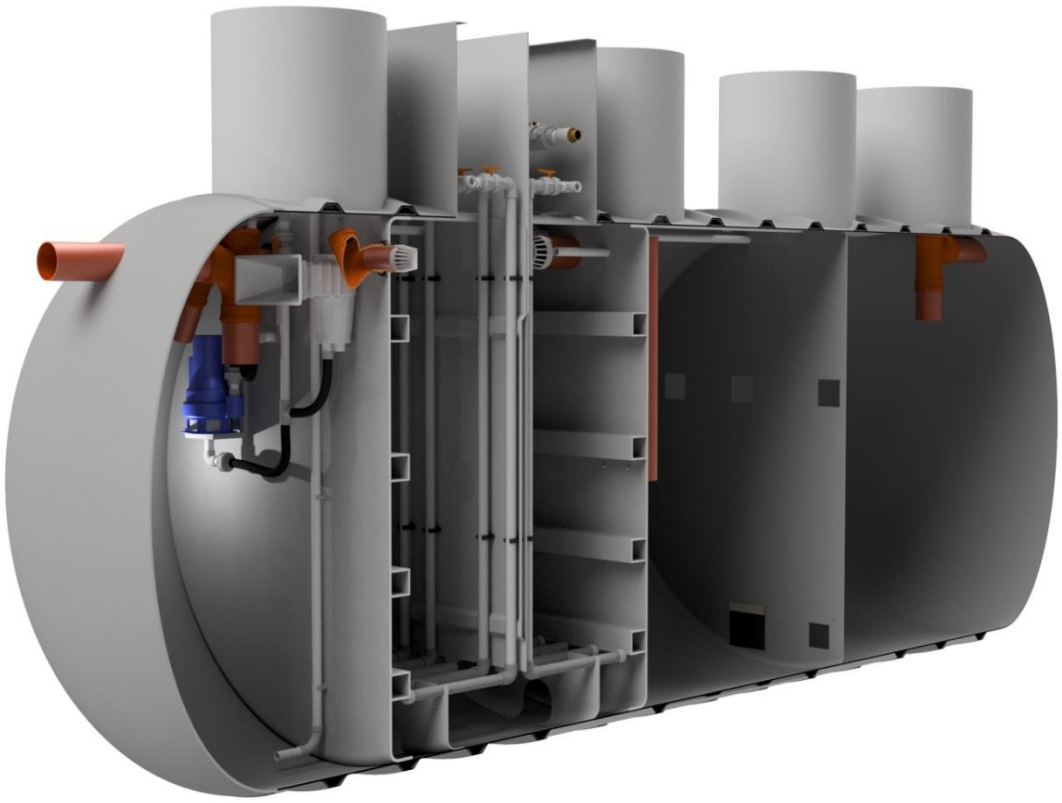
PREMIER TECH

OPERATION & MAINTENANCE GUIDE

REWATEC™

Moving Bed Biofilm Reactor (MBBR)



Operation & Maintenance Guide

Rewatec MBBR

Manual Version OM0052 Rev 6

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To Safeguard Warranty Please Ensure You Are Using The Latest Guide.

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Contents

1 Brief Installation Guide

To ensure an effective operation and problem free installation your installer,

MUST:

- Read this O&M Manual for full details
- Use the correct installation guidance for the shell class of the treatment plant
    - UTG9501 Granular Surround for Class 1 Shells
    - UTG9502 Concrete Surround for Class 1 and Class 2 Shells

- Take care when offloading the unit – internal pipework could be damaged.
- Ensure adequate ventilation, see section "Installation Instructions"
- Ensure adequate point of discharge either into a soakaway or into a flowing watercourse
- Provide a cable duct or install an armored cable to the control panel
- Isolate the main power supply to the control panel before opening it
- Incorporate a miniature circuit breaker (MCB) in the power supply to the unit.

MUST NOT:

- Install the treatment plant deeper than the supplied access turrets (i.e. do not extend the turrets)
- Install a Class 2 Shell plant in granular backfill. Class 2 shells are suitable for Concrete Backfill only

2 Health & Safety

The wastewater treatment plant has been manufactured in the United Kingdom and as per UK Health and Safety At Work Act 1974. Section 6(a) of this Act requires manufacturers to advise their customers on the safety and the handling precautions to be observed when installing, operating, maintaining and servicing their products. The user's attention is therefore drawn to the following:

- The appropriate sections of this manual must be read before working on the equipment.
- Installation and servicing must only be carried out by suitably trained or qualified personnel.
- Normal safety precautions must be taken and appropriate procedures observed to avoid accidents

2.1 Hazards

Wastewater contains innumerable microorganisms like bacteria, viruses, fungi and parasites from many sources. This water also contains organic matter, of which a large part consists of dissolved or colloidal impurities, and numerous other pollutants that must be removed completely or partially by the treatment system.

2.2 Working near a Rewatec septic system

Equipment must be maintained by a competent and qualified technician. As well, and without any exception, you must ensure that all electrical equipment is turned off before any action is carried out.

2.3 Risk assessment

2.3.1 Falling and drowning risk

Working on top of opened maintenance holes and concrete tanks (septic tank, equalization tank, sludge management tank and process tank (SAF, DSAF, CSAF, MBBR systems, etc.) may cause a worker to fall from height and possibly drown.

2.3.2 Injury risk

There is a risk of cuts and/or bruises when maintenance tasks are being done on moving parts of the septic system, when samples are being collected or during a routine inspection.

2.3.3 Electrocution risk

There is a risk of electrocution if electrical component maintenance is done without cutting off the power to equipment being worked on. Turn off the main switch of control panel before opening it.

2.3.4 Infection risk

There is always a risk of being infected by microorganisms through direct contact with wastewater or sludge.

