OPERATING MANUAL

Wastewater Treatment Plant
AT 6–20 by

AQUATEC®
INTRODUCTION

The plant operates on the biological principle. You have to take care of the plant carefully for it to provide an optimal failure-free operation. Please read through the manual and/or visit the website: [www.aquatec.sk/en](http://www.aquatec.sk/en) for more information and warranty clauses.

The wastewater treatment plants AT 6-20 serve for the treating of sewage wastewater from buildings for 2 – 18 PE (people equivalent). A daily wastewater production for is 150 l / person / day. Production of pollution in BOD units is 60 g / person / day.

DESCRIPTION

The domestic wastewater treatment plants AT 6-20 use a continuous – flow activated sludge process, with a suspended growth process (see the technological scheme in figure No.1). The equipment is comprised of a single vertical cylindrical tank made from polypropylene - the biological reactor, which combines the following processes in a single tank: mechanical pre-treatment, excess sludge storage, biological treatment using a low – loaded activated sludge process, separation of the treated water from activated sludge in the final clarification chamber and flow balancing of fluctuating inflow of wastewater in the retention zone.

The bioreactor tank is divided into three chambers:

1. Non-aerated chamber for mechanical pre-treatment, denitrification and collection of excess sludge is composed of four compartments that form a “vertical flow labyrinth” VFL®
2. Aerated activated sludge chamber
3. Final clarification chamber.

The raw wastewater with coarse impurities enters through inlet (1) into the first compartment of the non-aerated chamber (4) in the bioreactor where is placed the basket screen (2) for mechanical pre-treatment. There is an outlet of an air-lift pump (14) below the basket screen (2) under the surface of the water - with large bubble aeration - to break up the coarse impurities in the basket. There is an outlet from an air-lift pump(3) located above the water level in the first compartment of the non-aerated chamber (4) which pumps the mixture of sludge and water from the fourth compartment of the non-aerated chamber (4). Hydrodynamic forces of large bubble aeration below the basket screen(2) and the recirculation of the sludge by the air - lift (3) disintegrates the coarse impurities.

The mechanically pre-treated wastewater flows into the non - aerated chamber (4) of the bioreactor, which contains four alternatively connected compartments at both the normal level of the water and at the bottom of the bioreactor forming the vertical flow labyrinth.
This chamber with four compartments serves for mechanical pre-treatment, denitrification, and collection of excess sludge. The sludge and water mixture flows from the fourth compartment of non-aerated chamber (4) to the aerated activated sludge chamber (5). The activated sludge chamber (5) includes fine bubble diffusors (6) on its base.

The activated sludge flows into the final clarification chamber (7) where the activated sludge is separated from the treated wastewater. The activated sludge is pumped by an air-lift pump (8) from the bottom of the final clarification chamber (7) to the third compartment of the non-aerated chamber (4) and to the activated sludge chamber (5). A flow regulator (9) (see figure No.3) is installed at the water level in the final clarification chamber (7) which serves for controlling the outflow in order to maintain the water level between the normal and maximum level in the tank (retention zone).

The excess sludge is pumped from fourth compartment to the first compartment of the non-aerated chamber (4) by an air-lift (3) where the sludge volume is decreased by decomposition under anaerobic-anoxic conditions and the excess sludge along with heavier primary sludge is stored in the bottom part of the non-aerated chamber (4) to be pumped out and removed once or twice per year depending on wastewater treatment plant loading, once a high concentration of sludge is reached.

An air pump provides compressed air for aerating the activated sludge chamber (5) and for driving the air-lift pumps (3, 8, 11). The air pump supplies the air into the air distribution unit, which divides the air into the air-lift pumps through regulation valves C,D,F for AT6-20 (see figure No.2) respectively D,E,G for AT 15 and AT20 (see figure No.3) into the fine bubble diffusor(s) (6) through regulation valves B or into the flow regulator (see figure No.3).

The air pump can be controlled by a microprocessor control unit AQC Basic/AQC Basic GSM and is turned on and off at various time intervals. Optical and audible alarms will signal air pump failure or a loss of electrical supply. The air pump and the control unit is placed outside the biological reactor (in a building, garage, basement or the tank for air pump) and is connected to the el. supply system of the building secured by a safety cutout switch. In case of a larger distance from the building (more than 5 m) the air pump is placed into the tank for air pump near to the biological reactor.

The scheme of AT 6-20 is in the annex No.1. The basic parameters of AT 6-20, like capacity parameters, basic dimensions, air pump parameters, electricity consumption and noise level of the air pump are in the annex No.2.
Figure No.1 – Technological scheme of a biological reactor AT 6-20

1. Inlet
2. Basket screen
3. Air-lift pump in non-aerated chamber
4. Compartments of the non-aerated mechanical pretreatment and activated sludge chamber
5. Aerated activated sludge chamber
6. Fine-bubble diffuser
7. Final clarification chamber
8. Air-lift pump for return and excess sludge
9. Flow regulator
10. Outlet
11. Air-lift pump for mixing the content of the basket screen

Figure No.2 – Regulation of air amount – Air distribution panel for AT 6 – AT 12
The air distribution panel for AT6-AT12 is made as a plastic injection moulding part with five outputs in which are screwed the control valves. In case of replacement of the gasket, the valves can be completely unscrewed.

