

SCOPE OF SERVICES AND PLANT INFORMATION



Mobile

Demonstration Plant

FLEXBIO-AFBBM-1.MV

Anaerobic-aerobic wastewater treatment

ONLY SUPPLIER OF ANAEROBIC WASTEWATER TREATMENT IN COMPACT

CONTAINER DESIGN

FlexBio Technologie GmbH

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1. Introduction

By using our mobile demonstration plant, an effective demonstration of an up-to-date wastewater treatment is achieved. Furthermore, the on-site trial operation enables an effective potential determination under practical conditions. In addition, planning errors are mitigated and process optimization already takes place during the pre-test. The demonstration plant is able to efficiently run through process engineering adaptations and variations to the specific wastewater in advance. The demonstration plant is completely mounted in a trailer. This allows us to demonstrate the function and performance of our process. The mobile plant is dimensioned in such a way that upscaling to a larger plant is easily doable.

The demonstration plant records various parameters such as **biogas yield**, **COD purification performance** and **nitrogen elimination**. In addition, regular sampling takes place to enable **accurate documentation** of the results. The scope of services can be adapted according to **customer requirements**.

Your advantages at a glance:

- Fast potential determination
- Significant results
- On site investigations
- Continuous online measurement
- Easy Upscaling
- Customer friendly design
- Laboratory support



2. Property rights and copyrights

Unauthorized reproduction and use

The present process, design and technical documentation submitted are protected by national and international conventions on industrial property rights and copyrights and against unfair competition.

- Act on Copyright and Related Rights (Copyright Act - UrhG) BGBl. I p. 1273, Art. 7 G of April 4, 2016, (BGBl. I p. 558, 565).
- Collecting Societies Act May 24, 2016 (BGBl. I p. 1190)
- Publishing Rights Act Art. 2 G of March 22, 2002 (BGBl. I p. 1155, 1158)
- WTO Agreement (15/04/1994)
- Agreement on Trade-Related Aspects of Intellectual Property Rights (BGBl. II 1730)

FlexBio Technologie GmbH is and remains the owner of all industrial property rights and copyrights as well as the know-how concerning the delivered process, regardless of whether the process was specifically developed for this purpose. This applies in particular to all technical documents, drawings, proposals etc. provided.

The customer/distributor/cooperation partner commits not to copy or reproduce the offers, representations and technical documents submitted to him or to pass them on to third parties. The information contained in this technical description may not be reproduced or published in any form, printed, photographed or stored on microfilm without the prior written consent of FlexBio Technologie GmbH.

The customer/distributor/cooperation partner is obligated to keep all information concerning the procedure strictly confidential.

3. Scope of services

The scope of services includes the provision of a mobile demonstration unit AFBBM-1.MV for the purpose of determining the potential. The demonstration unit is provided for the rental period specified in the order confirmation. This will be agreed with the customer before the order is placed and can be inbetween 3 to 6 months, depending on requirements. The mobile demonstration unit AFBBM-1.MV is and remains the property of FlexBio Technologie GmbH.

The range of services includes:

- Planification of experiments
 - Coordination of the installation site
 - Definition of the interfaces
 - Determination of a suitable sampling point
 - Determination and planning of the examination
- Delivery of the mobile demonstration unit incl. accessories
- Installation, alignment and connection of the plant at the defined interfaces
- Commissioning and instruction of personnel on site
- Delivery of the sampling vessels
- Monitoring of the plant via remote access
- Maintenance and ensuring trouble-free plant operation
- Weekly analysis report
- Preparation of an evaluation in the form of a report

The treatment plant is based on a development of FlexBio Technologie GmbH. It is a multi-stage plant with an integrated anaerobic main treatment and a downstream activated sludge stage with built-in MBR plant (membrane bioreactor). The anaerobic fixed-bed digester enables effective removal of organic load with methane production. The device is installed in an insulated box trailer (car trailer). The methane-rich gas produced is rendered harmless and odorless by a biofilter (methane oxidation biofilter) integrated into the mobile unit. During the trial, the treatment stages are continuously monitored via remote access. Regular sampling of the influent and effluent is performed on site by the customer's operating personnel. The wastewater samples are sent by mail to FlexBio Technologie GmbH for laboratory analysis.

4. Installation site

For smooth potential determination, the following requirements are assumed for the installation site:

- Installation takes place in the open or in a partially open, well-ventilated hall. The final installation site will be agreed with the contractor.
- Installation takes place on a level, paved surface (asphalt or concrete).
- The mobile demonstration unit will be spatially close to:
 - Of the potential wastewater extraction point (max. 30 m)
 - Drainage of purified water (max. 20 m) as well as
 - Power connection: 400V, 3 Ph., CEE three-phase plug 400 V/32A (**Attention: do not use RCD fuse**); Maximum distance from the installation site 20 m.
- Minimum installation area: 9 m x 4 m
- Sufficient maneuvering space for parking the trailer at the installation site.

Sampling point can be realized as follows:

- Connection of the supply line to an on-site pressure line (max. 1 bar) with a 1 inch external thread connection with a ball valve or gate valve. The demonstration unit controls a valve internally and fills an internal receiver level-controlled.
- Alternatively, the wastewater can be taken from a receiver or pump shaft via a supplied pipe.
- Furthermore, there is the possibility of integrating a submersible pump (included as an accessories), which can be connected to the mobile system and controlled via the system.

The mobile demonstration unit produces methane-containing gas from the organic contamination of the wastewater, which is harmlessly disposed together with the exhaust air from the aerobic (ventilated) stage via a biofilter. In case of failure of the biofilter, methane leakage may occur. To ensure safe operation, there must be no open fire in the immediate vicinity of the system. An explosion protection zone is defined directly at the outlet of the exhaust air above the roof of the trailer. This is marked accordingly.

The following figure shows the connection points, attachments and dimensions of the mobile trailer system.