2.4 Preventive measures

- All circulation areas around the treatment system must be designed to reduce the risk of slipping and/or falling;
- All structures must be checked often and kept in proper working order;
- If work is required inside one of the tanks, each section must be emptied. Pumps and valves controlling the water intake must be set to stop influent entering the tank whilst in operation. The safety procedures to enter a confined space must be followed. Using a safety harness, independent respirator and gas detector may be necessary;
- When the work requires the use of electrical tools, these tools must be double insulated. It's wise to use compressed air tools;
- The worker must wear the protective clothing required to work in places that are contaminated by wastewater.

2.5 'Installation and Maintenance' team 's responsibility

Employees must observe all safety rules established to protect them and the treatment system. All personnel must follow the instructions below:

- Observe all written and verbal safety rules and be aware of the danger related to the various tasks;
- Do not undertake any task until you have received and understood the appropriate instructions;
- Immediately report any dangerous equipment, condition or work method;
- Report any accident or injury to your immediate supervisor;
- Consider the water in the treatment station as contaminated and not drinkable;
- Avoid operating any equipment that is not equipped with safety and protective devices;
- Keep all tools clean and in proper working order and correctly use the right tool for the job;
- Use appropriate protective gear for each task (PPE);

- Observe personal hygiene rules to prevent infections;
- Never put speed of execution before safety;
- Never consider a job done before making sure that the next person using equipment or facility is completely safe.

2.6 'Installation and Maintenance' team's hygiene

Wastewater and its by-products present dangers for the personnel working in the treatment facilities, namely diseases transmitted through water, like typhoid fever, parathyroid fever, dysentery, viral hepatitis, hepatitis and tetanus. Personal hygiene is the best defense against infections. Anyone working near wastewater must observe the following guidelines:

- Avoid touching/putting your hands on your face (nose, mouth, eyes, ears, etc.)
- Wear rubber or latex gloves to carry out any work requiring direct contact with treatment equipment, wastewater or raw/organic sludge;
- Wear gloves when your hands are chapped, burnt or damaged;
- Wash your hands thoroughly with soap and warm water before eating, before and after going to the washroom, before and after smoking a cigarette, etc.;
- Keep your fingernails short and remove any foreign object using soap and a stiff-bristle scrubbing brush;
- Avoid putting clean clothing in contact with work clothing;
- Report any cut or scratch and administer appropriate first aid;
- Take a shower after every work day.

2.7 Security equipment and personal protection

The types of safety/protective equipment used in purification facilities vary according to the sites and the tasks that need be carried out. In all cases, notices/signs pertaining to safety must be read and respected. The treatment station's safety rules must include detailed instructions on how to use the safety equipment. Specific needs for safety equipment must be determined after studying the conditions in each establishment. The following list of safety/protective equipment, although not exhaustive, does provide useful information:

- Large diameter portable and flexible fan to ventilate openings, sewers, suction pits, wells and confined spaces;
- Equipment used to detect a lack of oxygen and/or the presence of explosive, toxic and combustible gases in the air;
- Hydrogen sulfide and carbon monoxide detectors;
- Self-contained breathing apparatus for every person working underground or in a confined space;
- Inhaler or ressuscitator;
- First aid kit;
- Barricades, markers, specific caution/warning signs and flashing lights, as needed;

- Fire-fighting equipment, including dry chemical fire extinguishers and carbon-dioxide snow fire extinguishers;
- Portable explosion-proof lights;
- Safety harness and life line;
- Safety vests or ring buoys and life line;
- Personal protective clothing and gear, including glasses, face mask, safety helmet, and rubber boots with protective steel caps, safety shoes and rainwear.
- Using electrical tools and/or equipment
- Wastewater treatment plant equipment is powered by electricity. If safety rules are not strictly observed, undertaking maintenance tasks may cause electric shocks, very serious injuries and even result in death. The following general guidelines should be considered as the minimum measures when using electrical equipment in the treatment station:
- Maintenance tasks on electrical equipment should always be done by competent and authorized technicians;
- Plan for and use safety switches and identification labels in all isolated places or when starter switches are located away from equipment they control;
- Consider electrical equipment and wires as being live unless you are sure
- they are not and are properly grounded;
- It is forbidden to use metal ladders or metal measuring tapes near electrical equipment;
- Employees who work on live electrical equipment must work in teams of two;
- Use approved rubber gloves when the voltage exceeds 400V;
- Electrical panels must always be closed unless work requires them to be opened;
- Before working on live equipment, equipment must first be turned off, unplugged and properly grounded;
- Never check whether a circuit is live by touching it;
- The personnel working on electrical equipment or wiring must avoid touching water, pipes, drains, metal objects, etc.;
- Avoid unplugging or shunting any electrical safety device;
- Before working in a confined space, cover all live circuits with insulating blankets;
- All tools must have insulated handles and shafts;
- Avoid using flashlights with metal casing;
- Avoid wearing jewellery while working on or near electrical circuits;
- All electrical tools must be grounded or doubly insulated;
- Use rubber mats in control centers and near electrical control panels;
- Any electrical motor, switch and case must always be kept clean.

2.8 Problem-free system operation

It is NOT RECOMMENDED to discharge any of the following substances into the septic system:

- Oil and grease (motor oil, cooking oil, etc.);
- Wax and resins;
- Paints and solvents;
- Any kind of petroleum product;
- Any kind of pesticide;
- Any kind of septic tank additive;
- Any kind of toxic substance;
- Anything not easily biodegradable (for example, coffee beans, cigarette butts, sanitary napkins, tampons, condoms, cotton swab, etc.).