- **Air supply “A”** – supply of air from air pump.
- **Valve “B”** - controls the volume of air supplied into the fine-bubble diffuser. **Valve fully open** – on the water surface of the aerated activated sludge chamber is seen a fine bubbling.
- **Valve “C”** - controls the volume of air supplied to the air-lift in non-aerated chamber. **Valve partially open**, the flow from the 2nd chamber to the 3rd chamber of non-aerated part of the reactor must be visible. The activated sludge must flow continually, the flow must not be nor weak neither strong.
- **Valve “D”** - controls the volume of air supplied into the air-lift pump for return and excess sludge, which serves for sludge recirculation from the bottom of final clarification chamber into non aerated sludge collection chamber and partially into aerated activated sludge chamber, whereby proportion is 4:1 – 1:1. The proportion of flow into the chambers can be changed by turning of the elbow at the end of pipe of the air-lift, if needed. By turning down of the elbow, the sludge is pumped in higher amount into the aerated activated sludge chamber, by turning up the elbow the sludge is pumped in higher amount into the non-aerated chamber. **Valve partially open** – the activated sludge must flow continually; the flow must not be nor weak neither strong.
- **Valve “E”** - controls the volume of air supplied into the flow regulator. When opened fully, serves for cleaning the flow regulator unit occasionally. In standard operation is set the way that approx. once in 1 – 2 seconds is released one bubble for automatic cleaning of the flow regulator. This bubble ruffles the water surface and at the same time automatically cleans the throttling hole of the flow regulator. **Valve minimal open**.
- **Valve “F”** - controls the amount of air supplied to the air-lift pump for mixing the content of the basket screen in the first compartment of non-aerated chamber. Large air bubbles mix the content of basket screen, a visible whirling should be on the water surface. **Valve partially open**.

The air distribution panel is set during the production control in the factory. If necessary, new setting can be made, but it is necessary first to close all valves and then follow the above instructions.

During weekly or monthly visual control of the plant is necessary to control the setting of the air by the valves if there were some changes of the volume of air due to the rising amount of sludge in the system.
Figure No.3 – Regulation of air amount – Air distribution panel for AT 15, AT20

- **Air supply „A“** – supply of air from air pump
- **Two valves „B“** – controls the volume of air supplied into the fine-bubble diffusers. Valve fully open – on the water surface of the aerated activated sludge chamber is seen a fine bubbling.
- **Valve „C“** – controls the volume of air supplied to the air-lift in non-aerated chamber. Valve partially open – the activated sludge must flow continually; the flow must not be nor weak neither strong.
- **Valve „D“** - controls the volume of air supplied into the air-lift pump for return and excess sludge, which serves for sludge recirculation from the bottom of final clarification chamber into non-aerated sludge collection chamber and partially into aerated activated sludge chamber, whereby proportion is 4:1 – 1:1. The proportion of flow into the chambers can be changed by turning of the elbow at the end of pipe of the air-lift, if needed. By turning down of the elbow, the sludge is pumped in higher amount into the aerated activated sludge chamber, by turning up the elbow the sludge is pumped in higher amount into the non-aerated chamber. Valve partially open – the activated sludge must flow continually; the flow must not be nor weak neither strong.
- **Valve "E"** controls the volume of air supplied into the flow regulator. When opened fully, serves for cleaning the flow regulator unit occasionally. In standard operation is set the way that approx. once in1 – 2 seconds is released one bubble for automatically cleaning of the flow regulator. This bubble ruffles the water surface and at the same time automatically cleans the throttling hole of the flow regulator. Valve minimal open.
- **Valve „F“** - controls the amount of air supplied to the air-lift pump for mixing the content of the basket screen in the first compartment of non-aerated chamber. Large air bubbles mix the content of basket screen, a visible whirling should be on the water surface. Valve partially open.
The air distribution panel is set during the production control in the factory. If necessary, new setting can be made, but it is necessary first to close all valves and then follow the above instructions.

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**Figure No.4 - Flow regulator**

![Flow regulator diagram](image)

The flow regulator serves for controlling the outflow in order to maintain the water level between the normal and maximum level in the tank (retention zone). It is periodically cleaned by the release of coarse bubbles during the running phase of the air pump. It should be periodically checked for free flow through the throttling hole, the treated water should not flow permanently through the emergency overflow.