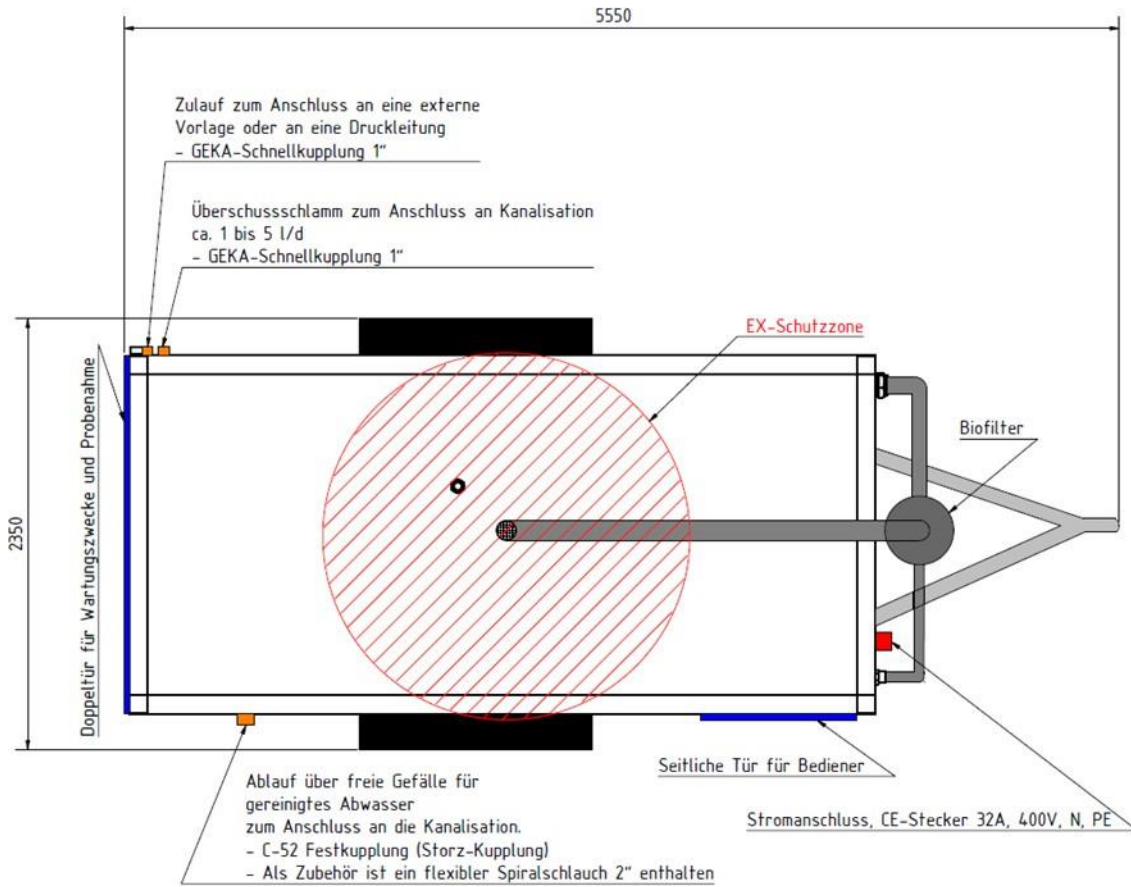


Illustration 1: Connection diagram of the mobile demonstration unit



Illustration 2: Mobile demonstration unit AFBBM-1.MV

5. Analytics

Sampling is carried out according to the instructions of the operating personnel at defined (labeled) sampling points. In order to assess the performance of the plant, online and offline measured values are recorded regularly. Offline analysis is wastewater analysis, which can only be defined to a limited extent using online measurement technology. Therefore, the following measurement parameters are repeatedly recorded by laboratory analysis

- COD concentration in the influent and effluent
- Nitrogen concentration in the influent and effluent
- Phosphorus concentration in the inflow and effluent

Further parameters will be included in the measurement program as required. Sampling is carried out by the client according to the specifications of FlexBio Technologie GmbH. The **sample** should be sent **in the prepared and stamped shipping bag by Wednesday at the latest**, so that the sample arrives before the weekend. The laboratory analysis runs at our partner laboratory (Laboratory for Environmental Analysis, HAWK University of Applied Sciences, Faculty of Resource Management). Alternatively, sample analysis can be arranged at any recognized/accredited laboratory. Laboratory reports must be provided to the contractor in a timely manner when outsourcing. The sample should be cooled if possible, especially if it contains very unstable material.

The delivery address for the sample is:

FlexBio Technologie GmbH
z.Hd. Frau Katharina Simon
Rudolf-Diesel-Str. 12
37075 Göttingen

According to the integrated measurement technology, the following parameters are continuously recorded online:

- Volume flow of the wastewater (flow rate, flow meter)
- Biogas volume (raw gas)
- Gas composition: CH₄, CO₂, H₂S, O₂
- Gas temperature (for determination of standard volume)
- Absolute pressure biogas (for determination of standard volume)
- Process temperature (in all stages)
- Oxygen concentration of the aeration
- pH-value (in all stages)
- Redox (in all stages)
- Conductivity (in the inlet)

6. Procedure description

For a complete degradation of organic substances into inorganic end products such as methane and carbon dioxide, the interlocking of several degradation steps and thus the interaction of different microorganisms is necessary.

In the first step of degradation, known as hydrolysis, the enzymes secreted by the microorganisms break down long-chain and often undissolved substances such as carbohydrates, fats and proteins into low-molecular compounds. These include the simple sugars, long-chain fatty acids and amino acids. These units are soluble in water and can be taken up intercellularly by microorganisms. The low-molecular compounds formed in this phase, such as butyric acid, propionic acid and acetic acid, are thus basic products of the further degradation steps.

In acidogenesis, also known as the acidification phase, facultative and obligate anaerobic bacteria reduce the products of hydrolysis to low molecular weight organic acids, alcohols, hydrogen and carbon dioxide. The resulting lower carboxylic acids are converted to acetic acid by bacteria in acetogenesis with the formation of hydrogen and carbon dioxide. Under normal conditions, the degradation step does not involve energy production. In the final phase of the degradation process, methanogenesis, microorganisms produce methane from the previously formed degradation products. These are strictly anaerobic and, as substrate specialists, use only a few substances for conversion. The greatest energy gain can come from the formation of methane from carbon dioxide and hydrogen. The **optimum conditions** for methanogenesis are **a temperature between 30 °C and 40 °C** and a **pH value between 6.0 and 7.5**.

The individual degradation steps are built on each other and are partly interdependent. This results in a necessity for the formation of biocenoses, which are freely present in the biogas reactor in the form of complex flakes/pellets of specialized microorganisms or are fixed to carrier material in the biofilm.