AND, it is recommended to:

- NEVER open or go inside the primary/septic tank or the treatment plant.
- Keep all lids of the septic system accessible at all times. NEVER cover them with mulch, dirt or any permanent structure (patio, swing, shed, etc.).
- NEVER connect a drain pipe, roof gutter, sump pump or air conditioner drain to the septic system.
- NEVER discharge content or water from a water softener backwash, a spa or pool in your septic system.
- NEVER discharge wastewater from a recreation vehicle (camping trailer, caravan, etc.) into any of the components of your septic system.
- NEVER use automatic toilet bowl cleaners
- NEVER plant trees within 6 m (20') of the treatment plant and within 2 m (6' 6") of the absorption bed.
- ALWAYS maintain the surface of the lid of the treatment plant free of any accumulated material or too close to blow snow, backfill, landscaping material, rocks, the bottom of a slope, an embankment or a retaining wall, etc. Minimum distances to respect are 5 m (16' 5") for a fiberglass shell unit.
- Never install a septic tank in clayey soil.
- The profile of the lot must be such that surface run off flows away from the septic system.
- The septic tank must be watertight and be used for disposal of domestic wastewater only.
- Never cover or bury the access lids of the septic tank. It needs to be accessible for maintenance and emptying.
- Respect the minimum distances prescribed by regulations.
- Never enter the septic tank.
- Never discharge water from a recreational vehicle (camping trailer, caravan, etc.) into any of the components of your septic system.
- The home must be equipped with an air vent that is in proper working order and complies with the applicable standards.
- Ensure rapid growth of vegetation to prevent soil erosion

Troubleshooting

2.9 Flooding

Certain sites are prone to flooding or to rises in groundwater levels. This can lead to a malfunction in your septic system or alter the performance of your system. If this happens, contact Premier Tech.

2.10 Backflow

Backflow rarely occurs. But if it does happen, the primary/septic tank is usually the cause. Your primary/septic tank installer/maintenance team can generally take care of the situation.

2.11 Odors

All septic systems are apt to generate gases and odours. The position of the air vent, as well as other factors unrelated to the treatment plant itself, can prevent septic gases from dispersing properly and lead to odours. If this happens, contact Premier Tech.

2.12 Winter closing of premises

If you close your premises (i.e. close the circuit-breaker) during a potential freezing period for a long period of time exceeding the two months you must decommission your tank, contact Premier Tech to help establish the appropriate procedure if unsure. In doing so, you will ensure a longer life for your septic tank.

3 The Model Description

The unit is specifically designed to treat domestic sewage and other biodegradable waste and comprises of two distinct treatment stages (and optional final effluent pump sump). The process scheme is presented on Figure 1.

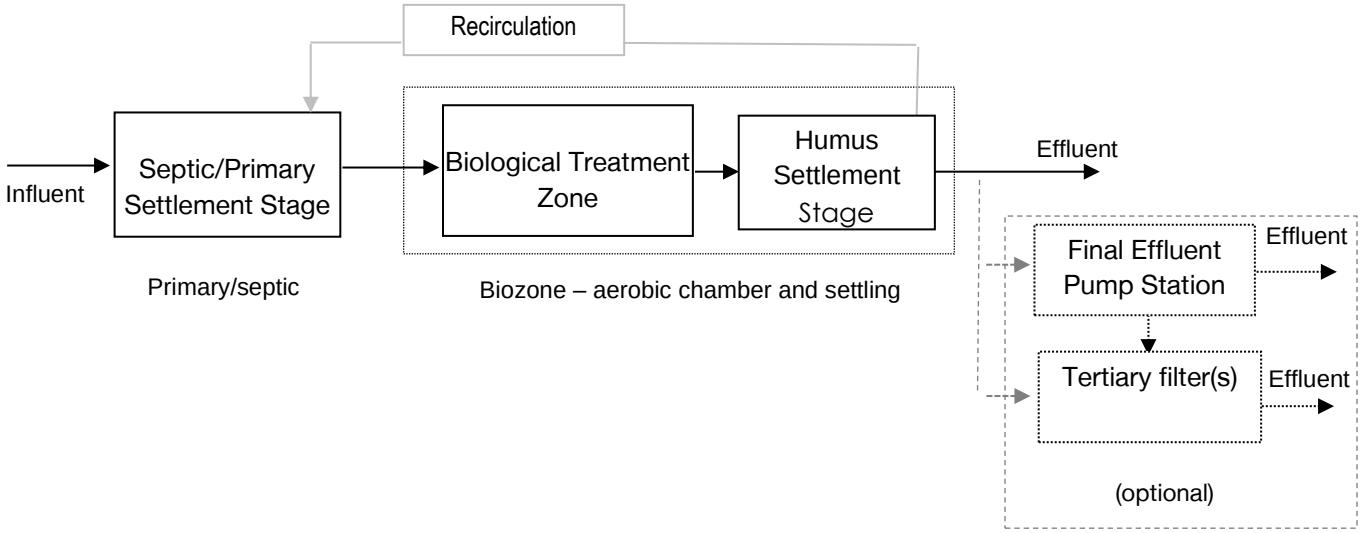

Figure 1 – Generic biological process scheme flow and chamber(s) arrangement; in dashed lines, the optional additions of a pump station and of a tertiary filter.

4 Operation of the primary/balancing tank

Septic tanks are offered as sludge management and flow balancing reservoirs. They are offered in either GRP or polyethylene depending on the required size.

4.1 Functioning

The main purpose of septic tanks and sludge management reservoirs is to settle and store sludge before it can be disposed of by regular pump outs. The sludge is predominantly solids present in the influent that has to be restricted from entering the biozone since part of the is hardly degradable. Another aim is to balance the incoming flow and absorb fluctuations of the influent that may occur.

Inside the septic tank, the primary type of sludge originating from the raw sewage is settled. The retention time inside the septic tank provides a minimal amount of time sufficient for the liquid-solid separation to occur, as required by the regulation. Extra volume for storm flows is integrated (3× dry weather flows for up to 10 minutes (unless otherwise specified)).

When a sludge management reservoir is integrated in a treatment chain (upwards a treatment plant), its purpose is to allow the settling and accumulation of secondary sludge produced by the biological treatment. The secondary decanter, which separates the biological sludge of the treatment chain, then pumps it directly into the sludge management reservoir. The supernatant of this reservoir is directed toward the beginning of the treatment chain, the septic tank.

4.2 Maintenance and Servicing

A primary/balancing tank must be inspected regularly (measurement of sludge and scum levels) and pumped out when required. The design of the treatment chain serves as a tool to assess the autonomy of the septic tank on a theoretical basis. However, this autonomy must be validated under real conditions. Various factors, inherent to the specific operation conditions of an installation can influence the production of primary sludge, making it difficult to evaluate theoretical designs with precision.