Cleaning of this equipment is done by fully opening the valve „E“ for a while on the air distribution panel, which causes a cleaning of the body of the flow regulator and simultaneously cleaning of the throttling hole with large bubbles of water flux. After cleaning the flow regulator is necessary to regulate the air volume in the way that once in 1–2 seconds is released one air bubble, so the automatic cleaning of the flow regulator is guaranteed. In case the flow regulator is clogged very frequently, there is excessive sludge production in the plant, it is necessary to remove it, wash it with a stream of water and find out the reason of excessive sludge production. The reason could be an overloading of the plant.
MANIPULATION, TRANSPORT AND STORAGE

There is necessary to take care in respect the plastic material (relatively low resistance to damage at low temperatures). Before manipulation with the biological reactor check the whole tank of biological reactor and is necessary to pump out the rainwater from the tank. The domestic wastewater treatment plants AT Plus is delivered as a completely assembled unit. During the transport and storage is necessary to put the tank onto a plane and firm surface and protecting from defects and manipulating by other people must be guaranteed till the time the plant is delivered. With long-term storage (more than 2 months) it is necessary to put a cover to protect the unit from solar radiation.

INSTALLATION

General considerations

As the installation details largely depend on the local conditions, the design should always be performed, or reviewed by an engineer. Factors to consider when installing the unit include:

- High groundwater table – „WET“ conditions: High groundwater table may complicate below ground installations. Engineer must be consulted; anchoring system or installation in underground concrete encasement may be required.
- There should be a source of freshwater for filling of the unit after its placing.
- The tank of biological reactor is not designed for loading caused by tire pressure of vehicles, base of buildings, etc.
- The lid of the plant is not to be walked on it.
- It is not recommended to install the unit in close proximity of a living house, below a window or balcony of living room.
- In case of installing in a basement, underground concrete encasement, etc. it is necessary to ensure access to the encasement in compliance with the governing rules and standards.
- The inlet pipe to the biological reactor should be provided with ventilation pipe up to the roof.
- The top edge of the tank of unit must be 5-10 cm higher than the terrain.
- In case the unit is placed deeper than the normal depth of placing, the tank of the unit must be reinforced with concrete enclosure or backfill must be made from dry concrete (mix of cement with gravel sand 1-4 mm, 200 kg cement to 1 m³ gravel sand)
- In case of high groundwater level (WET conditions), clayey, not permeable earth, the tank must be placed on a concrete slab, must be reinforced with a backfill of dry concrete, or must be prepared a concrete encasement, concrete tank around the unit, the concrete encasement or concrete tank must be protected against floating, the solution must be recommended by an authorized designer.
Preparing and construction work before placing of the tank

- In case of the presence of groundwater during the installation, it is necessary to decrease the groundwater level below the bearing surface.
- For installation of the unit is necessary to excavate a pit with the needed dimensions—minimally 15-20 cm deeper and 40 cm larger in diameter than the dimensions of the tank of unit (fig.1).
- The unit must be placed on a bearing surface, which can be a concrete slab made in level to within 5 mm from edge to edge, or made depending on local conditions from taped layer of coarse crushed stone with coarse sand layer on the top and level to within 5 mm from edge to edge (fig.2).
- Check the level of the bearing surface (must be within 5 mm from edge to edge), in case that is not within the allowed tolerance, stop the installation. There is needed to prepare a cement layer or sand layer and level the bearing surface.
- Check that the tank does not contain rainwater or waste, empty if needed.
- Check the integrity of the tank. If the tank is damaged, do not continue with the placing.
- Check the presence of stones, dirt, etc. on the surface of the bearing surface, clean the surface if necessary.
- Ensure fresh water for the filling of the tank with water – drinking water, water from creek or river, never use wastewater.

Placing of the unit

- Placing of the unit into the pit on the bearing surface - a hoist or a crane can be used (fig.3).
- Make watertight connections to the inlet and outlet pipeline, sealing with silicon sealant (fig.4).
- The best way of placing of the air pump and the microprocessor control unit AQC Basic/AQC Basic GSM is the placing into a plastic tank, which has to be placed close to the biological reactor.
- Lay a PP-HT or PVC DN50 pipe between the biological reactor and the tank for blower, which serves as a connecting a protective pipe for air hose and for dewatering the tank into the biological reactor. For this reason, take care to make an incline in direction of the biological reactor.
- The air pump and the microprocessor control unit AQC Basic/AQC Basic GSM put into the tank for air pump. The one end of the air hose connect to the air pump in the tank for air pump, pass it through a connecting, protective PP-HT or PVC DN50 pipe and connect the second end with the air distribution panel in the biological reactor.
- Consequently connect the feed cables:
  - First connect the air pump into the control unit by inserting the plug of air pump into the socket on the microprocessor control unit AQC Basic/AQC Basic GSM.
  - After connecting the air pump with the control unit, connect the control unit into the electrical network by inserting the plug on the microprocessor control unit into the socket of the feeding cable.
• Ensure the el. supply cable to the place, where the air pump is placed. The el. supply cable connected to the el. supply system of the building secured by a safety cutout switch.
• The tank of the biological reactor evenly fill with water up to the level of outlet pipe. It can be done by freshwater (drinking water, water from a well, surface water from creek, river) it cannot be wastewater (fig.4)
• After filling check the water tightness.

