Operating manual

WWTP TOPAS 5-15

TOPAS

wastewater
treatment plant with
a control unit TOM

TOPOLWATER

1. CONTENTS

2. APPLICATION RANGE OF THE WASTEWATER TREATMENT PLANT

TOPAS wastewater treatment plants (WWTPs) are designed to treat wastewater from small sources of contamination that means from households, recreation centres and small businesses if the characteristics of these waters are as specified in Table 1. When used for other than the household type of wastewater, wastewater must be biologically treatable and its volume and BOD load should correspond to the capacity of the plant.

SUBSTANCES WHICH ARE NOT WASTEWATERS

The following substances may not get into the inflow pipe of the WWTP unless they are part of wastewater in the volume permitted by water management regulations:

a. Wet wipes;
b. Radioactive substances;
c. Infectious substances;
d. Poisonous substances;
e. Caustic substances;
f. Explosives;
g. Herbicides;
h. Flammable substances, or substances which when mixed with air or water produce explosive, choking or toxic mixtures;
i. Petroleum substances in the quantity exceeding 20 mg per l of wastewater;
j. Other substances harmful to WWTP operators' health or safety
k. Rainwater.

PERMITTED LIMITS

The following table shows the limit values for the pollution of domestic sewage and basic civic amenities. The specific indicators given in the table should be monitored especially if the installed waste water treatment plant TOPAS provides operations and services assuming the content of these substances in waste water (e. g. car repair shops, medical facilities, laundries, dry-cleaners, meat industry, livestock production, oil stores etc.).

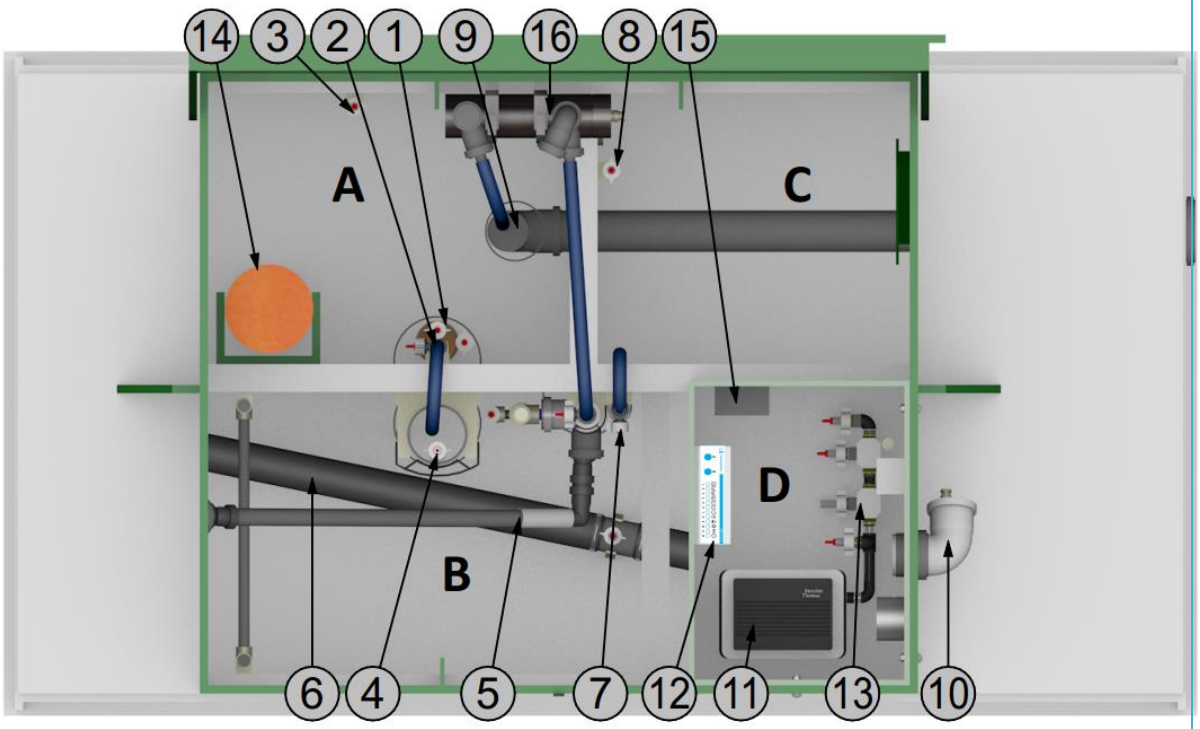
INDICATOR	PARAMETER	LIMITED VALUE	UNIT
Biochemical oxygen demand	BOD	150 - 500	mg/l
Chemical oxygen demand	COD	300 - 1000	mg/l
Total nitrogen	N_T	25 - 100	mg/l
Total phosphorus	P_T	5 - 20	mg/l
Water reaction	pH	6,5 – 8,5	
Suspend solids	SS	200 - 700	mg/l
Temperature	t	30°C	°C
Dissolved inorganic salts	DIS	1000	mg/l
Petroleum and petroleum products	TPH	5	mg/l
Grease	O&G	80	mg/l
Anionic surfactants	AS	10	mg/l
Chlorides	CL´	400	mg/l
Adsorbed organic substances	AOS	100	µg/l