The sludge management reservoir (sludge storage) must be inspected periodically (measurement of sludge and scum levels) and pumped out when required. The design of the treatment chain serves as a tool to assess the autonomy of the septic tank on a theoretical basis. However, this autonomy must be validated under real conditions. Various factors, inherent to the specific operation conditions of an installation can influence the production of secondary sludge, making it difficult to evaluate theoretical designs with precision. In certain cases, the sludge from the secondary treatment is returned to the septic tank. In those cases, the septic tank is oversized so it can receive the sludge produced by the secondary treatment.

A regular follow-up of sludge levels in each of these reservoirs must be ensured to evaluate the frequency of sludge pump outs under real conditions.

4.3 Monthly Maintenance

4.3.1 Inspection and sludge level measurement

- Measure the sludge and scum levels and make sure the septic tank is pumped out when required. Please refer to the local regulation for maximum levels at which the tank must be pumped out.
- Make sure the septic tank is pumped out when required. Please refer to your local regulation for maximal levels at which the reservoir must be pumped out.
- It is good practice to verify if there is an accumulation of sludge and scum in the equalization tank, to have it pumped out when required or anytime a preceding reservoir is being pumped out (in case of more than one primary tanks in series).
- Inspect the state of the pump in the balancing chamber

4.4 Start-Up and Seasonal Shutdown (Primary/balancing)

No specific action is required on the system, either at start-up or for a seasonal shutdown.

For seasonal shutdowns where frost is to be expected it is not recommended to empty the reservoirs. If to empty the content refill with clean water. The water level can be lowered below the inlet and outlet descending pipes to prevent frost damage.

For summer shutdowns or when the weather is warmer, it may be preferable to empty reservoirs to avoid the generation of foul odours during the shutdown period.

4.5 Troubleshooting (Primary/ balancing)

4.6 Increase in the Level of the primary Tank

Possible Causes	Explanations and Repairs
The conduits are obstructed	• Check if anything is obstructing the conduits. Clean if necessary.
The daily flow is greater than the design flow	• If the daily flow is greater than the design flow, the operation times of the pumps will need to be adjusted to meet the system's demands, without being fed on a continuous basis. To ensure an efficient treatment, it is essential that the treatment chain be set on dose feed mode; not in continuous feed.

4.7 High TSS Concentrations at the Outlet of the Septic Tank

Possible Causes	Explanations and Repairs
High sludge level in the septic tank	• If TSS concentrations are high at the outlet of the septic tank, the tank may need to be pumped out. • If this is a recurring problem, it is possible that the septic tank is undersized and that solid particles do not have enough time as expected to settle in the septic tank.

5 Operation of the Treatment Chain (Biozone/humus settling)

5.1 Introduction to the biological process

The treatment chain of the **Rewatec MBBR (MOVING BED BIO– REACTOR)** is comprised minimally of an MBBR reactor and a secondary decanter. The MBBR reactor is an aerated reservoir which contains a moving bed biofilm that ensures biological treatment. The purpose of the secondary decanter is to separate solids produced by the dead/sheared biofilm from the effluent so it can be safely discharged. Different treatment chain configurations may also be offered to meet more specific needs of clients.

The wastewater treatment process of the **Rewatec MBBR** is entirely managed by one (or more than one control panels in case of pump stations and/or dosing). The purpose of the control panel(s) is to apply power or disconnect the equipment of the treatment chain. The control panel(s) can manage:

- The feed pumps/airlifts of the MBBR reactor.
- The blowers ensuing the aeration inside the MBBR reactor.
- The sludge and scum pumps of the decanter.

5.2 Feeding of the MBBR from an Equalization Tank

In most cases, an equalization tank (primary for balancing) is integrated in the treatment chain to regularize the feed to the MBBR. The water contained in the equalization tank is directed to the **Rewatec MBBR** using submersible feed pumps or airlifts. Feeding of the bioreactor(s) is performed on an on-demand basis and depends on the activation of the floats in the equalization tank as well as the loading times. In certain cases, feeding the MBBR can be done by gravity directly at the outlet of the septic tank. Figure indicates possible position of the float placed the equalization tank of the **Rewatec MBBR;** alternatively integrated to the pumps floats are provided, this is to prevent the pump from running dry.

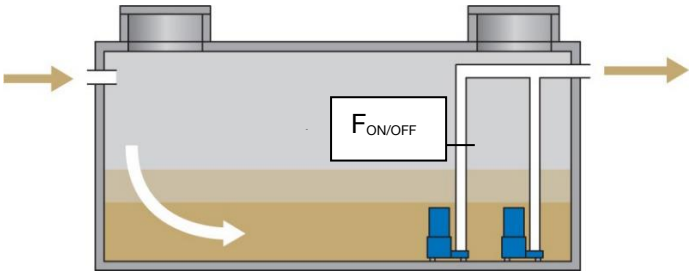

Figure 2: Schematic representation of the position of the floats in the Equalization Tank of the Rewatec MBBR treatment chain (pump arrangement for indication purposes only).

The level float is required, where applicable, to control the water level in the equalization tank. The float when at lowest position (F_{OFF}) controls the aeration system (blower) in the biozone. When at high position (F_{ON}) it enables the blower to operate at its maximum process-wise

capacity. This is to enable economy in operation and reduce the energy wastage that could occur when pumping air in the absence of influent (see details below). Where DO probe is provided such configuration is inapplicable.

The timed feed indication is presented on the wcontrol panel document available in the kiosk, copy available upon request.

5.2.1 Automatic Operation Mode

The automatic operation mode is the one prioritized under normal operations of the treatment chain. This operation mode allows the treatment chain to treat 100% of the design flow over a 24-hour period. During the start-up of the equipment, operation times of the pumps in automatic mode should be adjusted to make sure the treatment chain meets the needs of the client (see chapter 6.3).