Backfilling, concrete enclosure, terrain arrangement

• The backfilling can be started only after filling the tank for biological reactor with clean water up to the outlet pipe (fig.5).
• The backfilling material should be coarse sand 4-8 mm or 8-16 mm, coarse crushed stone 4-8 mm or 8-16 mm, dry concrete. The backfilling must be done by layers 300 mm thick; each layer must be compacted. In case of WET conditions is necessary to use dry concrete or a concrete encasement.
• One can continue only after hardening of the previous layer.
• After backfilling or reinforcing of the tanks should be done the terrain arrangement. The terrain around the tanks must have a slope which allows the rainwater flow away. Around the tanks must be enough place and access for servicing and sludge removal.
• After a longer time period is necessary to fill-up the settled terrain around the tanks.
START-UP

The start-up of the WWTP is an important step for good operation of the unit, for this reason it is necessary that this must be done by the manufacturer/authorized distributor, respective their qualified service partner or a trained person/user.

There are two possibilities for start-up of the WWTP after its installation. The first possibility is by using seed activated sludge. The start-up is performed by inoculation the unit with activated sludge from a well-operating biological treatment plant, the start-up period is 2-4 weeks:

- During the installation, the biological reactor was filled with clean water up to the outlet level and the air pump and control panel was connected to the el. supply network of the building, the air pump was connected via air hose with the air distribution panel.

Switch on the control unit (see the Annex No.5 – Instruction manual of the Microprocessor Control Unit AQC Basic/AQC Basic GSM).

- Check the working of air - lifts and the aeration, set the valves, if necessary (to be done by serviceman)
- Pour into the inlet part approx. 200 l activated sludge from a well-operating biological treatment plant.
The second possibility is the spontaneous start-up without seed activated sludge, where must be taken into account, that the start-up period will be longer, from 1-2 months up to half year:

- During the installation, the biological reactor was filled with clean water up to the outlet level and the air pump and control panel was connected to the el. supply network of the building, the air pump was connected via air hose with the air distribution panel.
- Switch on the control unit (see the Annex No.5 – Instruction manual of the Microprocessor Control Unit AQC Basic/AQC Basic GSM).
- Check the working of air-lifts and the aeration, set the valves, if necessary (to be done by serviceman)

**OPERATING INSTRUCTIONS AND MAINTENANCE**

**LIST OF BASIC INSPECTION AND MAINTENANCE ACTIVITIES**

The plant does not need a permanent presence of oversight, works automatically. It is necessary to do activities essential for operational control and periodical maintaining in mentioned intervals.

**Operational control (by owner/user)**

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<thead>
<tr>
<th>TYPE OF ACTIVITY</th>
<th>ACTIVITY INTERVAL</th>
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</thead>
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<tr>
<td>Visual control of operation and the control panel</td>
<td>1x/ week</td>
</tr>
<tr>
<td>Visual control of the basket screen</td>
<td>1x/ month</td>
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<tr>
<td>Visual control of the presence of floating sludge</td>
<td>1x/ month</td>
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<tr>
<td>Visual control of the flow regulator at the outlet</td>
<td>1x/ month</td>
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<tr>
<td>Visual control of the air pump</td>
<td>1x/ month</td>
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**Maintenance (by servicing company)**

<table>
<thead>
<tr>
<th>TYPE OF ACTIVITY</th>
<th>ACTIVITY INTERVAL</th>
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<tbody>
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<td>At need (approx. 1x/ 6 month)</td>
</tr>
<tr>
<td>Measuring of settled sludge volume</td>
<td>1x/ 6 month</td>
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<tr>
<td>Taking away the excess sludge</td>
<td>1x/ 6 month</td>
</tr>
<tr>
<td>Cleaning the air filter in the air pump</td>
<td>1x/ 6 month</td>
</tr>
<tr>
<td>Change the control unit AQC Basic / AQC Basic GSM</td>
<td>Approx. after 70000 working hours</td>
</tr>
<tr>
<td>Change the diaphragm in the air pump</td>
<td>Approx. after 20000 working hours</td>
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<tr>
<td>Set the regulation valves</td>
<td>1x/ 6 month</td>
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<tr>
<td>Taking samples – analyzing of samples</td>
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<td>Evaluation of the plant operation</td>
<td>based on local regulations</td>
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Operating diary
We recommend to keep an operating diary based on local regulations about the defects, their removals, change of spares, servicing at a time, etc.

Operating of mechanical equipment
Running of the unit is based on:
- switching on/off of the control unit.
- setting the control unit and the regulation valves B, C, D, E, F

Switch off the plant
Switch off the plant is done by disconnecting the control unit from electrical network. In this case is necessary to empty and clean the tank of biological reactor, and fill it with clean water.

