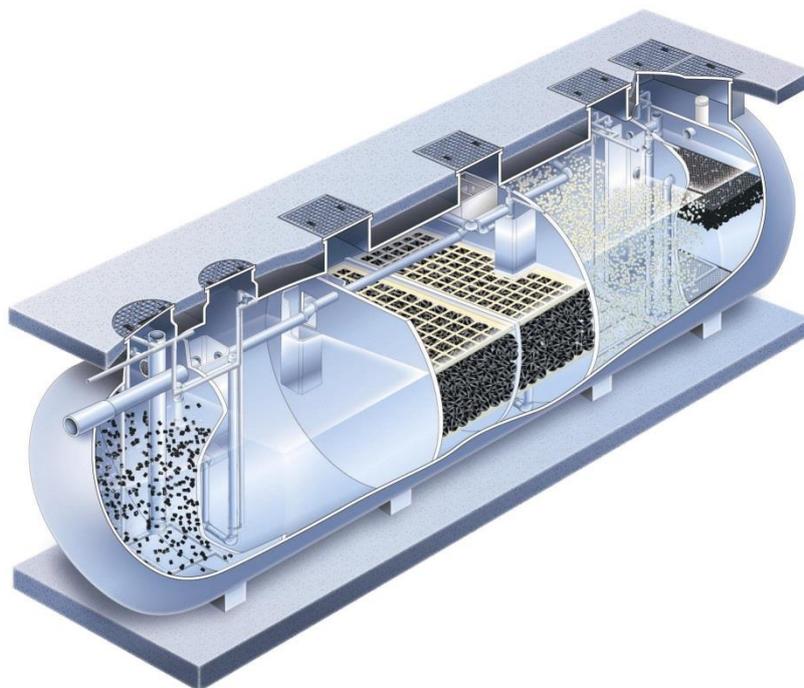


COMMERCIAL WASTEWATER TREATMENT SYSTEM

FUJI CLEAN PCN

Operation & Maintenance Manual



FOR SERVICE PERSONNEL ONLY

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1 SAFETY PRECAUTIONS

Read the safety precautions carefully before operating the plant.

The contents of this section are important to ensure safety. Please pay special attention to the following symbols.

 **WARNING:** This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.

 **CAUTION:** This symbol refers to a hazard or unsafe practice which can result in personal injury and/or the potential for product or property damage.

WARNING

Handling chlorinating agents

- There are two main types of chlorinating agents;
 - inorganic chlorinating agents such as calcium hypochlorite, lithium hypochlorite, sodium hypochlorite; and
 - organic chlorinating agents such as trichloroisocyanuric acid, potassium dichloroisocyanurate, sodium dichlorocyanurate.
- Organic and inorganic chlorinating agents are not compatible with each other. Mixing or cross-contamination of these chemicals can form an explosive mixture.
- Chlorinating agents are highly corrosive and very damaging to exposed body tissue. Always wear protective clothing and protective equipment such as gloves, safety glasses, etc.
- Dispose of the material according to manufacturer instructions and according to local regulations.
- Read the chemical label before opening the package. Understand the directions for use and safety information before starting an application.

Working in confined spaces

- Personnel required to enter and carry out maintenance work in the unit must comply with confined space regulations.

Electrical safety

- Do not touch any components in the blower box with wet hands.