Table 1: Limit values of indicators of polluted waste water

3. BASIC DESCRIPTION OF THE WATER TREATMENT PLANT

The WWTP consists of four separate tanks:

- Inflow (accumulation) tank, pumping station
- Activation tank (bio-reactor)
- Sludge tank



Description of tanks:	Standard equipment:	*Extra equipment:
A - Accumulation tank **B -** Activation tank **C -** Sludge tank **D -** Box for technology	**1 -** Pressure probe in the accumulation tank **2 -** Raw filter with raw sewage air-lift pump **3 -** Aeration of the accumulation tank **4 -** Pressure probe in the activation tank **5 -** Decanter **6 -** Aeration of the activation tank **7 -** Desludging air-lift pump **8 -** Aeration of sludge tank **9 -** Outlet of treated water + Emergency overflow of the WWTP **10 -** Electrical cable connection **11 -** Blower **12 -** Control unit **13 -** Electrical valves	**14 -** Dosing container **15 -** Dosing pump **16 -** UV lamp

Figure no. 1: Ground plan of TOPAS

Functions of the respective tanks and the decanter in the WWTP are as follows:

INFLOW TANK (ACCUMULATION TANK)

Wastewater enters the WWTP by flowing in this tank. The inflow (equalising, accumulation) tank is highly important for the functioning of the WWTP.

The following processes occur there:

- Balancing the irregular inflow of wastewater;
- Drawing sewage to the activation tank which has operating water levels above the sewage inlet;
- Capturing and disintegrating rough impurities;
- Pre-treatment; and
- Wastewater de-nitrification.

ACTIVATION TANK (BIO-REACTOR)

This tank is the place where biological treatment itself is carried out using micro-organisms hovering in sludge. To stay alive, micro-organisms (activated sludge) need both organic pollution, supplied in wastewater, and oxygen, supplied in the compressed air by the compressor (blower) of the WWTP. Compressed air mixes the activated sludge with wastewater. The activated sludge is heavier than water. After the end of aeration, which is accompanied with a stirring of the content of the tank, the activated sludge forms a layer at the bottom of the activation tank, separated from the layer of treated water which is periodically drawn from the plant.

SLUDGE TANK

It is used for accumulating excess activated sludge which is produced during the treatment process in the activation tank and must be regularly drawn from the WWTP.

DECANTER

The decanter is a special, patented system which is used for drawing treated water from the activation tank. Treated water is drawn from the layer approx. 15 cm below the water level in the activation tank. The decanter consists of a decanter arm, with a movable (revolving) connection to a tank (via a vertical pipe) with a treated water air-lift pump.