Visual control of the plant operation:

- **Basket screen** – must not be clogged or overflowed
- **Mixing the content of basket screen with coarse air bubbles** – there must be visible the whirling and mixing in the basket screen during the running phase of air pump, caused by the working air-lift pump below the basket screen. The whirling should not be too strong or too week.
- **Working air-lift pump in the non-aerated chamber** – there must be a visible flow from the outlet of the air-lift pump in the first compartment of non-aerated chamber during the running phase of air pump and the wastewater-sludge mixture must flow through the cascades made by the overflowed walls of the compartments in the non-aerated chamber.
- **Working of air-lift pump in the final clarification** – there must be a visible flow from the outlet of the air-lift pump into the third compartment of the non-aerated chamber and partly into the aerated chamber.
- **Working flow regulator in the final clarification** – The flow regulator must be clean, the treated water must flow freely through the throttling hole in the flow regulator, the treated water should not permanently flow through the emergency overflow in the flow regulator. Coarse bubbles must be released periodically which clean the surface of the flow regulator and slightly waving the water surface. The waving and bubbling on the surface of water in the final clarification should not be too strong or too week.
- **Fine bubble diffuser in the aerated chamber** – intensive and evenly bubbling and mixing is visible on the whole surface of the aerated chamber, no big bubbles in one or other side.
- **Floating sludge, excessive foaming** – floating sludge may emerge on the surface of the compartments of non-aerated chamber (mainly in second compartment), and final clarification chamber. Floating sludge in non-aerated chamber may happen also in normal operational circumstances – mainly if the plant is underloaded, it has no influence on the treatment efficiency. A little floating sludge on the final clarification surface may happen also in normal operational circumstances. Excessive foaming on the surface of the aerated chamber may happen also in normal operational circumstances (light white foam during the start-up period and brown foam during the normal operation).
Eliminating of defects:

- **Full, overflowed basket screen** – empty the basket, the content of the basket can be emptied into the garbage.
- **No mixing of the content of basket screen with coarse air bubbles** – temporarily increase the air flow by opening the valve “F”. If does not help, check the possible clogging of the air piping, clean it with pressure air or water if necessary.
- **Air-lift pump in the non-aerated chamber does not work** – temporarily increase the air flow by opening the valve “C”. If does not help check the possible clogging of the air piping or pipe of the air-lift pump, clean them with pressure air or water if necessary.
- **No bubbles in the aerated chamber or big bubbles on one side** – temporarily close the valves for air-lift pumps “C”, “D”, “F”. If does not help check the possible clogging of the air piping, clean it with pressure air or water if necessary. If does not help, check the air flow from the air pump to the air distribution panel or clean the filter in the air pump. If the air flow is all right and the diffuser still not working, please contact your supplier. In case of big bubbles and intensive whirling contact your supplier.
- **Air-lift pump in the final clarification chamber does not work** – temporarily increase the air flow by opening the valve “D”. If does not help check the possible clogging of the air piping or pipe of the air-lift pump, clean them with pressure air or water if necessary.
- **Clogged throttling hole in the flow regulator, permanently high water level, which flows through the emergency overflow** – temporarily increase the air flow by opening the valve “E”. If does not help, clean the throttling hole by a stick or dismantle it and clean it manually by stream of water.
- **Floating sludge, excessive foaming** – too thick and long-lasting floating sludge on the surface of the non-aerated chamber – must be removed mechanically by agitation or removed. The floating sludge is covering the whole surface of the final clarification chamber – the sludge must be removed from the surface and there must be selected a program with lower number in the control unit (by 2 digits), check after 1 week, if the problem still exist, contact your supplier. Excessive brown foam from the aerated chamber goes through the walls to the surface of final clarification chamber - there must be selected a program with lower number in the control unit (by 2 digits), check after 1 week, if the problem still exist, contact your supplier. Walls of the plant, inlet, outlet and the piping in the biological reactor should be kept clean by occasional cleaning with stream of water or by brushing.
Measuring of settled sludge volume in the aerated chamber

**Settled Sludge Volume (SSV):** SSV or settle ability of mixed liquor is determined by recording the volume occupied by the sludge in 1000 ml sedimentation test cylinder or a transparent bottle after allowing it to settle for 30 minutes. (If the sludge does not settle in the sedimentation test bottle it may be due to inflow of toxic substances into the plant or low dissolved oxygen content). Take a sample of 1 l of activated sludge mixture from the aerated chamber and pour into a transparent cylinder, glass or bottle. The sample is to be taken from depth of min. 1 m below the surface, when the air pump is working. Let it settle for 30 min. After 30 min count out the volume of settled sludge (visible border line between water and sludge). This value should be in interval 300 – 700 ml sludge per 1 l water. In this condition the plant reaches the highest efficiency of cleaning.