In the following figure, the biofilm on a packing (carrier material) is shown schematically:

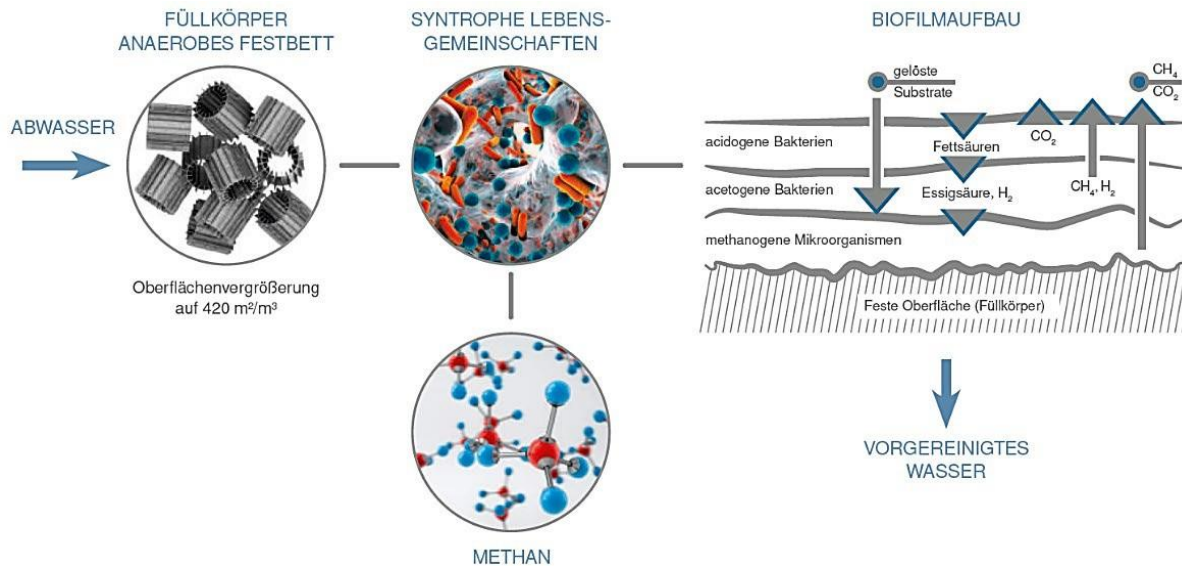


Illustration 3: Schematic representation of a biofilm on a packed bed in a fixed bed

The liquids charged with organics are effectively used in the first step in a compact fermentation plant. Like the conventional biogas plants, the fermentation plant produces the biogas from the supplied organics. During anaerobic treatment, the organic load can be reduced by 99%. Under aerobic conditions, nitrification of ammonium, partial denitrification and further COD elimination occur in the aeration (aerobic treatment stage). A partial stream from the aeration is returned to the fixed bed reactor. Simultaneous feeding with organically contaminated wastewater leads to denitrification under anaerobic conditions and thus to the degradation of nitrate to atmospheric nitrogen (N₂). This process of recirculation and denitrification in an anaerobic fixed-bed reactor is new.

Partial flow recirculation is based on the limit values to be complied with for COD or ammonium and nitrate concentrations in the treated water, with the nitrate content representing a control variable. It is therefore a form of anaerobic respiration, also known as nitrate respiration. The degradation of nitrate to molecular nitrogen takes place in the fixed bed by special microorganisms (denitrifiers). The fixed-bed reactor offers almost ideal conditions for this due to its anaerobic environment, neutral pH range and a carbon source present in the feed. This process simultaneously subjects the activated sludge formed in the activation to anaerobic treatment, which further reduces the amount of sludge to be disposed of and contributes to an increase in the gas formation potential.

Figure 4 outlines the biological process of a FlexBio plant.

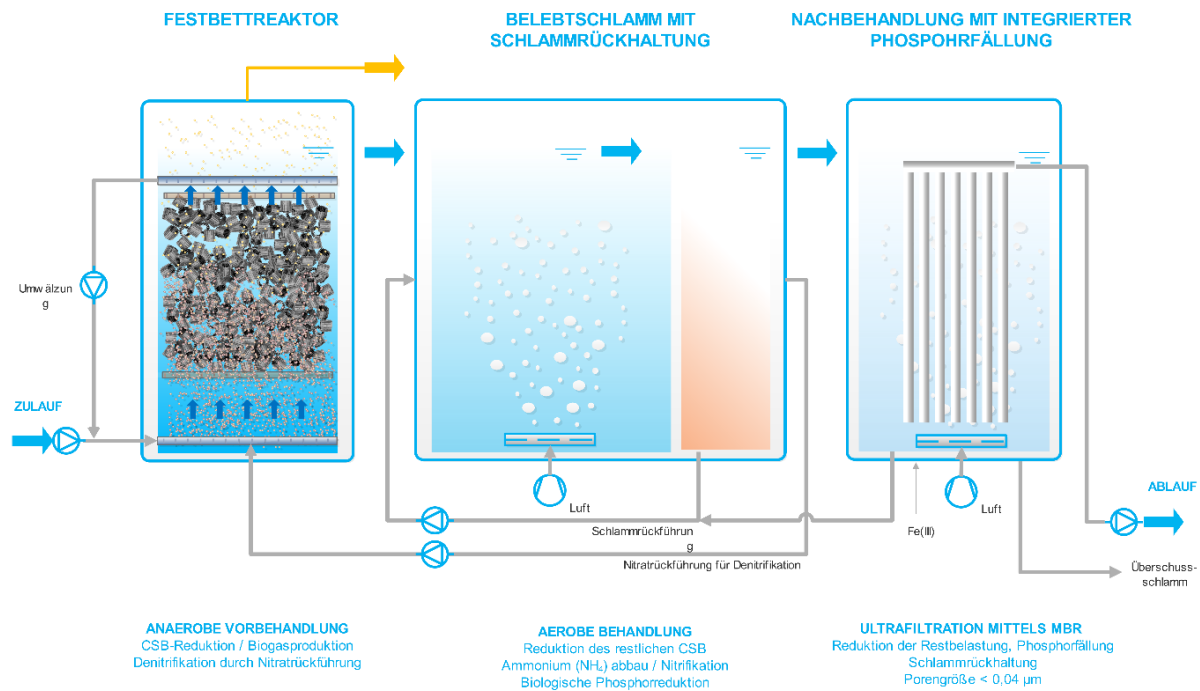


Illustration 4: Principle of the FlexBio process of biological wastewater treatment

Essentially, wastewater treatment takes place in the following process steps :

1. Process step: organic degradation in fixed-bed reactor (anaerobic), production of biogas
2. Process step: nitrification and degradation of the remaining organic matter in the aeration (aerobic)
3. Process step: denitrification and activated sludge degradation by partial flow recirculation in fixed bed reactor (anaerobic)
4. Process step: membrane bioreactor (MBR) as secondary treatment stage, sludge retention and hygienization (aerobic or anoxic)

The process is already being implemented in practice in different modules (treatment stages in different plant sizes).

With the unique combination of anaerobic and aerobic wastewater treatment with membrane technology, in so-called membrane bioreactors (MBR), particularly strict discharge values can be met. Membrane bioreactors result from the further development of biological wastewater treatment with suspended biomass in bioreactors, where membrane modules are used instead of a sedimentation stage to separate the biomass from the biologically treated wastewater. The FLEXBIO-MBR modules used thus allow filtration in the nanoscale around 40 nm (ultrafiltration).