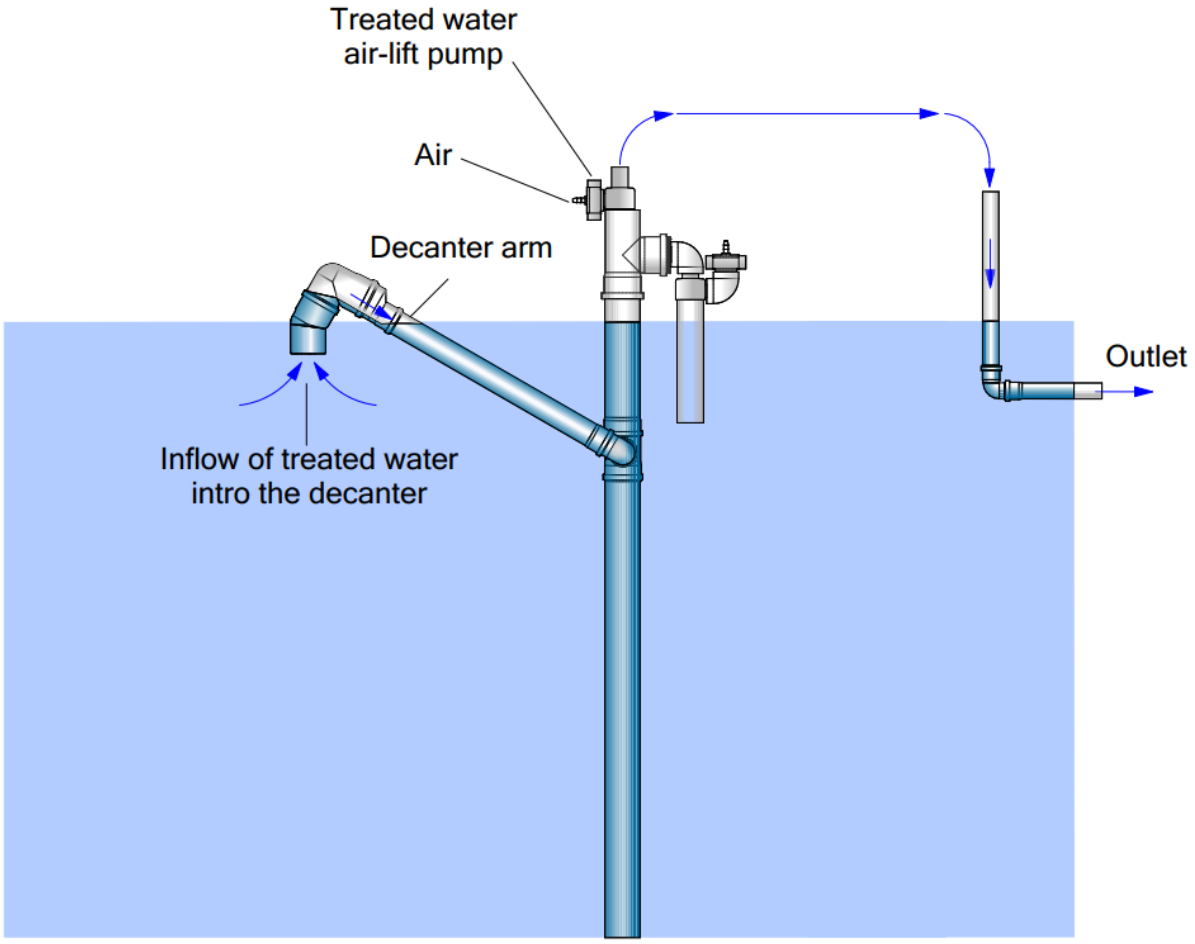


Figure no. 2: Principle of the decanter functioning

4. TREATMENT PROCESS TECHNOLOGY

Wastewater treatment in the WWTP is performed in two stages:

- Flow (nitrification) stage
- Backward (denitrification, desludging) stage

An increased water level in the accumulation tank is a sign of a sufficient inflow of wastewater. This is a pre-requisite for the continuation of the flow stage, during which treated water flows out of the WWTP.

FLOW STAGE (NITRIFICATION)

Wastewater flows into the accumulation tank and is continuously drawn by the air-lift pump to the activation tank which is being filled from the default minimum water level to the default maximum water level. During the filling, the activation tank is being aerated, and biological treatment is thus carried out and ammonia oxidises (nitrification). When the activation tank is filled up to the maximum level, aeration is interrupted and sedimentation starts, i.e. sludge settles at the bottom and treated water is drawn via the decanter out of the activation tank. The quantity of treated water drawn off usually represents 10–15% of the volume of the activation tank. When the activation tank is not being aerated, air from the compressor is directed to the accumulation tank. Wastewater is pre-treated by aeration and mixing of the accumulation tank before it is drawn to the activation tank. During the nitrification the water level in the accumulation tank may vary between the minimum and maximum levels (or even up to the level of emergency overflow).

The flow stage is finished and changed to the backward stage if three conditions are met:

- The default minimum duration of the flow stage elapsed.
- The water level in the accumulation tank dropped below the default operating level. (It is a sign of a reduced inflow of wastewater.)
- The water level in the activation tank has not reached the maximum level.

If these 3 conditions do not occur concurrently, the flow stage continues even after a lapse of the default time. Each cycle of the flow stage consists of the following processes:

A. FILLING OF THE ACTIVATION TANK

The activation tank is aerated, water is drawn from the accumulation to the activation tank, and filtration on the SF is in progress (the draw-off of the filtrate). Usually, the sludge tank is also aerated. The filling time is primarily defined by the hydraulic delivery of the raw sewage air-lift pump (drawing water from the accumulation to the activation tank). The air-lift pump delivery grows with its sinking, i.e. with the depth of water in the accumulation tank. At an increased sewage inflow and the filled-up accumulation tank, the filling time of the activation tank from the minimum to the maximum water level is thus significantly shorter than when the accumulation tank is partly emptied. This secures a high hydraulic flexibility of the WWTP operation. When the maximum water level in the activation tank is reached, the filling of this tank stops and then sedimentation follows.