Please note that in all these cases when a pump is operating:

- The power switch of the pump's motor is activated.
- If the pump is overloaded, a message will appear on the operator interface.

5.2.2 Manual Operation Mode

The manual mode can be only used for testing the equipment (i.e. pumps).

Note: Avoid operating the pumps when dry.

5.2.3 Operation Mode: Stop

In this position, no power is sent to the motors of the different pumps.

5.3 Operation of the Aeration of the REWATEC MBBR System

Two operation modes are possible for the blowers of the MBBR reactor, namely the economy mode (C1) (Optional) and the normal mode (C2). In the presence of a DO probe air input is regulated by the probe only.

5.3.1 Economy Mode (C1)

- Activates itself when the $F_{OFF/ON}$ float is deactivated (low position).
- Deactivates itself when the $_{FOFF/ON}$ float activates itself (high position).
- The aeration is reduced because there is no new flow of wastewater (pre-established sequence)

5.3.2 Normal Operation Mode (C2)

- Activates itself when the FOFF/ON float is activated (high position).

- **REWATEC MBBR** reactor receives a constant level of influent doses at a set frequency.
- The aeration inside the reactor is frequent because of the regular arrival of water to be treated (pre-established sequence).
  Deactivates itself when the FOFF/ON is deactivated (low position).

5.3.2.1 Start-Up Mode

During the start-up (expected for up to 2 months), the operation can be set as C1, where aeration is kept minimal to avoid excessive foaming and allow biofilm formation.

5.3.2.2 Intermediary Mode

After the start up period it is possible to increase the aeration to optimize the consumption of the organic load in the reactor and the mixing of the media.

5.3.2.3 Full Operation Mode

When the system has reached an equilibrium and if the reactor is deprived of oxygen, the aeration must be adjusted for the reactor to reach its maximum performance in terms of organic and nitrogen load removal, if applicable.

5.3.3 Summary of the Operation Modes of the Blowers

Table 1 – Summary of the operational features of the blowers

OPERATION Mode	Air supply
Economy	60%
FULL OPERATION	100%

*option for DO probe and controller should be available

5.3.4 Operation with a DO probe

When a DO probe is connected, the panel is sensing the levela of oxygen in the tank and accordingly automatically adjust its air output. Further details on that are avaiable on the panel document in the kiosk, available upon request.

High Level Alarm in the MBBR Biological Reactor (optional)

A high-level float is installed inside the reactor. It is activated if the water level is higher than the height of the outlet. The control panel will indicate an alarm to inform the client of the situation. The likely cause of a high level in the reactor is:

- The holding grid of the media is clogged and the water cannot flow freely to the subsequent treatment step.

5.4 Operation Mode of the Secondary Decanter (humus)

The secondary decanter is, in most cases, gravity fed. It is located downstream of the MBBR biological reactor. When the water level in the reactor has reached the invert of the outlet of the MBBR reservoir, the water flows toward the decanter. A scum pump and, at the minimum and a sludge pump is integrated in each chamber. The purpose of the scum pump is to remove the sludge floating on the surface of the chamber. The purpose of the sludge pump or pumps is to remove the sludge which has settled at the bottom of the tank.

Under normal condition, the pumps both activate themselves once per day (in alternation unless otherwise stated on the control document in the kiosk (available upon request), depending on pre-established sequences). The pumps operate independently of the operation mode of the MBBR (economy or normal mode). The operation and stop times of each type of pumps can be adjusted in the control panel. The operation and stop times should be adjusted at the start-up of the treatment chain. Depending on the actual operation (real loads), it will be possible to increase the frequency of sludge removal based on the speed at which the sludge and scum accumulate in the decanter. However, it is important to consider the volume of the supernatant recirculated at the beginning of the treatment chain by the sludge removal.

5.5 Low Level Control of the Secondary Decanter (humus) – pumped recirculation

A 'start' float is integrated at the scum pump(s) in the secondary humus. When it is deactivated (low position), the scum pump(s) will not start. An independent low-level float is present to avoid running the scum pump dry from extensive operation of the sludge return pump. This condition indicates there has not been any inflow of water for a certain time. The height of this float needs to be such so the float corresponds in a vertical position to the level of the middle of the scum pump.

5.6 Operator Interface and Alarm Management

The operator interface located in the control panels allows you to consult and modify the operation parameters of the electro-technical components of the treatment system, namely of the pumps and blowers for the MBBR reactor and scum and sludge pumps/airlifts of the decanter. The panel of the controls will indicate of the alarms occurred. When the panel indicates an alarm make a note so the alarm to be corrected. Please consult the Troubleshooting Section at the end of this document to identify the issue. If the problem persists, please contact **Premier Tech**. To cancel an alarm, press the Reset button. A persisting alarm indicates that the problem is still occurring. If the alarm disappears by pressing the Reset button, the problematic condition is no longer in effect. However, it is good practice to investigate further to identify and understand what caused the alarm.

6 Process Control – Biology

6.1 Biological Operation Parameters

6.1.1 Dissolved Oxygen in the MBBR

To ensure adequate biological treatment and prevent an excessive proliferation of filamentous bacteria, a minimal dissolved oxygen concentration of 4 mg/L should be maintained in the bioreactors (monitored by a DO where applicable).

The lack of oxygenation can lead to a dark coloration of the contents of the MBBR, an unpleasant odour characteristic of a « septic condition », an accumulation of biomass on the media and diminish treatment performances. Various potential solutions can be considered:

- Special attention must be paid not to aerate excessively to limit the destruction of the biofilm flocs suspended by the movement of the media pieces.
- Reduce the frequency when the tank is set to the economy mode or increase the DO setpoint.
- Reduce the frequency of the feed periods (be careful with these last two adjustments). You must make sure that you will be able to respect the daily flow of wastewater to be treated).