CAUTION

Preventing overload on the tank

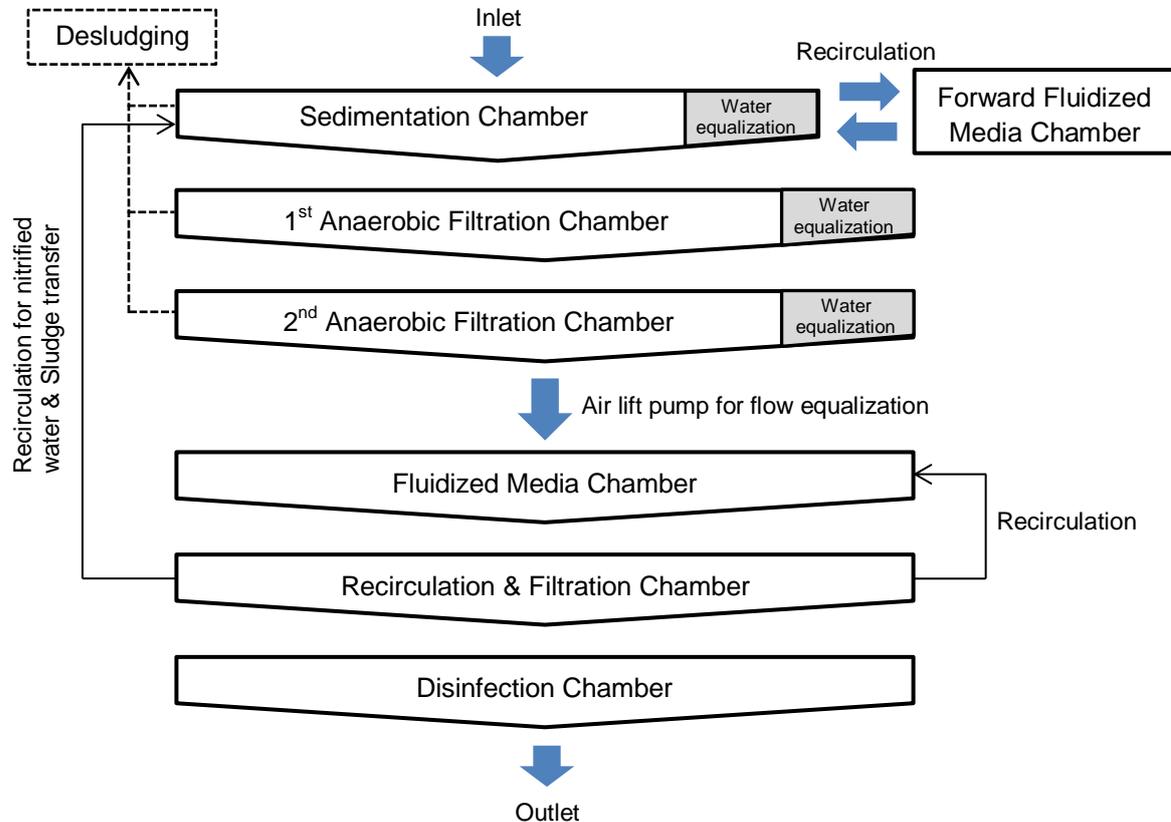
- Maintain the area where the system is installed free of all vehicle traffic.

Prevention of public health risk

- Do not use treated water for human consumption, livestock watering or irrigating edible crops.

2 PROCESS DESCRIPTION

2-1. Flow Diagram



2-2. Process Description

Sedimentation Chamber (KJ)

This chamber is designed to physically separate the solids from the incoming water.

Forward Fluidized Media Chamber (ZR)

This chamber contains a hollow type of fluidized media for aerobic treatment. The intermediate water coming out of the sedimentation chamber transfers to this chamber by an air lift pump. Treated water then returns to the sedimentation chamber.

Anaerobic Filtration Chamber (KR1, KR2)

These two chambers contain a spherical-skeleton type of filter media. Water goes upward in the 1st chamber and water goes downward in the 2nd chamber. Through bacterial growth processes on the surface of the filter media, biological anaerobic treatment thrives while suspended solids are captured. Furthermore, the bacteria in this chamber convert nitrates in the recirculated water returning from the aerobic chamber to gaseous nitrogen. The nitrogen then escapes to the atmosphere.

Fluidized Media Chamber (R)

This chamber contains a cylindrical type of foam media. The media constantly get fluidized by aeration. Organic matters are decomposed and the ammonium nitrogen is oxidised by micro-organism/bacteria on the contact media surface.

Recirculation & Filtration Chamber (JR)

This chamber is filled with a small media functioning as a filtration.

First, treated water flow downward through the vertical pipe that has an outlet in the bottom.

After the treated water comes out of the pipe flow upward through plastic media so that the media captured the Suspended Solid(SS) as well as the SS will be settled down at the bottom.

Also after flowing through the media some treated water will be returned to the previous chamber. By repeating this more and more SS will be removed.

This chamber also backwash the media for a couple of minutes every day and the backwashed water will be returned to the sedimentation chamber.

For the purpose of nitrogen removal the treated water will be transferred to the sedimentation chamber all the time.

Disinfection Chamber

This treated water is ready for discharge after disinfected by chlorine tablet.