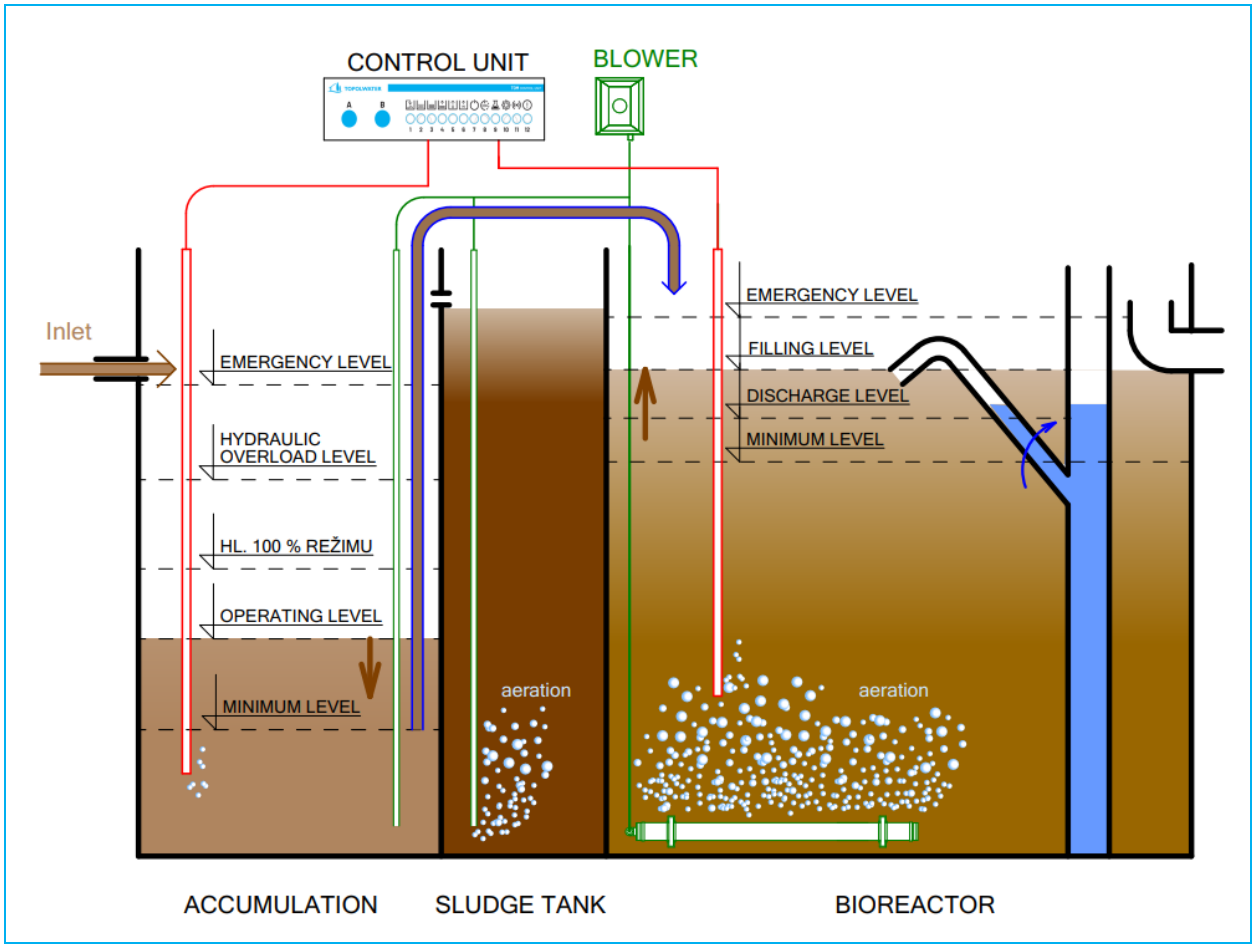


Figure no. 3: Flow (nitrification) stage – filling of the activation tank (bioreactor)

B. SEDIMENTATION

Aeration of the activation tank stops. Sludge settles at the bottom of the activation tank and treated water is thus separated from the sludge layer. The sedimentation process lasts for a default time (usually for 10 minutes). During that time, the accumulation tank is being aerated and wastewater pre-treated. SF and the sludge tank are without air supply, which means in standstill.

C. DESLUDGING

The accumulation tank is being aerated. The desludging air-lift pump is running in the activation tank. Excess sludge is being drawn from the activation tank to the sludge tank. The desludging causes drop of the water level by a defined layer (usually 5 cm). The desludging lasts until the defined drop of the water level in the activation tank is reached, however, no longer than for the defined desludging limit.

Then, the desludging stops (even if the water level in the activation tank does not decrease to the pre-set value) and the activation tank starts being drawn off.

D. DRAWING WATER OUT OF THE ACTIVATION TANK (DECANTING)

The treated water air-lift pump is in operation, being located in the decanter to draw water from the activation tank to the treated water container which has an overflow leading to outlet When the minimum water level in the activation tank is reached, water stops being drawn out of the activation tank, which is followed by another filling of the activation tank.