**Removing of excess sludge**
Removing of excess sludge is necessary if the SSV is higher than 700 ml sludge / 1l water.

**Ways of excess sludge removal**
- a) By usage of a submersible sludge pump. The stabilized sludge can be used as fertilizer in the garden if the local legislative allow such a usage.
- b) Taking away of the sludge by specialized company, which have the necessary approvals from the authorities. Sludge pumping is charged.

**Ways of excess sludge removing**
Disconnect the control unit from electrical network and let to settle the content of the biological reactor approx. for 30 min. Carefully put the suction pipe or the submersible pump alternatively into the compartments of non - aerated chamber and the aerated chamber of the biological reactor and pump away the settled sludge (the highest concentration of sludge is in the second compartment of non-aerated chamber).

The sludge must be pumped away evenly from the compartments and chambers of the biological reactor the way not to cause water level difference between the compartments higher than 10 cm. Take care of the diffusers and piping at the bottom of the tank. Fully empty the non-aerated chamber and let about 20 cm of water in the aerated chamber. After this operation, the biological reactor should be filled with water up to the operating water level – **take care of the water level difference between the compartments and chambers lower than 10 cm during the filling.*** The SSV after desludging and filling with clean water should be approx. 200 ml/l.

**Taking samples of treated water**
Taking samples of treated water is possible from the surface of treated water in the final clarification chamber or from discharge pipe, if possible. The frequency of taking samples and the parameters to be analyzed depends on local legislative requirements.
**Adverse aspects influencing the operation**

You have to take care of the plant carefully and to provide for optimal failure-free state. The plant operates on the biological principle.

The bacteria and other organisms which play an active role in wastewater treatment are most effective at a neutral to slightly alkaline pH of 6.5 to 7. That is the reason why it is necessary to save from disturbing influences that can influence its operation negatively.

**TO ENSURE TROUBLE FREE OPERATION, IT IS ESSENTIAL THAT THE FOLLOWING MATERIALS ARE NOT PRESENT IN THE INFLUENT WASTEWATER:**

- remains of chemicals, medicaments, etc.,
- **highly concentrated organic substances**, such as food residues, fruit and vegetables, kitchen shredder waste, etc.
- toxic materials – solvents, inflammables, fixtures for the plant protection, motor oil,
- **indecomposable materials** – nappies, bond paper, newspaper, wet paper rolls, foils, impregnated paper, cigarette butts, condoms, baby wipes, cleaning wipes, tampons, pads, and others
- **oils and grease** in high concentration. These fats and oils are very unfavorable for biomass that is produced in the WWTP. It prevents the access of air in the activation part of the WWTP and thus causes the collapse of biomass. It is recommended to dispose of excess fats and oils e.g. by feeding, composting, etc.
- cleaning and disinfecting substances **containing Sodium Hypochlorite, Dimethyl Benzyl Ammonium Chlorides, Benzalkonium Chloride, Hydrogen Peroxide, Natrium Hydroxide and other environmentally hazardous substances in high amounts**. Cleaning products (i.e. SAVO, Domestos, Asanox, Clorox, Bref Duo Active, Devil, Tiret Profesional, Cillit Duo, Lysol etc.) which contain sodium hypochlorite and other elements, slows down the activity of activated sludge. In the case of the use mentioned disinfectants, a maximum daily dose of 0.1 l is recommended. Even if this limit is exceeded by 0.1 l, **extinction of activated sludge**.

For cleaning, we recommend using a Natural & Eco-Friendly cleaning products that does not contain sodium hypochlorite and does not have a bactericidal effect i.e. FROSCH (B-Energy), ECOS etc.
Excessive foaming in aerated chamber
This is normal during the start-up period for several weeks. Add activated sludge into the system or wait several weeks the sludge arise. Avoid the excessive use of detergents and laundry agents. It is enough to wash the foam by a stream of water.

Maintenance of the air pump
All instructions connected with the operation and maintenance is included in Annex No. 4 – Instruction manual – air pump.

WHAT TO DO IF

The drain water has turbidity and a sensory defect
low O₂ saturation at the outlet
• intensify the aeration of the aerated activation space. Release more air into the control valve aeration element (see page 6) and desludge the WWTP (see “Sludge removal during WWTP operation” on page 15).

hydraulically overloaded treatment plant
• reduce the amount of inflowing wastewater

organically overloaded treatment plant / BOD₅ permanently above 400 mg / l /
• reduce the concentration by diluting or pumping off excess sludge

blower failure
• check the filter, replace the work kit after 20,000 mth (see appendix no. 4 - blower maintenance instructions).

insufficient biomass activity
• at the time of onset (approx. 4 - 12 weeks), pH change due to a large amount of detergents and detergents, toxic inflow substances in waste water