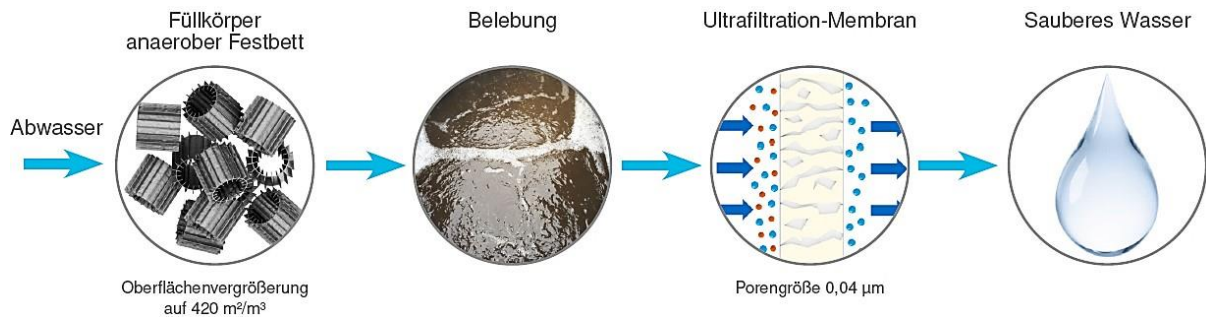


Illustration 5: Unique plant combination (anaerobic pretreatment combined with an MBR plant)

6.1 Important degradation processes in wastewater treatment

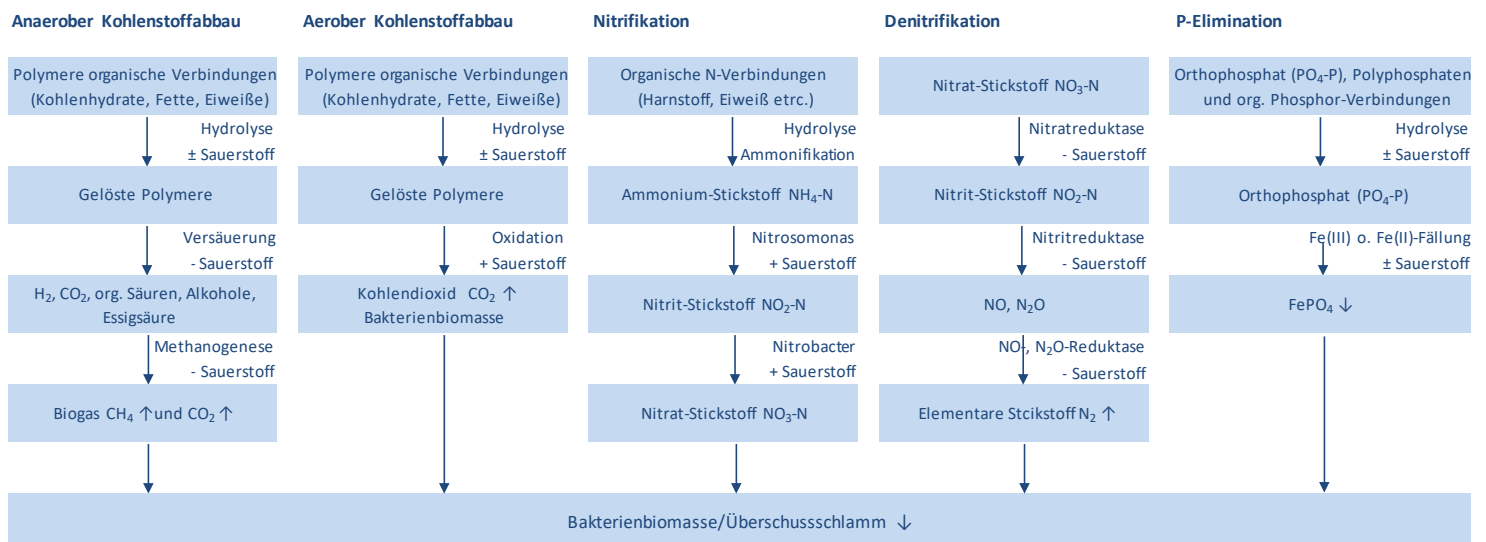


Illustration 6: Degradation processes in anaerobic/aerobic C-degradation, nitrification, and denitrification

6.2 Carbon degradation

Carbon is the main component of all organic impurities in water. It is predominantly converted to biogas by the anaerobic microorganisms (methanogenesis) in the anaerobic environment of the anaerobic filter (1st process phase). The other (remaining) carbon is degraded by the microorganisms in the activated sludge under anoxic environment conditions and in the aerated part of the biological stage (nitrification zone of the 2nd process phase). In the activated sludge tank, the C-compounds are needed by the microorganisms to build up their own cell structures and to produce energy.

Carbon compounds are determined as COD and BOD5 (as sum parameters for organic impurities).

6.3 Nitrogen

In the influent of the treatment plant, the nitrogen is organically bound (org. N) and present as ammonium nitrogen (NH₄-N). During the biological treatment processes, the organic N is converted into NH₄-N by the bacteria and, together with NH₄-N from the influent, is via nitrite to nitrate (2nd process phase/nitrification). The part of the nitrogen compounds that is not biologically incorporated into the activated sludge is transformed into elemental nitrogen under anoxic or anaerobic conditions in the anaerobic filter by recirculation (denitrification of the 3rd process phase).

Nitrogen compounds are determined as NH₄-N, NO₂-N, NO₃-N and TN (total nitrogen/organic and inorganic N).

6.4 Phosphorus

The P-load in the influent of the treatment plant is composed of orthophosphate phosphorus (PO₄-P), polyphosphates and organic phosphorus compounds. Phosphorus is metabolized by microorganisms and accordingly bound in sludge. The amount utilized depends on the organic load introduced. Some of the phosphates contained in the influent are incorporated into the biomass and removed with the excess sludge. The incorporation into the excess sludge can usually be estimated at 1 % of the influent BOD₅ or 0.005ΣC COD (ATV-DVWK-M 206).

Downstream chemical P-precipitation is provided for the remaining P-reduction. This form of P-precipitation enables particularly effective P-elimination and ensures compliance with strict limit values. The P-precipitation takes place in a fully mixed tank downstream of the activated sludge stage. This tank is mixed with air. In addition to very good mixing, this has the advantage that FE II can also be used in addition to FE III. FE II requires oxygen, since it must be oxidized to FE III for P-precipitation. The resulting sludge is separated in the downstream secondary clarifier.

Phosphorus is determined as orthophosphate and as sum parameter total phosphorus (P_{ges}).