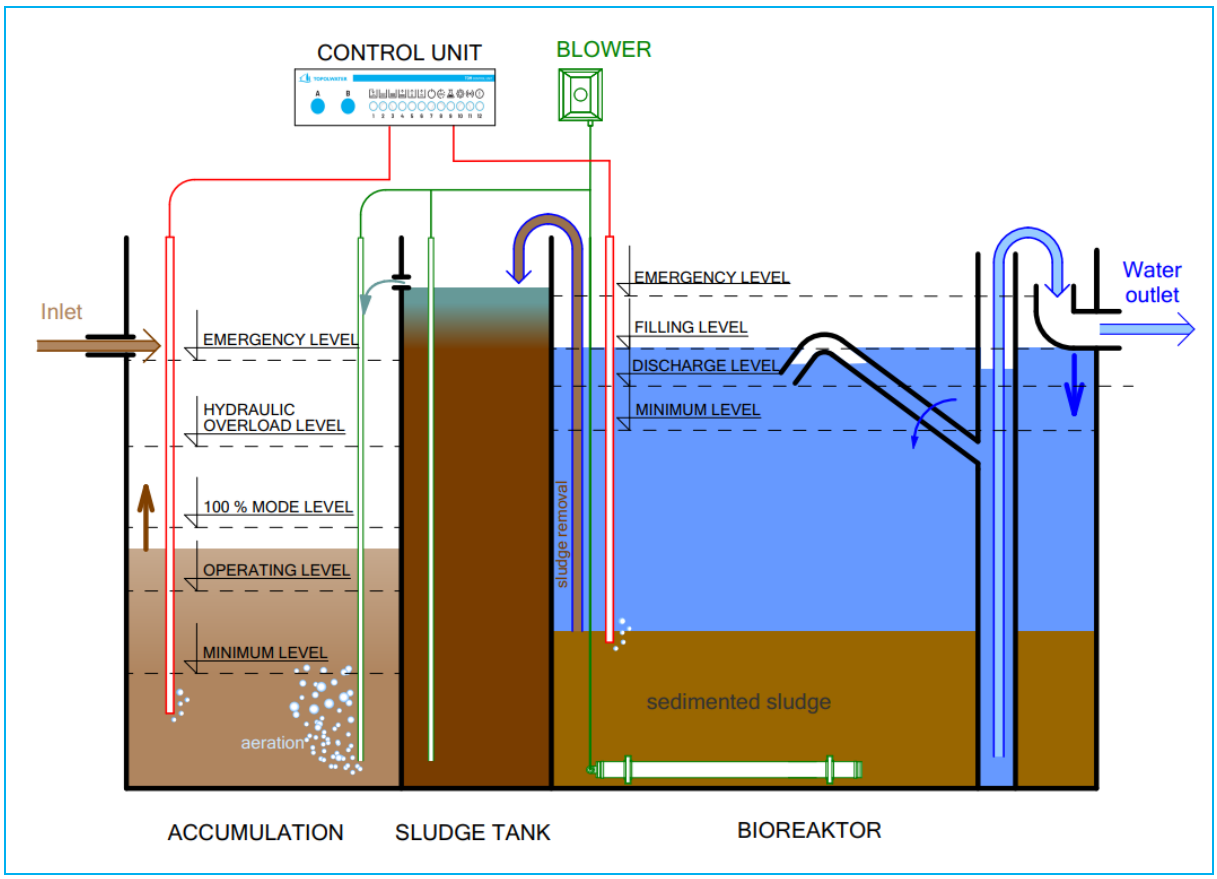


Figure no. 4: Flow (nitrification) stage – drawing water out of the activation tank (decanting)

The flow stage (nitrification) may last for the duration of one cycle (A–E) or multiple cycles as long as there is a sufficient amount of wastewater in the accumulation tank – the water level is above the pre-set operating level.

BACKWARD STAGE (DENITRIFICATION)

The backward stage starts with an interruption of the filling of the activation tank, when the water level in the activation tank is below the maximum level, whereas the water level in the accumulation tank is below the operating level and the minimum time of the flow stage elapsed. The backward phase starts with an interruption of the aeration in the activation tank. After the present time (usually 20 minutes) is desludging air-lift pump included in the operation. The nitrified layer with excess sludge is drawn from the desludging air-lift pump from the activation tank via the sludge tank to the accumulation tank. This results in lowering the water level in the activation tank and simultaneously in filling the accumulation tank. The backward phase lasts until the water level **does not rise above the default operating level in the accumulation tank.**

Completion of the backward stage starts another flow stage with filling the activation tank. At the same time, the duration of the flow stage starts being measured. Denitrification is a result of mixing the treated nitrified water in anoxic environment of the accumulation tank with a sufficient amount of organic substrate in raw sewage, when bacteria consume nitrate oxygen, liberating gaseous nitrogen to the air.

5. REGULATION OF THE WWTP OPERATION (DEPENDING ON THE VOLUME OF WASTEWATER)

AUTOMATIC MODE

When the WWTP is put into operation, data are entered in its control unit to include the area of the activation tank at the height between the maximum and minimum water levels and the design capacity of the WWTP, i.e. the maximum volume of wastewater which the WWTP is designed for. The control unit compares the actual volume of treated wastewater that was drawn from the activation tank with the design volume. If the actual volume exceeds 90% of the design capacity, the plant operates at 100% capacity, i.e. the blower operates continuously for 24 hours a day. If the actual volume of sewage is lower 90% of the design capacity, the oxygenating activity of the WWTP starts being regulated (decreasing).

