back and a plurality of "Z"-shaped channels coupled with each other in a rectangular form so as to contact top surface of the separation membrane unit;

a hook plate connected to a chain block over the lifting frame and connected to the lifting frame through a plurality of chains, for moving up and down along with the lifting frame; and

lifting link units rotatably coupled with both sides

of the lifting frame, for latching with and removing from the holder coupled with both sides of top surface of the separation membrane unit.

12. The system of claim 11, wherein the lifting link unit comprises:

rotation shafts coupled rotatably with both sides of the lifting frame;

a pair of lifting links coupled with both sides of each rotation shaft, for rotating with respect to the rotation shaft and having gravity center at lower portion thereof to couple with and remove from each holding hole of the holder having at least one holding hole;

a tension chain connected to any one lifting link of the pair of lifting links coupled with each rotation shaft, for moving along force transmitted from the outside and controlling the rotation of the lifting link; and

connection members coupled between the pair of lifting links, for connecting the pair of lifting links to each other to rotate the lifting links at the same time according to moving of the tension chain.

13. The system of claim 11, wherein upper and lower guide rollers corresponding to each other with respect to the lifting frame are installed to be perpendicular to each other and rotated with contacting inner surfaces of the guide rail, the inner surfaces being different from each other.

14. A submerged type membrane separation system for filtering and treating sewage and wastewater, which comprises a grit bath, a screen bath, a flow control bath, a microfiltration screen, a treatment tank and a sludge thickening underflow bath, the system comprising:

a membrane separation aerobic bath installed outside

of the microfiltration screen, for removing contaminants and phosphorous material from the mixed liquor and having a separation membrane unit with a plurality of separation membrane for removing floating material.