3 MAINTENANCE PROGRAM

Follow the lists of the PCN service report when maintaining the system.

- STEP 1 : Check condition of effluent water (i.e. turbidity)
- STEP 2 : Check the fluidized media chamber
- STEP 3 : Check pH, DO, and temperature in each chamber
- STEP 4 : Measure the scum and sludge accumulation
- STEP 5 : Degassing the 1st and 2nd anaerobic filtration chambers.
- STEP 6 : Check flow rate for each air lift pump, clean the airlift pump, and adjust the rate.
- STEP 7 : Transfer sludge at surface and bottom of Recirculation & Filtration Chamber and Disinfection chamber.
- STEP 8 : Check health of backwash operation in Recirculation & Filtration Chamber.
- STEP 9 : Check the sludge transfer rate on backwash operation in Recirculation & Filtration Chamber
- STEP 10 : Clean the media separation slit
- STEP 11 : Check the residual chlorine and refill the chlorine tablet
- STEP 12 : Check operations for each electric device

STEP 1 : Check condition of effluent water

Take a sample from each chamber and check turbidity and colour. (→ Record in the service report)

Taking a picture for the samples would be recommended. When taking a sample, do not stir the suspended solid attached to tank wall and accumulated at bottom as it could affect water quality.

Important note

Do not break any scum outside of baffles in the sedimentation chamber and the anaerobic chamber. Breaking scum could affect the water quality.

STEP 2 : Check conditions of the fluidized media chamber

Check the chamber is evenly aerated and there is no accumulation of the media. (→ Record in the service report)

STEP 3 : Check pH, DO, and temperature in each chamber

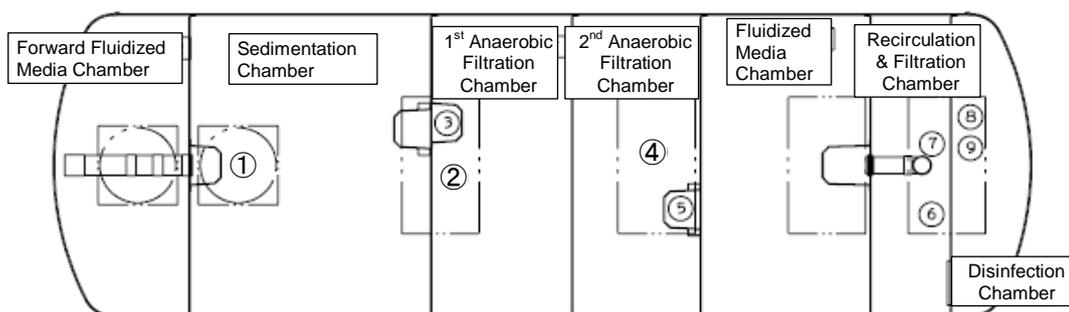
Measure the pH, DO, temperature, and turbidity in each chamber. (→ Record in the service report)

STEP 4 : Check amount of sludge (scum and accumulated sludge)

Measure scum depth and accumulated sludge depth as specified in the following. Make sure to check visually for the scum depth.

Where to measure the scum and accumulated sludge

- ① Scum & accumulated sludge in the sedimentation chamber → centre area of chamber
- ② Scum in the 1st anaerobic filtration chamber → centre area of chamber
- ③ Accumulated sludge in the 1st anaerobic chamber → inside of the flow baffle
- ④ Scum in the 2nd anaerobic filtration chamber → centre area of chamber
- ⑤ Accumulated sludge in the 2nd anaerobic chamber → inside of the outflow baffle
- ⑥ Scum in the recirculation & filtration chamber → Visual check
- ⑦ Accumulated sludge in the recirculation & filtration chamber → bottom of the inspection opening
- ⑧ Scum in the disinfection chamber → Visual check
- ⑨ Accumulated sludge in the disinfection chamber → centre of the chamber

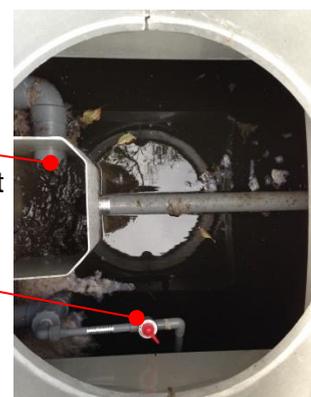


STEP 5 : Degassing the 1st and 2nd anaerobic filtration chambers.