6.1.2 Nutrients

The organic matter, the nitrogen and the phosphorus constitute a source of food and are essential nutrients for the microorganisms responsible for the treatment. Their activity will be maximal when all their needs are met. Nitrogen and/or phosphorus deficiency can favour the growth of filamentous organisms and impair treatment performances. A balanced mass ratio (BOD_5/N/P) of 100/5/1 must be present for the biological activity. In the event of a deficiency, the situation can be corrected by adding nitrogen and/or phosphorus to obtain a more balanced mass ratio.

6.1.3 pH and Alkalinity Variations

pH will vary if acid or basic wastewater is driven into the system or if the alkalinity of the water is insufficient in the raw sewage. A drop in the pH can impair treatment performances. Usually, the occasional addition of small quantities of acid or alkaline products in the wastewater will not impair the treatment due to the dilution rate inside the reactor. However, a significant spillage of acid or alkaline products could impair or even inhibit the treatment.

A lack of alkalinity ($CaCO_3$) in the wastewater (buffering capacity) can lead to a decrease in pH. Typically, the alkalinity is consumed by the nitrification process during the biological treatment under aerated conditions. While mostly used by the nitrifiers, the chemical removal of the phosphorus can also consume a fraction. A residual alkalinity at the effluent of 50 mg/L is generally recommended to ensure the stability of the pH during the treatment.

Significant pH variations in the system on a regular basis may make it necessary to add an automatic pH control equipment or some alkalinity.

6.1.4 Biofilm Control

The efficiency of the biological treatment is based on the activity of the microorganisms stuck on the media pieces. A sufficient quantity of such microorganisms must thus be found in the biofilm covering the media surface. However, an excessive quantity of biofilm can impair the process treatment. Under normal conditions, the thickness of the biofilm should be barely visible up to 1 mm.

To reduce the clogging of the media pieces and optimize the thickness of the biofilm, the operator must make sure aeration is sufficient. The purpose of the aeration is twofold: it cleans the media by stirring and abrasion, and ensures sufficient input of dissolved oxygen for the biological treatment. The operation of the blowers, if it respects minimal mixing criteria, will usually allow for the adequately recurring of the surface of the media. An optimal thickness of biofilm will thus be maintained.

In certain cases, where the applied load is much lower than the design loads, it may be necessary to reduce the duration of the aeration times to limit the excessive abrasion of the suspended pieces of biofilm. In fact, a very elevated retention time can lead to suspended biomass flocs breakage and impair the separation of solids by the decanter. To limit the flocs from breaking, the agitation must be controlled. Be careful not to lower the aeration too much to maintain a sufficient biological activity for the treatment.

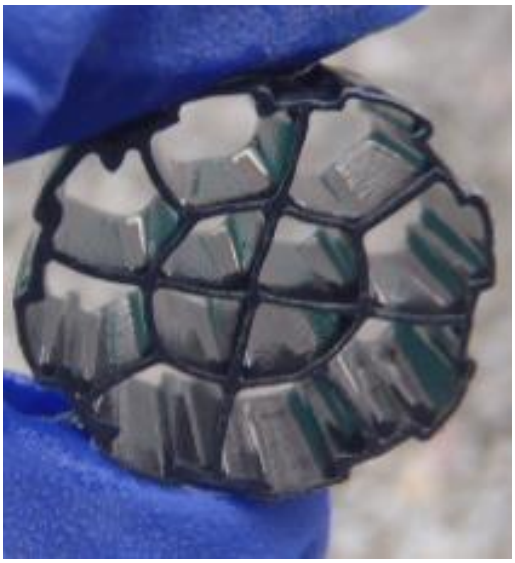

Figure 3: Media with little colonization

Figure 4: Very colonized media

6.2 Environmental Follow-Ups

The operation of a **Rewatec MBBR** is done automatically. However, it is necessary to perform periodical follow-ups of its performances to ensure that the control parameters are always properly adjusted. To do so, it is generally appropriate to perform a sampling of the effluent of the treatment chain. Certain precautions must be taken during the sampling procedures to avoid contaminating the samples collected and skew the obtained results. As such, it is essential that the instruments and materials used for the sampling (sampler, sampling points, bottles, etc.) be carefully cleaned and disinfected. Moreover, it is strongly recommended, when more than one sampling points are concerned, to begin with the least contaminated point and move back up the treatment chain. This will limit the risks of cross contamination.

The following parameters are generally analyzed (influent and effluent is recommended:

- Total carbonaceous biochemical oxygen demand after 5 days (BOD_5).
- Chemical Oxygen Demand (COD).
- Total Suspended Solids (TSS).
- Ammoniacal Nitrogen (NH_3-N; or Ammonium Nitrogen as NH_4-N)
- Total Phosphorus (when required by the regulation or for a system diagnostic).
- All forms of Nitrogen (i.e. NO_3-N when required by the regulation or for a system diagnostic).
- Fecal Coliforms (when required by the regulation or for a system diagnostic).
- Soluble Carbonaceous Biochemical Oxygen Demand after 5 days (BOD_5) (system diagnostic).
- Other parameters can be required as per the local regulation as well as discharge requirements specific to your installation.

7 Maintenance and Servicing of the System

7.1 Weekly Inspection and Maintenance

The operation principle of the **Rewatec MBBR** treatment process is simple, but the system does require regular, preventive inspection and maintenance. A minimal weekly follow-up is recommended as a preventive measure to be able to react swiftly in the event of an electro-technical operation failure. It is not required that this follow-up be performed by a person trained by Premier Tech. Here are the actions to be undertaken during these visits:

7.1.1 Weekly Inspections

- Visual inspection of the proper operation of the electromechanical components, pumps/airlifts and blowers.
- Visual inspection around the **Rewatec MBBR** treatment chain (equalization tank, bioreactor, decanter, pumping stations, etc.).
- Note down any failure or other particularities related to the operation of the system.
- If possible, note the operation time of every equipment.
- Note the status of the green overflows (in biozone), flush with water if evident solids build-up.

7.2 Periodical Operation and Maintenance Follow-ups

The maintenance of the **Rewatec MBBR** system should be performed by a person trained by Premier Tech. Premier Tech service partners inspect and maintain the mechanical components and perform the follow-up required for the proper functioning of the treatment process.