Regulation of the WWTP operation consists in that at the filling of the activation tank, which is accompanied with its aeration, the blower switches on and off automatically at pre-set intervals depending on the amount of inflowing wastewater. The pre-set minimum duration of the nitrification stage thus extends, because the time when the blower is off is not counted in the total duration of the flow stage. At the backward stage and at the time of other processes of the flow stage, the blower does not switch off. The regulation stops at the reduction of the WWTP capacity at 10%. The blower is only 12 minutes in operation during the 120-minute interval, being off for the remaining 108 minutes. If the inflow of sewage stops entirely and the minimum duration of the flow stage is set e.g. at 6 hours, the filling process, consequently the nitrification stage, takes approx. 50 hours. The system switches only then to the backward stage. After the re-started inflow of sewage the WWTP capacity increases gradually. However, if the inflow is so extensive to raise the water level in the accumulation tank above the pre-set limit, the WWTP switches to 100% capacity immediately.

For holiday homes with a complete cut off of the inflow, it is advisable to adjust the standard factory settings as follows:

Basic. reg. interval:	1 day
Acc. operating level	95 cm
Acc. level P = 100%:	105 cm

In case of holiday homes, it is assumed that the wastewater treatment plant is in maintenance mode before the wastewater inflow. The blower switches at intervals of 2h for 12min. and after about 50 hours the backward phase is realized. If the inflow is restarted, the plant must react immediately. For these reasons

is set the level 100% low mode so that even a small inflow causes an increase in the level in the accumulation tank and the plant is put into full operation, at least on completion of the plant's operating day. At the registration interval of 1 day, the next day of operation the plant will work according to the load of the previous day. If this is not enough, the level will rise again and then temporarily 100%. After the inflow is interrupted, the plant continues to operate for one more operating day according to the inflow of the previous day. It then goes into hold mode until the inflow is restored.

The actual volume of wastewater which is compared with the design capacity of the WWTP is assessed based on the volume of the most recent day or as an arithmetic mean of several recent days (3 days are usually set).

The accuracy of the measurement is given by the level sensing accuracy in the activation tank by the pressure probe. The level sensing accuracy is approx. ± 15 mm. In individual treating cycles, errors can be summed and canceled. Because the measurement error can be up and down. in the total, longer-term, summation measurement, it is possible to realistically count on a statistical measurement error of 15 mm.

For smaller plants (up to approx. 15 PE), the set level difference is usually 200 mm. Then the measurement accuracy and thus the recording of the amount of treated water is 5%. For larger sizes of WWTP the level difference is usually set to 300 - 350 mm. Then the measurement accuracy is about 4%. The actual measurement accuracy can be verified by comparing the manually measured water depth in the reactor with the depth shown on the display.

CAPACITY CONTROL DEPENDING ON WASTEWATER CONTAMINATION

Depending on wastewater contamination, the contamination coefficient is set via the display. At a standard (design) contamination, the coefficient is set up at 100%. The WWTP can be entered by heavily organically polluted waters (water brought from septic tanks, water saving, food-processing industry) as well as diluted waters (waste of water, groundwater). Regulation of WWTP capacity depending on the wastewater volume is not optimal at these situations. Therefore, the operating time of the blower regulated depending on the measured volume of wastewater is additionally multiplied by the contamination coefficient. If water is heavily contaminated, the coefficient is set higher than 100% and the operating time of the blower calculated based on the wastewater volume extends. At diluted wastewater, on the contrary, the contamination coefficient is set up lower than 100% and the operating time of the blower is reduced. **For case of increased wastewater contamination than is the standard, just to be sure the coefficient is factory set up at 130%**.

MANUAL MODE

In the situation when the WWTP has been switched off or out of operation for a rather long time, the blower needs to operate continuously for several days. Then the 100% run is set manually, i.e. the blower does not switch off. This also applies to heavily contaminated waters when the maximum oxygenating capacity of the WWTP has to be utilised permanently.