STEP 6 : Check flow rate for each airlift pump, clean the airlift pump unit, and adjust the rate.

A. Raw Water Recirculation pipe

- Regulate the flow rate at the pipe end in the sedimentation chamber.
- Use the red valve in the sedimentation chamber to adjust the raw water recirculation.



B. Transfer Airlift Pump + Flow equalization box

- Regulate the flow rate at the pipe opening in the Fluidized Media Chamber.
- Use the red valve in the 2nd anaerobic filtration chamber to adjust the Transfer Airlift Pump flow rate.



C. Nitrified Water Recirculation Airlift Pump

- Regulate the flow rate at the end of the recirculation pipe in the Sedimentation Chamber.
- Use the blue valve in the Fluidized Media Chamber to adjust the Recirculation flow rate.



D. Filtered Water Recirculation. Airlift Pump

- Regulate the flow rate at the pipe opening in the Fluidized Media Chamber.
- Use the red valve in the Fluidized Media Chamber to adjust the Recirculation flow rate.



1. Check flow rate

Measure current flow rate for each air lift pump unit. Make sure the water level of the 2nd anaerobic chamber is more than 60mm above the Low Water Level when measuring the flow rate.

The flow rate should be adjusted differently depending on the water level in the 2nd anaerobic chamber. Refer to the commissioning procedures for the adjustment.

2. Clean the airlift pump unit

Clean inside of the air lift unit pipework and the flow equalization box on every inspection with brush and pressure tap water.

3. Adjust the flow rate

Remeasure the flow rate of each air lift pump unit. If the rate is still off the designated rates, follow the commissioning instruction again.

Daily Hydraulic Loading (m3/day)	Air Lift Pump Adjustment			
	B. Transfer AP	C. Nitrified Water	A. Raw water Recirc.	D. Filtered Water
2.55	8.0	5.4	0.9	5.4
4.0	12.5	8.4	1.4	8.4
6.0	18.8	12.5	2.1	12.5
8.0	25.0	16.7	2.8	16.7
10.0	31.3	20.9	3.5	20.9
12.0	37.5	25.0	4.2	25.0
14.0	43.8	29.2	4.9	29.2
16.0	50.0	33.4	5.6	33.4
18.0	56.3	37.5	6.3	37.5
20.0	62.5	41.7	7.0	41.7
24.0	75.0	50.0	8.4	50.0
28.0	87.5	58.4	9.8	58.4
32.0	100.0	66.7	11.2	66.7
36.0	112.5	75.0	12.5	75.0

STEP 7 : Transfer sludge at surface and bottom of Recirculation & Filtration Chamber and Disinfection chamber

1. Surface and bottom of the recirculation & filtration chamber

Sludge could be accumulated on the media separation slit in Recirculation & Filtration chamber and scum could be generated on the top of the chamber. At the bottom sludge could be accumulated too.

In this case, transfer the sludge and scum to the sedimentation chamber, using the air lift pump unit or suction pump.

- (1) When the scum is found in the chamber, transfer them to the sedimentation chamber with a scoop or a suction pump
- (2) Conduct the manual backwash and transfer the accumulated sludge to the sedimentation chamber.
- (3) Remove the sludge on the media leak prevention net using tap water, and transfer to the sedimentation chamber.

2. Disinfection chamber.

When sludge was found in the disinfection chamber, transfer this to the sedimentation chamber with a suction pump. Also remove sludge on the tank wall with tap water.

In case that scum is in baffle, manually transfer them to the sedimentation chamber.

STEP 8 : Check health of backwash operation of Recirculation & Filtration chamber.

Conduct the manual backwash and check if the backwash aeration is even.

- Kick on Manual Backwash operation by rotating the dial in the control panel slowly to the left end "MANUAL".



STEP 9 : Check the sludge transfer rate on backwash operation in Recirculation & Filtration Chamber

1. Check the backwash flow rate

If backwash bubbles are weak or not even, increase the backwash rate by adjusting the valves.

2. Check the backwash sludge transfer rate

Recirculation pipework is designed to transfer sludge on backwash process. Check water level drops 15 – 20 cm within 15 minutes. When the water level fails to drop, adjust with the sludge transfer adjustment valve.