Table 1: Principal operation points of the Rewatec MBBR System

Activities
Operation of the treatment chain
Inspection of the primary treatment and sludge measurement
Reading of key operational parameters
Inspection and maintenance of the **MBBR** system
Inspection and maintenance of the secondary decanter/humus

7.2.1 Operation of the Treatment Chain

- Verification of the general operation condition of the treatment chain.
- Verification of the operation of the pumps/airlifts.
- Verification of the operation of the control panel(s) and alarm system.
- Perform the maintenance of the pumps/airlifts and blowers as per the recommendations of the manufacturer.

7.2.2 Reading of Key Operation Parameters

- Note the operation times of the various pumps/airlifts and blowers.
- Note the total number of operation hours of the electrotechnical components.
- Note any failure or particularities related to the operation of the system.
- Make the required adjustments based on the observations made.

7.2.3 Inspection and Maintenance of the Rewatec MBBR System

- Evaluate the correct feed rate of the **Rewatec MBBR** system.
- Verify the proper operation of the blowers and the homogeneity of the mixture in the tank.
- Note the pressure indicated on the manometer while the blowers are operating.
- Verify if the clogging indicator of the blower's filter has indicated any clogging. Clean the filter, if required.

7.2.4 Inspection and Maintenance of the Decanter/humus

- Verify the operation of the pumps/airlifts and make sure the sludge is properly directed to the storage tank (septic or sludge management tank).
- Note the accumulation of scum on the surface of the decanter (inlet, middle and outlet section).
    - If there is scum, increase the frequency of the scum removal.
    - If there is scum in the inlet and outlet sections, it will need to be removed manually.
- Measure the sludge accumulation at the bottom of the decanter/humus (inlet and outlet section). There should not be any sludge there.
    - If there is an accumulation of sludge at the bottom of the decanter/humus, increase the frequency of the sludge removal.

7.3 Environmental Follow-Ups

To validate the treatment performance of the treatment system, a sample and analysis of the physical and physicochemical parameters may be required.

Moreover, for all types of treatment chains designed for community, commercial and institutional establishments, local authorities may require environmental follow-ups of the treatment performances of the treatment chain while in operation.

A list of recommended installation and maintenance teams can be provided upon request.

8 Intermittent Operation and Seasonal Fluctuations

A prolong no-flow period (one week) could lead to the death of a fraction of the microorganisms present on the media. Depending on the duration of the no flow period, a few days to a few weeks could be required for the complete re-establishment of the treatment performances. Moreover, it is possible that such a situation generates foam. This foam will be controllable by the addition of an anti-foam agent available from any speciality supplier and by reducing the duration of the aeration (please consult Section 6.3).

In certain applications, it is possible that loads vary depending on the period of the year the system is in operation. For example, a restaurant may only operate in the summer.

A significant variation in the BOD_5 concentration at the influent could have a negative impact on the treatment. As such, and in certain cases, it may be necessary to adjust the aeration. Premier Tech recommends adjusting the duration of the aeration proportionally to the difference of the mass loading to be treated. Please consult premier Tech if you feel that your flows and loads are about to change.

9 Start-Up and Seasonal Shutdown

When the treatment chain is not operating in the winter, certain actions must be undertaken to prevent any equipment breakage:

- Drain the treatment plant (primary, biozone and humus) if decide to switch off the plant for a period longer than 2 months.
- Drain any other pipes that may freeze in the winter.
- Make sure that pumps are not located at a level where the water could freeze and lead to breaks. For the decanter, it is preferable to lower the pumps to the bottom of the reservoir for the winter period. At start-up, the pumps should be placed back in their original position.

During start-up, following a temporary BOD_5 shutdown of the treatment chain, it is important to open the lids of the reactor and secondary decanter to verify if any component may have broken during the stoppage period.

10 Troubleshooting

IMPORTANT: certain operations can only be executed by a qualified electrician or technician.

10.1 Mechanical Features

10.1.1 High-float alarm – Equalization Tank

Turn off the feed pumps. Keep the water consumption to a minimum until the issue is resolved.

Possible Causes	Explanations and Repairs
Mechanical problem leading to a high level	• Reset the circuit breaker of the pumps, if required. • Reset the overload relay of the pumps, if required. • Verify the operation of the pumps manually. • Verify if a high-level float is stuck in the equalization tank. • Verify the operation of the level floats in the equalization tank. • Proceeded with the necessary verification, repairs or part replacements if the problem continues.
Air lock in the pump's conduit	• Activate the pump and wait a few minutes for movement in the conduit to begin. • Activate the pump and, if possible, move the pump and its conduit vertically to let the air out. • With the pump deactivated, dissemble the union to purge the air and reconnect the union.
Calibration of the pumps	• Verify if anything is obstructing the pumps or feed conduits. • Validate the flow of the feed pumps. • Based on the flow of the feed pumps and their pre-established operation sequences, evaluate their daily treatment capacity. • Evaluate the daily flow to be treated based on the flow of the feed pumps and the daily operation time totalizators. • Adjust the flow or the operating times if the treatment capacity is lower than the daily flow to be treated.
Obstruction of the holding grid of the MBBR media	• Clean the holding grids inside the MBBR.
Runoff water flowing to the treatment chain	• Inspect all the elements of the treatment chain and verify if any runoff water is flowing to the installation. • Correct what may be required to address the issue.
Real flow is greater than the design flow	• Revise the design of the **Rewatec MBBR** treatment chain.

10.1.2 Problem with the pumps of the Rewatec MBBR System

Turn off the feed pumps. Keep water consumption to a minimum until the issue is resolved.

Possible Causes	Explications et Repairs
Defective pump(s)	• Identify the defective pump with the error message on the operator interface. • Reset the circuit breaker of the defective pump, if required. • Reset the overload relay of the defective pump, if required. • Test the operation of the pumps manually. • Proceed with the necessary verification, repairs or part replacements if the problem continues.
Obstructed Valve adjustments	• Verify that water flows freely in the valve when it is in the open position. • If the valve seemed obstructed, use a push rod to unblock it.
Obstructed airlifts	• Press the test switch to confirm whether there is adequate flow from the airlift or not. • Remove blockages at the pipe of the airlift (from solids, organics and/or pieces from rags wipes etc.).