Significantly different color of water in individual sections of the non-aerated space
clogging of the air pump (mammoth) suction inlet in the last section of the non-aerated space
• mechanically remove dirt, plug the mammoth's outlet in the first section of the non-aerated space and fully drain air into the mammoth. In reverse, the clogged suction inlet of the mammoth is released. If the remedy did not occur, the mammoth needs to be cleaned with a stream of water, or dismantled and cleaned manually and subsequently adjusted.
Excessive foaming in the aerated activation space
start-up of WWTPs and excessive use of detergents
- excessive foaming may occur during the start-up of the WWTP. This phenomenon disappears by increasing the volume of activated sludge after for a period of about 1 to 3 months. The consequence of insufficient concentration of biological sludge is also possible. This phenomenon is possible also monitored during excessive use of detergents and laundry detergents. The color of the resulting foam is white to gray. It can grow to a height of several tens of centimeters. This phenomenon is more or less as an adverse visual effect. Just rinse the foam with running water.

Mustard brown foam
- biomass decomposition caused by increased wastewater temperature in the WWTP or increased organic load, darken WWTP, bring about 0.5 m³ of cold water, do not put food residues, fruit and vegetable pomace, cooking oils and fats etc.

Floated sludge
clogged mammoth separation
- it is necessary for the mammoth to be running continuously (see air distributor settings on page 6)
no air flows into the storage device
- adjust the amount of air flowing into the storage device (see air distributor settings on page 6)
excessive amount of active sludge
- remove excess sludge. See “Sludge removal during WWTP operation” on page 15
rapid recirculation of non-aerated space
- reduce the amount of air flowing into the mammoth non-aerated space. By slowing down the pumping intensified decomposition of nitrogen and thus the formation of sludge flotation is reduced. Active sludge flocculates due to buoyancy active sludge with undissolved nitrogen.

Contaminated level of separation
- undecomposed parts (tomato peels, pea grains and maize) remain at the level of separation. These particles decompose considerably longer than other organic pollutants. The occurrence of such particles is only an aesthetic defect, after about a week decomposes. If necessary, it can be removed manually.
BIOLOGICAL WWTP OPERATING LOGBOOK

Operations Monitoring Instructions and Operating Logbook

Visual inspection and maintenance of WWTP

In the record keeping table of WWTPs write down the monitoring, maintenance, sludge removal, failure and its troubleshooting together with the date and signature of the responsible person. To assess the operation of the WWTP it is important the dry matter content of the sludge in the activation.

During the increase, the amount of increase and appearance are evaluated - gray (lack of oxygen), brown to green (good oxygen conditions) - the assumption of good efficiency of WWTP operation.

The dry matter content is optimal, when the volume of sludge in the sample taken in the activation chamber of the WWTP is after half hour of sedimentation about 30 - 70% of the volume of the taken sample (see the pic.).

Record Keeping Table of WWTP - Sample Record

<table>
<thead>
<tr>
<th>DATE / SIGNATURE</th>
<th>VISUAL INSPECTION</th>
<th>POTENTIAL INTERVENTION</th>
<th>VOLUME OF SLUDGE ml/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-4-2020</td>
<td>WWTP is dirty, otherwise everything is fine.</td>
<td>Cleaned with water.</td>
<td>Did not measure.</td>
</tr>
<tr>
<td>26-4-2020</td>
<td>Measuring the volume of the sludge.</td>
<td>Adjusting air valves.</td>
<td>450 ml/l</td>
</tr>
<tr>
<td>6-5-2020</td>
<td>Checking on basket screen in which was a solid waste from the house (wipes)</td>
<td>Emptying basket screen.</td>
<td>Did not measure.</td>
</tr>
<tr>
<td>30-5-2020</td>
<td>Measuring the volume of the sludge.</td>
<td>Without intervention</td>
<td>480 ml/l</td>
</tr>
</tbody>
</table>
# Record Keeping Table of WWTP

## Safety and Health Protection at Work

<table>
<thead>
<tr>
<th>Date / Signature</th>
<th>Visual Inspection</th>
<th>Potential Intervention</th>
<th>Volume of Sludge ml/l</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
• Service is allowed to be operated by the person over 18 years old who is mentally and physically capable to do this work. The person must be trained and familiar with operating instructions.
• Any contacts with electrical parts of the plant are operated only by a person with electro-technical qualification.
• Use specified protective means at work with the wastewater.
• Wash hands after the contact with wastewater.

Personal and protective means:
It is necessary to use following personal and protective means:
• working clothes, shoes,
• protective rubber gloves.

Recommended Tools for maintenance carried out by the operator:
• Transparent bottle 1000 ml (glass or plastic) for measuring of settled sludge volume.
• Rubber gloves.
• Brush with long handle.

WARRANTY

• Warranty of the WWTP technology is 24 months.
• The waterproofness of the casing is 10 years from the date of installation.
• Warranty for the air pump is 24 months.
• Warranty for the submersible / water pump is 12 months.