Example of normal backwash →

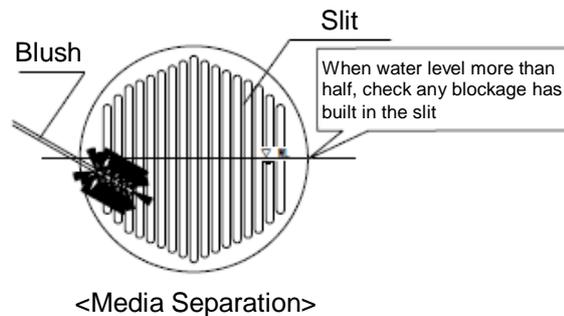
3. **IMPORTANT** - Turn off the manual backwash operation by rotating the dial to the right end "AUTO".

STEP 10 : Clean the media separation slit

Clean the media separation unit on every inspection whether sludge is found or not.

The media separation slit, which is mounted in the Forward Fluidized Media Chamber and Recirculation & Filtration chamber, is designed to be cleaned by having media contacted in the chamber so that blockage with excess biofilm will be avoided.

On regular service, make sure to check if there is abnormal water rises and excess biofilm at the media separation unit.



STEP 11 : Check the residual chlorine and refill the chlorine tablet

- (1) Check the residual chlorine concentration
- (2) Refill chlorine

STEP 12 : Check operations of each electric device

- Clean the air filter of the air blowers and ventilation of the control panel.
- Check operation of the air blowers.
- It is recommended that the air filters and the diaphragm kits are replaced once every year.

Check the standard setting for the automatic operation (page10)

Items to check: Current time, start time for backwash (ex-factory setting is AM2:00)

5 POINTS FOR MAINTENANCE & INSPECTION

(1) Forward Fluidized Media chamber

Inspection items	Inspection details
<ul style="list-style-type: none"> ● Fluidized media separation device ● Blocking of air diffuser ● Foaming 	<ul style="list-style-type: none"> ● Confirm that the fluidized media contacts the slits of the fluidized media separation device, and that the slit section is constantly washed (no biofilm, etc. has adhered). <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The water level may have risen abnormally. Check whether the anaerobic chamber is blocked, etc., and remove the cause. ➢ The raw water circulation rate may be excessive. Check the raw water circulation rate, and adjust it as necessary. ● If the air diffuser might be blocked based on the diffusion state, unblock it with the following method. <ul style="list-style-type: none"> <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ "Fully close" the peak cut water rate adjustment valve to temporarily increase the air volume and remove the block. (* When done with this step, always adjust each air volume and water rate again.) <p style="margin-left: 20px;">* <i>The air diffuser should not become blocked with normal use. If blocking is confirmed, unblock the air diffuser and check for causes of blocking (high load, insufficient aeration air volume, etc.).</i></p> ● If heavy foaming is found, use a commercially-available defoaming agent.

(2) Sedimentation chamber

Inspection items	Inspection details

<ul style="list-style-type: none"> ● Amount of residual sludge ● Raw water circulation rate ● Blocking of raw water circulation airlift pump 	<ul style="list-style-type: none"> ● Use a sludge thickness measurer, etc., and check the thickness of the scum and accumulated sludge. If scum is found inside the baffle on the discharge side, transfer it to outside the inflow baffle using a dipper, etc. <p style="text-align: center;">* If the "accumulated sludge thickness + scum thickness" is more than 100cm = the "retention upper limit", clean the chamber regardless of the regular cleaning frequency (once or more every six months).</p> ● Confirm that the raw water circulation rate is correct. ● If the raw water circulation airlift pump might be blocked, unblock it with the following method. (* Make sure that the raw water circulation is stopped before starting cleaning.) <p><u>Troubleshooting</u></p> <ul style="list-style-type: none"> ➢ Remove the inspection opening for the raw water circulation airlift pump, and clean out the insides with a brush, etc.
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(3) 1st and 2nd Anaerobic chambers