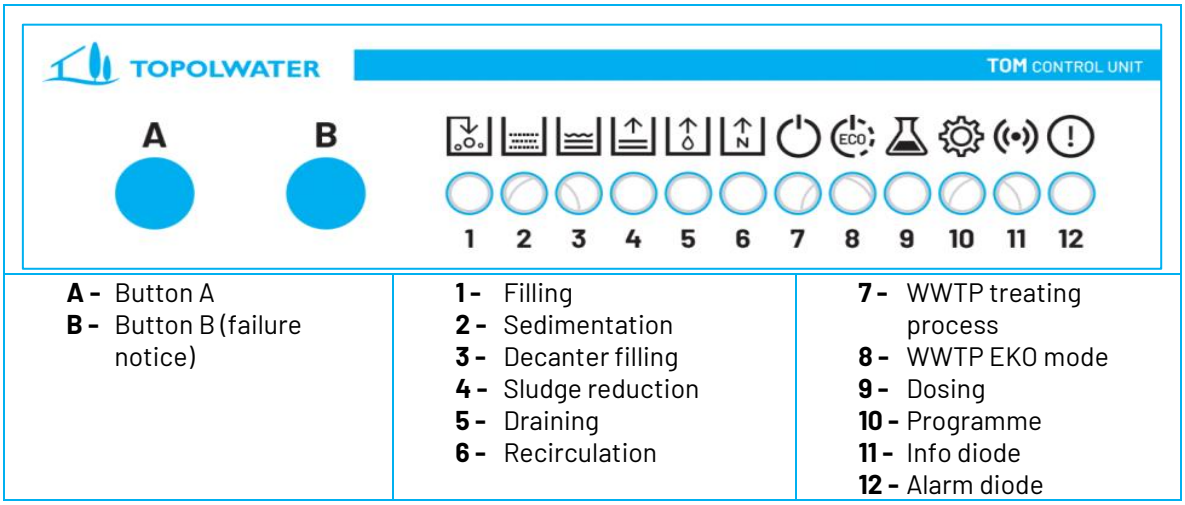
PUTTING THE WWTP INTO OPERATION AND ELECTRICITY FAILURE

After a power supply cut and at starting up the WWTP, the water level in the activation tank must be measured first. If the water level is below the maximum level, the filling process starts and the start of the nitrification stage begins to be measured. The filling process ends with the maximum water level reached or after 10 minutes if the maximum water level is reached earlier. **After the power supply is restored, the WWTP starts always working in the automatic mode!**

WATER LEVEL MEASUREMENT

The control unit measures the water level in the accumulation tank and the water level in the activation tank separately by pressure sensors. Measurement is conducted with two pressure probes. Each of them is inserted in either of the tanks. Hydrostatic pressure is transferred from plastic tubes located in tanks via 2 thin small hoses to the control unit. For the hydrostatic pressure transfer to be reliable, a small amount of air is directed to the tubes from the blower. The compressed air distribution to sensors must be tight. If the blower is in operation and sensors detect no pressure, the control unit signals a failure of the blower.

6. CONTROL UNIT



A - Button A **B -** Button B (failure notice)	**1 -** Filling **2 -** Sedimentation **3 -** Decanter filling **4 -** Sludge reduction **5 -** Draining **6 -** Recirculation	**7 -** WWTP treating process **8 -** WWTP EKO mode **9 -** Dosing **10 -** Programme **11 -** Info diode **12 -** Alarm diode

Figure No. 6: Control panel description

CONTROL PANEL OPERATING

BASIC DISPLAY

The diodes (LEDs) always lit according to actual process in compliance with the control panel at the starting process:

LED	Signalization	Process description
1	**On**	The **filling phase** is in progress
2	**On**	The **sedimentation phase** is in progress
3	**On**	The **filling decanter phase** is in progress
4	**On**	The sludge reduction phase is in progress
5	**On**	The **drain phase** – pumping of treated water
6	**On**	The **recirculation phase** is in progress
7	**On**	WWTP operates in a treating mode in the range of **90 - 100% output,** ie the blower operates 24 hours/day without shutting down
8	**Flashes**	WWTP operates in maintenance mode **below 10%** of output
8	**On**	WWTP operates in Eko mode, ranging from **10% to 90%** of output
9	**On**	Chemical dosing in progress
10	**On**	Signalling of additional equipment switched on, e.g. UV lamp, pump, etc.
11	**On**	Information signalling, e.g. network connection (WiFi)
12	**Flashes**	**Warning or non-standard action** during treating process (WWTP check recommended)
	On	**Serious error** - immediate check of the WWTP is necessary, there is a risk of outflow of untreated water

Table 3: Meaning of individual LEDs signalling

SIGNALIZATION OF DEFECTS (LED FLASHES) AND (LED LITS)

Emergency or malfunction in WWTP is indicated by LED 12 (see Table 3). If:

- LED 12 flashes - this is an **emergency**

- LED 12 is on - this is a **malfunction.**

If LED 12 is on or flashing, we can identify the type of fault state by **pressing the "B" button**. The type of emergency or malfunction can then be determined according to the following table.