10.1.3 Presence of an important amount of foam in the MBBR

The presence of controlled foam inside the reservoir is not necessarily problematic. Foam becomes an issue when it is so abundant that it begins to seep out of the tank.

Possible Causes	Explanations and Repairs
At Start-Up • Initial Start-up • Seasonal Start-up • Start-up after a long period of no flow	• At the initial start-up, reduce the aeration times as per Section 5.2.3. Set the operational times to normal when the foam is well controlled. • If the adjustment of the aeration is insufficient, add an anti-foam product during the start-up period as per the recommendations of the manufacturer.
Under normal operations	• Investigate how the system is used by the occupants of the serviced building. Verify if certain products rejected into the wastewater may cause an accumulation of foam. • Measure the concentration of the dissolved oxygen of the water inside the MBBR while in normal operation mode. If the water is saturated, the mixing could be excessive and produce foam. Reduce the aeration rate all the while making sure to maintain a minimum of 4 mg/L in dissolved oxygen. • If the adjustment of the aeration is insufficient, add an anti-foam product as per the recommendations of the manufacturer.

10.1.4 Problem: plant does not function but main switch is in the «ON» position

Possible Causes	Explanations and Repairs
Defective electrical and phase connections	• Verify the various phases with a voltmeter. • Reset the main circuit breaker or replace any burnt fuse.
Defective electrical connections	• Verify if all electrical connections were performed concord with the electrical plans.
Defective control unit	• Verify if the voltage before and after the main switch concord with the electrical plans.
System in manual mode	• Verify if every equipment is in «AUTO» mode.
Problem with the float(s) inside the equalization tank	• Verify if you can visually confirm that the height of the float in the equalization tank (on the control panel and inside the tank). Verify the electrical connections, if necessary.

10.1.5 Problem: Defective blower

The blower refuses to start or stop.

Possible Causes	Explanations and Repairs
Temporary loss of communication	• If the equipment is operational, ignore this error.
Burnt out feed fuse	• Verify the feed fuses. • Replace any fuses, if required.

10.1.6 Blower surcharge

Possible Causes	Explanations and Repairs
Closed valve or obstructed conduit	• Verify if the valves before and after the blower are open. • Verify that the conduits before and after the blower are not obstructed.
Defective motor	• Use an ammeter to verify the current used by the motor. • Verify the condition of the winding of the motor. An electrical resistance. should be present at each phase of the grounding. • Replace the motor, if required.
Defective blower	• Verify the general condition of the blower (leaks, temperature and colour). • Reassemble or replace the blower, if required.
Incorrect adjustment of the maximum current in the frequency inverter	• Verify that the adjustment maximal current of the frequency inverter corresponds to the motor (FLA).

10.1.7 High-level alarm – MBBR

Possible Causes	Explanations and Repairs
Clogging of the holding grid of the media	• Clean the holding grid inside the MBBR.

10.1.8 Problem: Decanter

Possible Causes	Explanations and Repairs
Scum accumulation on the surface	• The frequency of scum removal is insufficient. Increase the frequency of scum removals depending on the site's needs as specified in Section 5.4. • The loading time of the conduits is elevated and not enough water is directed to the sludge holding tank. Increase the « ON » time of the scum removals to make sure the sludge is directed to the scum storage tank adequately. • Clean the surface at the inlet and outlet of the decanter via desludging.
Sludge accumulation at the bottom of the tank	• The frequency of the scum removal is insufficient. Increase the frequency of the scum removals depending on the site's needs as specified in Section 5.4. • The loading time of the conduits is elevated and not enough water is directed to the sludge holding tank. Increase the «ON» time of the scum removals to make sure the sludge is directed to the holding tank properly.

10.1.9 Problem: Odours

Identify the source of the odour carefully. Air can circulate between reservoirs and on the site. Sometimes, an odour detected near an equipment may be triggered by another equipment.

Possible Causes	Explanations and Repairs
Not enough aeration	• Septic type of odour from the MBBR. Measure the level of aeration and increase the aeration frequency while in normal operation mode if the dissolved oxygen is below 4 mg/L. • Ensure the tank is well ventilated • Re-calibrate the DO probe if applicable
Location of the treatment chain near human activity	• Perform a smoke test inside the reservoirs to validate the presence of leaks and the source of the odour. • Install an air vent further away from where human activities takes place. • Waterproof the reservoirs' access point, if they are leaking. • Install a carbon filter to treat odours.

10.1.10 Problem: The treatment performances overage

Possible Causes	Explanation and Repairs
Total BOD_5	• Verify if the real loads are higher than the design loads. If so, revise the design of the treatment chain. • Measure the soluble BOD_5. • If the soluble BOD_5 is 50% lower than the discharge objective in total BOD_5, refer to the section below about TSS. • If the soluble BOD_5 is greater than the discharge objective in total BOD_5, increase the aeration inside the MBBR while in normal operation mode. • Then, if the soluble BOD_5 is greater than the discharge objective in total BOD_5 total, lower the volume of water dosed to the MBBR by dose.
TSS	• Refer to Section 10.1.8. • Verify that the design of the surface loading rate is respected. • Reduce the volume of water dosed at each dose. • Reduce the aeration inside the MBBR, if the oxygenation is excessive.
NH_4.N	• Refer to Section 10.1.8. • Confirm the incoming flows and loads, the status of the incoming flow as well as potential fluctuations is crucial to understand the feeding regime. • Check the alkalinity status of the influent • Re-calibrate the DO probe if applicable

10.1.11 Power Outages

In the event of a power outage, the program with restart by itself and will store any previously entered data. If you have any questions about the functioning of the **Rewatec MBBR** treatment system, please do not hesitate to contact Premier Tech.


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