7. Technical description of the demonstration unit

Performance data of the mobile demonstration unit AFBBM-1.MV

Treatment medium	Organically contaminated wastewater; production wastewater
Hydraulic load	0,5 – 4 m ³ /d
Organic load (COD)	> 2.500 mg/l
Outlet values	COD: < 120 mg/l (depending on the purification target and wastewater quality)
Process temperature	25 – 35°C (Anaerobic fixed bed)
Power connection	32A, 400V, 3Ph, N, PE
Biogas production	60 – 90 % Methane content; max. 0,35 m ³ methane per kg COD

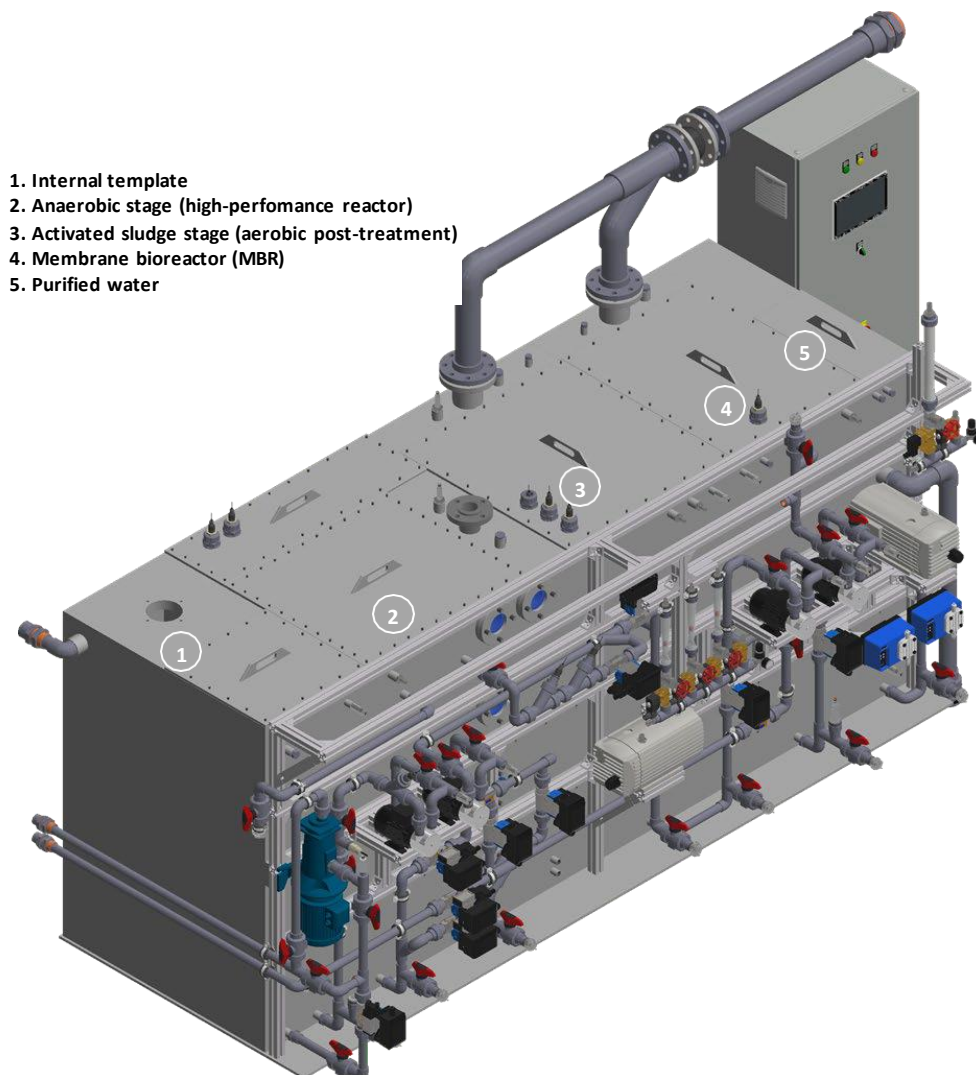


Illustration 7: AFBBM-1.MV, mobile demonstration unit in a car trailer

Procedure	Anaerobic pretreatment combined with an aerobic activated sludge stage and a membrane bioreactor.
General	<p>The system is installed in a car trailer.</p> <p><i>External dimensions:</i> 401x185x205cm</p> <p><i>Empty weight:</i> 2.500 kg</p> <p><i>Tank:</i> material PP, suitable for operation with 5 mbar permanent/ 50 mbar short-time, max. inlet temperature 40°C</p> <p><i>Total volume:</i> 5 m³</p> <p><i>Container distribution</i></p> <ol style="list-style-type: none"> 1. Receiver approx. 650 L 2. Anaerobic fixed bed with settling tank: 1000 L 3. Activated sludge basin with integrated settling tank: 1500 L 4. MBR basin: 1000 L 5. Purified water: 330 L <p><i>Inspection openings:</i> Maholes 6 pcs.</p>
Anaerobic fixed bed	<p>Useful volume approx. 900 L</p> <p>Support with grating made of GRP for receiving fixed bed Packing: 850 L, BT30 made of PE, surface area: 420 m²/m³</p> <p>Inlet distributor (8 pieces) in the tank bottom for evenly distributed recirculate line with evenly distributed inlets (outlet at the top)</p> <p>Overflow channel / collection line for pre-cleaned wastewater</p> <p>Biogas collection line</p> <p>Overpressure protection and overflow protection</p>
Activated sludge basin	<p>Useful volume approx. 1250 L</p> <p>Aeration System: Membrane plate aerator</p> <p>Overflow channel to sedimentation tank</p> <p>Integrated sedimentation tank with total volume: approx. 250 L</p> <p>sludge recirculation</p> <p>Overflow trough to MBR</p> <p>Exhaust air duct</p>
MBR-basin	<p>Useful volume: approx. 800 L</p> <p>8 m² membrane area</p> <p>Frame material 1.4301 Polymer:</p> <p>Polyethersulfone Membran type:</p> <p>Ultrafiltration Pore size (nominal): 0,04 µm max.</p> <p>backwash pressure 350 mbar</p> <p>max. operating temperature 50°C</p> <p>Permissible pH range: 1 -12</p> <p>Average flux in MBR applications: 25 to 35 l/m²h</p> <p>Max. short-time flux MBR applications: 40 to 50 l/m²h</p> <p>Flat ventilator: max. air volume flow: 10 m³/h (at standard conditons)</p>