If warranty is meant to be enforced, the condition is that the unit is installed, operated and maintained in compliance with this Installation and Operating manual and construction design.

Warranty is not enforced if:
• the plant was not put into operation by an authorized firm/trained person,
• the plant was not placed in terms of Installation and Operating manual,
• the plant is not operated in terms of Installation and Operating manual.
• the population of the household / m³ volume is greater than the capacity of the WWTP (the WWTP is undersized)
• the air supply hose from the blower to the WWTP is longer than 5 m
• usage of high concentrations of chemical detergents detected despite company consultation to replace by Natural & Eco-Friendly products as indicated on page 16.

Customer service within 24 hours. For each trip to the customer due to a complaint or paid service intervention is charged the price for transport from the service organization to the customer and back. This condition does not apply to a justified complaint.
Annex No.1 - Scheme of a biological reactor for AT 6-20

1. Inlet
2. Basket screen
3. Air-lift pump in non-aerated chamber
4. Compartments of the non-aerated mechanical pretreatment and activated sludge chamber
5. Aerated activated sludge chamber
6. Fine-bubble diffuser
7. Final clarification chamber
8. Air-lift pump for return and excess sludge
9. Flow regulator
10. Outlet
11. Air-lift pump for mixing the content of the basket screen
Annex No.2 – Basic parameters of AT 6-20

**Tab. No. 1 – Capacity parameters**

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of PE (PE)</th>
<th>Nominal daily inflow (m³/d)</th>
<th>Maximal hourly inflow (m³/h)</th>
<th>Nominal daily organic loading (kg BOD₅/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT 6</td>
<td>4</td>
<td>0.60</td>
<td>0.05</td>
<td>0.24</td>
</tr>
<tr>
<td>AT 8</td>
<td>6</td>
<td>0.90</td>
<td>0.08</td>
<td>0.36</td>
</tr>
<tr>
<td>AT 10</td>
<td>8</td>
<td>1.20</td>
<td>0.12</td>
<td>0.48</td>
</tr>
<tr>
<td>AT 12</td>
<td>10</td>
<td>1.50</td>
<td>0.14</td>
<td>0.60</td>
</tr>
<tr>
<td>AT 15</td>
<td>13</td>
<td>1.95</td>
<td>0.20</td>
<td>0.78</td>
</tr>
<tr>
<td>AT 20</td>
<td>18</td>
<td>2.70</td>
<td>0.27</td>
<td>1.08</td>
</tr>
</tbody>
</table>

**Tab. No. 2 – Basic dimensions**

<table>
<thead>
<tr>
<th>Type</th>
<th>Reactor diameter (D1)</th>
<th>Bottom diameter (D2)</th>
<th>DN inlet (D3)</th>
<th>DN outlet (D4)</th>
<th>Height of retention chamber (D5)</th>
<th>Height of inlet (H1)</th>
<th>Height of outlet (H2)</th>
<th>Total height (H3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT 6</td>
<td>1350 [mm]</td>
<td>1400 [mm]</td>
<td>125 [mm]</td>
<td>125 [mm]</td>
<td>200 [mm]</td>
<td>1300 [mm]</td>
<td>1150 [mm]</td>
<td>1800 [mm]</td>
</tr>
<tr>
<td>AT 8</td>
<td>1350 [mm]</td>
<td>1400 [mm]</td>
<td>125 [mm]</td>
<td>125 [mm]</td>
<td>200 [mm]</td>
<td>1300 [mm]</td>
<td>1150 [mm]</td>
<td>2200 [mm]</td>
</tr>
<tr>
<td>AT 10</td>
<td>1750 [mm]</td>
<td>1800 [mm]</td>
<td>125 [mm]</td>
<td>125 [mm]</td>
<td>250 [mm]</td>
<td>1700 [mm]</td>
<td>1500 [mm]</td>
<td>2200 [mm]</td>
</tr>
<tr>
<td>AT 12</td>
<td>1750 [mm]</td>
<td>1800 [mm]</td>
<td>125 [mm]</td>
<td>125 [mm]</td>
<td>200 [mm]</td>
<td>1700 [mm]</td>
<td>1500 [mm]</td>
<td>2400 [mm]</td>
</tr>
<tr>
<td>AT 15</td>
<td>2050 [mm]</td>
<td>2100 [mm]</td>
<td>150 [mm]</td>
<td>150 [mm]</td>
<td>200 [mm]</td>
<td>1700 [mm]</td>
<td>1500 [mm]</td>
<td>2200 [mm]</td>
</tr>
<tr>
<td>AT 20</td>
<td>2050 [mm]</td>
<td>2100 [mm]</td>
<td>150 [mm]</td>
<td>150 [mm]</td>
<td>200 [mm]</td>
<td>2200 [mm]</td>
<td>2000 [mm]</td>
<td>2700 [mm]</td>
</tr>
</tbody>
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