Inspection items	Inspection details
<ul style="list-style-type: none"> ● Residue sludge amount ● Peak cut water rate ● Blocking of peak cut airlift pump and transfer pipe ● Water level ● DO (Dissolved Oxygen) 	<ul style="list-style-type: none"> ● Use a sludge thickness measurer, etc., and check the thickness of the scum and accumulated sludge. If scum is found inside the baffle, transfer it to the sedimentation chamber using a dipper, etc. <ul style="list-style-type: none"> ➢ If the accumulated sludge in the 1st anaerobic chamber has reached 50cm = the retention upper limit, clean it out. ➢ If accumulated sludge is found in the 2nd anaerobic chamber, it is time to clean it out. ● Check that the transfer water rate is correct. ● Remove the inspection opening for the peak cut airlift pump, and clean out the insides with a brush, etc. ● Clean the inside of the transfer pipe from the peak cut airlift pump to the fluidized media chamber with a brush, and remove any biofilm, etc. ● During the time that the inflow is stopped, confirm that the water level drops to LWL. <p><u>When water level does not drop to LWL</u></p> <ul style="list-style-type: none"> ➢ The peak cut water rate may be too low. Check the water rate, and adjust it as necessary. ➢ The nitrified fluid circulation rate may be excessive. Check the nitrified fluid circulation rate, and adjust it as necessary. ● Check whether DO is at an abnormal value. (As a guide, the DO value for the 2nd anaerobic chamber should be approx. 2mg/L or less.) <p><u>When DO is high</u></p> <ul style="list-style-type: none"> ➢ The nitrified fluid circulation rate may be excessive. Check the nitrified fluid circulation rate, and adjust it as necessary. ➢ The raw water circulation rate may be excessive. Check the

	raw water circulation rate, and adjust it as necessary.
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(4) Fluidized Media chamber

Inspection items	Inspection details
<ul style="list-style-type: none"> ● Aeration state ● Transparency in chamber 	<ul style="list-style-type: none"> ● Confirm that there is no media splattering or retention, etc. <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The nitrified fluid circulation rate, which shares the main blower, may be excessive. Check the nitrified fluid circulation rate, and adjust it as necessary. ● Sample the water in the chamber, and confirm that the transparency is 10cm or more. <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The aerobic circulation rate may be abnormal. Check the aerobic circulation rate, and adjust it as necessary.

Inspection items	Inspection details
<ul style="list-style-type: none"> ● DO (Dissolved Oxygen) ● pH ● Fluidized media separation device ● Blocking of air diffuser ● Foaming ● Aerobic circulation rate ● Blocking of aerobic circulation airlift pump 	<ul style="list-style-type: none"> ● Confirm that the rate is 3mg/L or higher. <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The peak cut water rate may be excessive. Check the peak cut water rate, and adjust it as necessary. ➢ The retention time in the fluidized media chamber may be insufficient because of an abnormal nitrified fluid circulation rate or peak cut water rate. Check the nitrified fluid circulation rate and peak cut water rate, and adjust them as necessary. ● A pH level within the range of 5.8 to 8.6 is acceptable, and it should be about 7.0. <u>Troubleshooting</u> <p>The retention time in the fluidized media chamber may be incorrect because of an abnormal nitrified fluid circulation rate or peak cut water rate. Check the nitrified fluid circulation rate and peak cut water rate, and adjust them as necessary.</p> ● Confirm that the fluidized media contacts the slits of the fluidized media separation device, and that the slit section is constantly washed (no biofilm, etc. has adhered). <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The water level may have risen abnormally. Check whether the anaerobic chamber is blocked, etc., and remove the cause. ➢ The peak cut airlift water rate may be abnormal. Check the water rate, and adjust it as necessary. ➢ Confirm that the media is flowing properly. ● Clean the fluidized media separation device with a brush and city water, etc., at each inspection regardless of whether biofilm, etc., is adhered on it. ● If the air diffuser might be blocked based on the diffusion state, unblock it with the following method. <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ Fully close" the nitrified fluid circulation rate adjustment valve to temporarily increase the air volume and remove the block. ● If heavy foaming is found, use a defoaming agent. ● Confirm that the aerobic circulation rate is at the set value. ● If the aerobic circulation airlift pump might be blocked, unblock it with the following method. <ul style="list-style-type: none"> ➢ Remove the inspection opening for the airlift pump, and clean the inside with a brush, etc.