Engine room	<p>Feed pump anaerobic filter up to 200 L/h Circulation pump anaerobic filter up to 200 L/h Sludge recirculation Activated sludge tank up to 200 L/h MBR suction and backwash pump max. 200 L/h Activated sludge tank aeration compressor with capacity: 10 m³/h MBR aeration compressor with capacity : 10 m³/h Heat recovery: Tabular heat exchanger for connection to primary circuit of corrugated heat exchanger (heat recovery from plant effluent), circulation pump for premer circuit Heating system: Electrical 4 kW Circulation pumps MBR cleaning chemicals: storage tank and metering pump Phosphorus elimination: storage tank and metering pump for Fe(III)</p>
Control	<p>Control cabinet with control panel display and control panel with display for operating states, connection to the control room possible (interface must be defined when commissioning). Digital and analogue inputs and outputs for comprehensive operation of the unit for connection of the measurement/monitoring technology (temperature, flow, pressure, if necessary biogas filling level, CHP or combustion plant) Operation by plain text display Complete process visualization Input option for pumping times, capacity, control parameters, etc. Password protection of operating data, logbook Remote access to the control system by operator, service personnel and maintenance company via LAN or GSM modem (SIM data card) Storage of process data, parameters and measured values as csv file (evaluation and further processing with Excel) Online error diagnosis with plain text error log (alarm manager) Outdoor display for operating states/failure/maintenance Emergency stop switch (outside)</p> <p>PLC programming PLC: electronic control system FlexBio-Control XSOFT-Codesis according to IEC-1131-3</p> <p>Measuring/monitoring technology Temperature, redox potential, pH, oxygen measurement, feed quantity, level measurement and monitoring gas flow and quality measurement</p> <p>Power management and monitoring Uninterruptible power supply (UPS)</p>

8. General notes and safety

This chapter contains information on safety measures and restrictions. Read the following information carefully before using the equipment to ensure the safest possible handling.

8.1 Explanation of notes, warnings and prohibitions



Follow operating instructions



Warning of a general danger point



Warning of dangerous electrical voltage



Crash hazard warning



Hot surface warning



Warning of explosive atmosphere



Prohibition of fire, open light and smoking



Entry prohibited for unauthorized

8.2 Important notes

For the safe operation of the supplied equipment we would like to list some important notes:

- ⚠ The AFBBM-1.MV Mobile Demonstration Facility must be operated in accordance with the operating instructions supplied. Locally applicable work and safety regulations and laws must always be followed, even if they are not explicitly listed in this document. The same applies to environmental regulations.
- ⚠ To ensure safety, all persons who come into direct contact with the system must take note of the contents of this documentation. The safety instructions must be followed.
- ⚠ It is not permitted to use the system for any purpose other than that described by the manufacturer.
- ⚠ If the operator detects errors or hazards, the manufacturer (FlexBio Technologie GmbH) must be notified immediately.
- ⚠ These operating instructions assume that the equipment is installed in workplaces where all mandatory safety regulations are followed; in particular, personnel must be provided with personal protective equipment for all activities to be carried out.
- ⚠ Maintenance and repair work may only be carried out by FlexBio Technologie GmbH. The maintenance work of an external company may only be carried out in agreement with FlexBio Technologie GmbH and after a written consent.
- ⚠ The AFBBM-1.MV Mobile Demonstration Plant is designed for the treatment of organically contaminated production wastewater. The treatment of other wastewaters, which have not been approved in writing by FlexBio Technologie GmbH, is not permitted.
- ⚠ The employees of FlexBio Technologie GmbH must be informed immediately of any deviating inlet values than were already known or communicated at the time of delivery/order.
- ⚠ In the event of improper operation of the system or changes to the installation or the control system, the operator is liable for possible damage.
- ⚠ Biocides, toxic substances or biologically incompatible substances shall not enter the plant, as these hinder the bacteria that are important for the treatment process and lead to biological process disturbances.
- ⚠ The power supply must be permanently ensured. The plant must always be left switched on, except for maintenance purposes, otherwise correct wastewater treatment cannot be guaranteed. The plant is not connected via a FI-Switch fused, so that no personal protection can be guaranteed. Work of any kind on electrical equipment and power lines may only be carried out by a specialist company or an electrician.

- ⚠ Do not place containers with liquids on top of electrical control cabinets; spilling the liquid may cause short circuits.

8.3 Safety instructions



Danger to life due to dangerous electrical voltage

Only qualified personnel may work on this equipment after becoming familiar with all safety, installation, operation and maintenance instructions provided in this manual. The equipment carries dangerous voltages. These may be present on the DC link of all the equipment installed in the system, even after it has been switched off. There are dangers with:

- ⚠ Use of unsuitable power supply and peripheral devices.
- ⚠ Damage due to electrostatic discharge or lightning strike.
- ⚠ Improper use of the plant or individual plant components.
- ⚠ When dismantling or disassembling the equipment.
- ⚠ Working in the control cabinet.

Attention: Even when the main switch and/or emergency stop switch is switched off, the control cabinet of the system is still under tension!

Note: The installation work/repairs/maintenance work on the control cabinet and the electrical installation may only be carried out by a qualified personnel after a written approval of the company FlexBio Technologie GmbH. The mains terminals, DC voltage, inverter and motor terminals carry dangerous voltages even after switching off and disconnecting from the voltage mains. The equipment of the plant must first be discharged after you have switched it off. Wait approx. 5 minutes before starting installation work. During installation or repair work, the warnings, regulations, precautions and condition instructions for the individual system components and devices must be followed.








Dangers when releasing biogas



Explosiv atmosphere



In the purification process, the biogas is produced in the anaerobic filter as well as in a biogas plant. Typically, the biogas from the treatment plant consists of the following components:

-  Methane 40 to 95 % by volume
-  Carbon dioxide 5 to 55 % by volume
-  Water vapor 0 vol. % to 12 vol. %
-  Oxygen 0 vol. % to 2 vol. %
-  Hydrogen sulfide 0 vol. % to 0.5 vol. %

As it can be seen from the composition, biogas is a gas with hazardous properties, which must be taken into account for the safe operation of the plant.

Methane (the main component of the biogas) is a flammable gas (highly flammable, which can form an explosive atmosphere when mixed with air. Areas that can potentially pose a hazard are marked with corresponding protection zones.



Risk of poisoning

In addition to an explosion hazard, there is a life or health hazard from inhaling biogas. The hydrogen sulfide contained in biogas is a very toxic, colorless gas that smells like rotten eggs and can be life-threatening even in low concentrations. Above a certain concentration, the sense of smell is paralyzed and the gas is not perceived.

Hazards in the area of the plant can emanate, for example, from:

- Escaping gas (risk of fire and explosion, poisoning and suffocation) due to damage to the **biogas pipes**, the **anaerobic filter** or **biofilter**,
- Expanding gas (with overpressure protection),
- When carrying out work on and in the anaerobic filter tank.

All work including maintenance work in these areas may only be carried out by qualified personnel from FlexBio Technologie GmbH.

9. FAQ – Demonstration plant

9.1 FAQ - Implementation

Why is the rental period 3 to 6 months?

Since this is a biological process, it requires an adaptation time. In addition, we would like to obtain meaningful results, which are dependent on the duration of the experiment.

Are the results transferable to a practical plant / large-scale plant?

The mobile plant is dimensioned in such a way that upscaling to a larger plant is possible without any problem.

How to produce a bypass for the test facility that is as close to reality as possible?