(5) Recirculation & Filtration chamber

Inspection items	Inspection details
<ul style="list-style-type: none"> ● Nitrified fluid circulation rate ● Accumulation of sludge on fluidized media separation net ● Cleaning of fluidized media separation net ● Backwashing state ● Backwashing process ● Blocking of nitrified fluid circulation airlift pump 	<ul style="list-style-type: none"> ● Check that the nitrified fluid circulation rate is at the set value. ● Check whether sludge is accumulated on the fluidized media separation net. (Is the filter media visible?) <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ There may be an error in the backwashing process. Check the backwashing air volume and sludge transfer rate. ● At each inspection, clean the fluidized media separation net with a brush and tap water using the following procedure. <ol style="list-style-type: none"> 1) Stop the sub-blower (peak cut airlift pump), and lower the water level in the recirculation and filtration chamber by about 5cm. 2) Carry out manual backwashing. 3) When the water level drops to near the upper net, wash the fluidized media separation net with city water and a brush for about 15 minutes. 4) Stop the backwashing. 5) Start the sub-blower (peak cut airlift pump), and return to regular operation. <p>* Always confirm that the timer on the control panel is set to "RUN".</p> ● Carry out backwashing with manual operation, and confirm that the backwashing air volume is appropriate. <u>Troubleshooting</u> * Insufficient air volume <ul style="list-style-type: none"> ➢ The nitrified fluid circulation rate may be excessive. Adjust it to the correct value. ➢ If the backwashing device might be blocked, "fully close" the fluidized media chamber aeration and nitrified fluid circulation adjustment values, which share the air supply blower, to temporarily increase the backwashing air volume and unblock the device. ● Confirm that the water level drops appropriately. (Backwashing process 1) <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The nitrified fluid circulation rate may be insufficient. Adjust it to the correct value. ● Confirm that the sludge transfer water rate is correct. (Backwashing process 3) <u>Troubleshooting</u> <ul style="list-style-type: none"> ➢ The sludge transfer rate may be insufficient during backwashing. Adjust the sludge transfer rate to the correct value. ● If the nitrified fluid circulation airlift pump might be blocked, unblock it with the following method. <ul style="list-style-type: none"> ➢ Remove the inspection opening for the airlift pump, and clean out the inside with a brush, etc.

(6) Disinfection chamber

Inspection items	Inspection details
<ul style="list-style-type: none"> ● Presence of scum and accumulated sludge ● Installation state of disinfectant ● Cleaning around disinfectant ● Replenishment of disinfectant ● Measurement of residual chlorine 	<ul style="list-style-type: none"> ● Check for the presence of scum or accumulated sludge. <ul style="list-style-type: none"> <div style="border: 1px solid black; display: inline-block; padding: 2px;">Troubleshooting</div> <ul style="list-style-type: none"> ➤ If there is any scum or accumulated sludge, transfer it to the inflow baffle of the sedimentation chamber with a dipper or self-priming pump, etc., and then wash out with tap water. ● Make sure that the disinfectant is installed vertically so that the treatment water and chemicals contact efficiently. ● Remove the disinfectant and make sure that no clumps of disinfectant, etc., are adhered on the bottom of the disinfectant or sluice. ● Replenish the disinfectant if it is low. ● If necessary, use a simple tester, etc., to measure the residual chlorine.

(7) Others

Inspection items	Inspection details
<ul style="list-style-type: none"> ● Blower ● Presence of insects ● Cleaning of inflow pipe, discharge pipe and joint basin 	<ul style="list-style-type: none"> ● Refer to the blower instruction manual for details on the inspecting the blower. ● If mosquitos or flies, etc., are breeding, use a hanging-type insecticide. ● Make sure that the pipes and basin are not blocked with foreign matter. Remove any foreign matter if found.

6 DESLUDGING

Conduct desludging as following processes.

STEP 1 : Scum in the 1st & 2nd chamber of anaerobic filtration chamber

STEP 2 : Scum in the sedimentation chamber

STEP 3 : Accumulated sludge and sludge inside the filtration media in the 1st & 2nd chamber of anaerobic filtration chamber

STEP 4 : Accumulated sludge in the Sedimentation chamber

STEP 5 : Accumulated sludge at bottom of Recirculation & Filtration chamber and on top of filtration media. (only if any)

STEP 6 : Scum and accumulated sludge in Disinfection chamber (only if any)

STEP 7 : Refill water