The filling of the integrated template runs continuously, for example hourly, depending on the throughput, so the results are practical.

What quantities of wastewater are treated per day?

Depending on wastewater quality and origin, approx. 500 - 4000l / day are treated.

Must the plant be operated by us?

Yes, there will be on-site instruction of personnel for this purpose. They are responsible for regular sampling of the inlet and the outlet as well as for the condition and visual inspection.

What personnel deployment must be expected during the trial phase?

Approximately 10 minutes per day is required. Weekend care is not necessary.

How often we are notified about the results?

There will be a weekly analysis report. At the end of the trial period, a final report is prepared, which includes the results / evaluation and recommendation.

In what way is the plant monitored?

During the test execution, the treatment stages are continuously monitored via remote access.

Must the trial costs be paid if the results are not satisfactory?

Yes, there is an expense to us in each case but you gain valuable knowledge regarding to your wastewater, even if it is not suitable for the proposed treatment.

Can the sampling interval also be shortened in the event of fluctuations in the inflow in order to obtain a larger data basis?

Yes, this will be adjusted in the course of the testing period.

Are steps under building law necessary to carry out the tests?

No, only an installation of a wastewater extraction point follows, if necessary.

Do special precautions have to be taken due to the biogas produced?

No, special permit and construction work is required. However, you will receive a safety briefing and training in plant operation. In addition, you will get a hand out with instructions and information on safety measures and restrictions. The AFBBM-1.MV mobile demonstration unit is to be operated in accordance with the operating instructions supplied.

9.2 FAQ – Measurement parameters and analysis data

What performance data is determined by the trial phase and collected online?

According to the integrated measurement technology, the following parameters are continuously recorded online:

- Volume flow of waste water (flow rate, volume meter)
- Biogas volume (raw gas)
- gas composition: CH₄, CO₂, H₂S, O₂
- Gas temperature (for determination of standard volume)
- Absolute pressure of biogas (for determination of standard volume)
- Process temperature (at all stages)
- Oxygen concentration of the activation
- pH value (at all stages)
- Redox (at all stages)
- Conductivity (at the inlet)

Which laboratory analyses are required and how is the sampling carried out?

Sampling is carried out according to the instructions of the operating personnel at defined (labeled) sampling points. In order to assess the performance of the plant, online and offline measured values are recorded regularly. Offline analysis is wastewater analysis, which can only be defined to a limited extent using online measurement technology. Therefore, the following measurement parameters are repeatedly recorded by laboratory analysis:

- COD concentration at influent and effluent
- Nitrogen concentration at influent and effluent
- Phosphorus concentration at influent and effluent

Can the sample analysis also be performed by another laboratory?

Alternatively, sample analyses may be arranged with any recognized/accredited laboratory. The laboratory reports must be made available to the contractor in a timely manner in the event of outsourcing.

What happens in the further course with the taken sample?

The sample should be sent in the prepared and stamped shipping bags no later than Wednesday, so that the sample arrives before the weekend. The laboratory analysis is carried out by our partner laboratory (*Laboratory for Environmental Analysis, HAWK University of Applied Sciences, Faculty of Resource Management*).

How is the plant built?

The treatment plant is a multi-stage plant with an integrated anaerobic main treatment and a downstream activated sludge stage with a built-in MBR (membrane bioreactor) system. The anaerobic fixed bed digester enables effective removal of organic load with methane production. This combination is unique and includes all stages.

9.3 FAQ – Installation site

Where must the plant be placed?

Installation takes place outdoors, or in a partially open, well-ventilated hall. The final installation site will be agreed with the contractor.

Can the equipment be placed on the lawn?

Installation should take place on a flat, paved surface (asphalt or concrete).

What are the requirements for the installation site?

The mobile demonstration unit will be spatially close to:

- The potential wastewater discharge point (max. 30m),
- Drain for purified water (max. 20m) and
- Power connection: 400V, 3 Ph., CEE three-phase plug 400V/32A (Attention: do not use FI protection fuse); Maximum distance from the installation site 20m.

Minimum installation area: 9 m x 4 m.

Sufficient maneuvering space for parking the trailer at the installation site

What do I have to pay attention to regarding to the sample / sampling site?

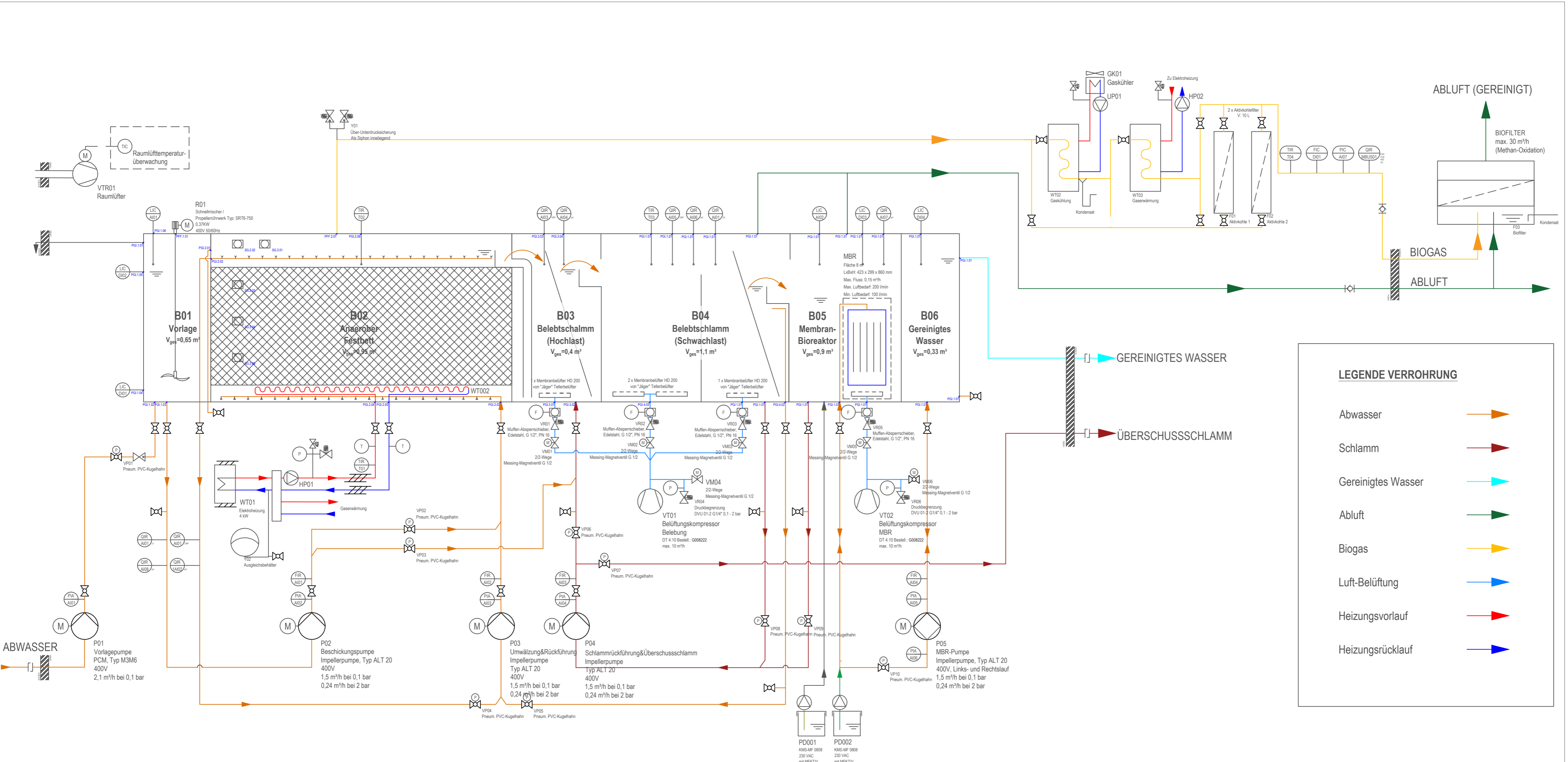
- Connection of the supply line to an on-site pressure line (max. 1 bar) with a 1 inch external thread connection with a ball valve or gate valve fitting. The demonstration unit controls a valve internally and fills an internal receiver level-controlled.
- Alternatively, the wastewater can be taken from a receiver or pump shaft via a supplied pipe.
- There is also the possibility of integrating a submersible pump (included as an accessory), which can be connected to the mobile system and controlled via the system.

10. Appendix

10.1 P&I of the mobile test facility

10.2 Operating diary checklist for daily control

10.3 Operating instructions



LEGENDE VERROHRUNG

- Abwasser →
- Schlamm →
- Gereinigtes Wasser →
- Abluft →
- Biogas →
- Luft-Belüftung →
- Heizungsvorlauf →
- Heizungsrücklauf →

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(Status)	(Norm)	Maßstab:	Gewicht:			
Ausführung	ISO 10628	(Beschreibung)				
7	Bearb. 24.03.2020	W. Ganagin	Abwasserbehandlung AFBBM-1.MV.01 Verfahrensfließbild / RUI			
6	Gep.					
5	Norm					
4						
3						
2		(Zeichnungsnummer)	Blatt			
1	überarbeitet	Versuchsanlage AFBBM-10	RUI-20-AFBBM-10.01			
Numb.	Modification	Date	Name	Uspr.:	(Ers.f.)	(Ers.f.)

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Company diary potential analysis AFBBM-1.MV

Client: _____

Protocol for self-monitoring

WK _____							
Date	Mo	Tu	We	Th	Fr	Sa	Su
Time							
Name of the employee							
Visual inspection indicator light							
Visual inspection leakage							
Visual inspection overpressure AF							
Sample shipment procedure							
Sample shipment anaerobic filter							
Sample shipment inlet							

Comments

OPERATING INSTRUCTIONS

Processing status: 11/20

Mobile demonstration unit AFBB-1.MV

Workplace/area if activity: Operational wastewater treatment plants

1. SCOPE

Work on the wastewater treatment plant FLEXBIO AFBB-010 (sewage treatment plant)

2. DANGERS FOR PEOPLE AND THE ENVIRONMENT



- Environmental hazard due to leaking plant liquids (overflowing of containers or leaks due to damaged/ faulty lines).
- Warning of electrical voltage:
 - Use of unsuitable power supply and peripheral equipment,
 - damage due to electrostatic discharge or lightning strike,
 - improper use of the system or individual system parts,
 - dismantling or disassembly of the plant,
 - work in the control cabinet, faults in the control system
- Slipping on wet or dirty floors
- Allergies, irritations due to contact with waste water, fermentation residue or sludge.
- Infections by bacteria as well as by contamination
- Danger to life due to poisoning with hydrogen sulfide (H₂S)
- Risk of asphyxiation due to carbon dioxide (CO₂)
- Explosion hazard due to methane (CH₄) and hydrogen (H₂)



Sehr giftig

3. PROTECTIVE MEASURES AND RULES OF CONDUCT



- The operating instructions of the manufacturer must be followed!
- The generally applicable safety and accident prevention regulations must be followed.
- Cleaning measures, sampling and repairs may only be carried out when the plant is at a standstill and secured against being switched on again.
- Before carrying out the work, the main switch must be switched off and secured against being switched on again, and the absence of voltage must be checked.
- The machine may only be operated by persons who have been trained, instructed and authorized to do so. The persons must know, understand and act according to the operating instructions (confirmation by signature). The authority of the operating personnel must be clearly defined.
- Operating personnel to be trained may initially only work on the machine under the supervision of an experienced person.
- Maintenance work, inspection and assembly work may only be carried out by authorized and qualified personnel.



- Do not switch the machine back on immediately if it has stopped for initially inexplicable reasons. Someone may have stopped the machine for manual intervention and neglected to secure it against restarting. Unexpected restarting can lead to serious injuries.
- After the work and before restarting, all protective devices, covers, gratings must be completely and properly refitted.
- Only start the system when the protective devices are in operation and rotating or moving machine parts cannot be reached unintentionally.
- Do not reach into the system parts (pump, fan, compressor) during operation.
- Regularly check the effectiveness of the circuit breakers, emergency stop and other protective devices.
- Wear protective shoes, safety glasses and gloves.

4. BEHAVIOUR IN THE EVENT OF MALFUNCTIONS



- In case of noticeable noises, defects or other deviations, inform the plant manufacturer/service company and shut down the plant if necessary.
- Consult qualified personnel for troubleshooting. Secure against unintentional switch-on beforehand.
- Before working on the system, switch off/shut off the power supply (**electrical and thermal!**) and secure it against being switched on again.
- Follow the operating instructions!

5. FIRST AID



- Secure accident site, shut down plant and secure against restarting.
- After inhalation of biogas: Supply fresh air, if necessary perform cardiopulmonary resuscitation, call in doctor immediately; inform doctor of possible poisoning by hydrogen sulfide.
- Call in first aiders

Emergency: 112

- Report accident
- Always record the first aid performed in the first aid book.
- Point out any hazards to arriving personnel.

6. MAINTENANCE/SERVICING



- Maintenance and repair may only be carried out by qualified and authorized persons.
- After maintenance, the protective devices must be checked.
- Follow the manufacturer's operating instructions during maintenance.
- Regular inspections (e. g. electrical, mechanical) by qualified persons.

Date:

Next

Review Date:

Signature: _____

Entrepreneur/Management