„12" ON + PRESS „B"

Defect type	Error	LED	State	Cause	Method of removal
Emergency	E002	-	-	Electricity power on	-
	E 104	1	Flashes	Raw water air-lift pump defect	- Remove and clean the raw water air-lift pump with the primary dirt filter if necessary
	E 105	8	Flashes	The increased level in the accumulation tank lasts longer than the set interval - Danger of drainage untreated water from the WWTP	- Check the volume of wastewater and the raw water-air lift pump function
	E 106	4	Flashes	Recirculation stage lasts over a max. set interval– defect of excess sludge air-lift pump	- Check the excess sludge air-lift pump function – remove and clean
	E 107	4	On	Desludging stage lasts over a max. set interval – defect of excess sludge air-lift pump	- Check the excess sludge air-lift pump function – remove and clean
	E 108	5	Flashes	Emergency water level in bioreactor - increased wastewater inflow - long interval of post aeration	- Check the function of decanter - Reduce post aeration interval -
	E 110	-	-	Air pressure drop in the accumulation tank	- Check the air supply to the sensor for leaks (the sensor must be bubbled through)
	E 111	-	-	Air pressure drop in the bio-reactor	- Check the air supply to the sensor for leaks (the sensor must be bubbled through)
	E 130	9	On	Dosing container is empty	- Fill in dosing container
	E 131	9	Flashes	Filling in dosing container gives out	- Fill in dosing container
	E 150			Critical temperature of control unit	- Check air inlet into the technical box
	E 155			Low voltage of backup battery of control unit	- Check the battery

Malfunction	**E 001**			Electricity power off	-
	E 101	**1**	**On**	Emergency water level in accumulation tank - emergency of outflow of untreated waste water: - increased wastewater inflow - clogged raw sewage air-lift pump	- Check the volume of wastewater - Remove and clean the raw water air-lift pump with the primary dirt filter - Check and, if necessary, clean the regulation nozzle on the air supply to the raw water air-lift pump
	E 102	**2**	**On**	Air pressure drop: - blower failure - leakage in air pressure distribution systems	- Check or repair the blower (in case of overheating, the blower is switched off by a thermal fuse until it has cooled down.) - Check the air supply to the sensor for leaks (the sensor must be bubbled through)
	E 103	**5**	**On**	The drainage stage lasts over a max. set interval - the decanter failure	- Remove, check and clean the decanter
	E 109	**8**	**On**	In the long term (more than 7 days) the treatment plant is overloaded above its design capacity	- Reduce wastewater and its pollution
	E 003			License is not valid (more than 10 day is WWTP overloaded 200% over the designed capacity)	-
	E131			Dosing container is nearly empty	- Fill in dosing container
	E151			External fault of input on D1 (230V)	-
	E152			External fault of input on D2 (5V)	-
	E153			External fault of input on D3 (5V)	-
	E154			External fault of input on D4 (5V)	-

Table 4: Defects scheme

Pressing the "B" button for 2 seconds clears the specific error that is lit. If the error is not corrected, the fault will be signalled again. The display returns to the basic state after 30 seconds from the first press!

DISPLAY OF OUTPUT STATUS – OPERATION OF MACHINES

When the **"A" button is pressed**, energized (running) devices light up:

1 - Blower 1
2 - Inactive
3 - Valve V 1
4 - Valve V 2 – treated water
5 - Inactive
6 - Inactive
7 - Dosing pump – if installed
8 - UV lamp – if installed
9 - Inactive

60 seconds after the last press or by pressing the **buttons "A" and "B" together**, the control panel returns to the basic display.

CHECKING THE WWTP FUNCIONALITY

Pressing **the "A" button** and then pressing the **"B" button repeatedly** will switch the phases and thus check the functionality of the device. In this mode, repeated pressing of the "B" button allows switching of the WWTP between the individual phases to check the function (see Table 3), ie 1x Filling, 2x Sedimentation, etc..... The selection is confirmed by 3 seconds without pressing "B". At the same time, the active option is signalled by a fast flashing diode for a particular option. After 30 seconds, the plant returns to its original state.

Diode nr.	Ongoing phases	Process description
1	**The filling phase**	The bioreactor is aerated and filled (the raw water air-lift pump works), the sludge tank is aerated
2	**The sedimentation phase**	The bioreactor not works, the blower is off
3	**The filling of decanter phase**	Decanter is filling with air-lift pumps
4	**The sludge reduction phase**	The bioreactor not works, the accumulation is aerated, the excess sludge air-lift pump works
5	**The drain phase**	The treated water air-lift pump works, the bioreactor not works, the accumulation is aerated
6 - 12	**Not used**	

Table 5: Testing of WWTP functionality by repeated pressing of button „B"

Attention! When switching on „3"– the drain phase without previous sedimentation for at least 10 min, the sludge mixture is drained into the treated water outlet.

WIFI SETTING

WWTP CONNECTION

TOPAS WWTP enables well-arranged setup and control via Wi-Fi application. Any device with OS Android or Windows can be used for control and you will choose connection to WiFi network of WWTP, SSID: Topas – serial number, **password: tom123456**.

If you do not have installed the application it is possible to access the WWTP directly by entering the address into the browser. Please see link: **http://www.topol.tom**
This address opens the WWTP baseline. There is information about the WWTP operation on this page.

OPERATING INFORMATION

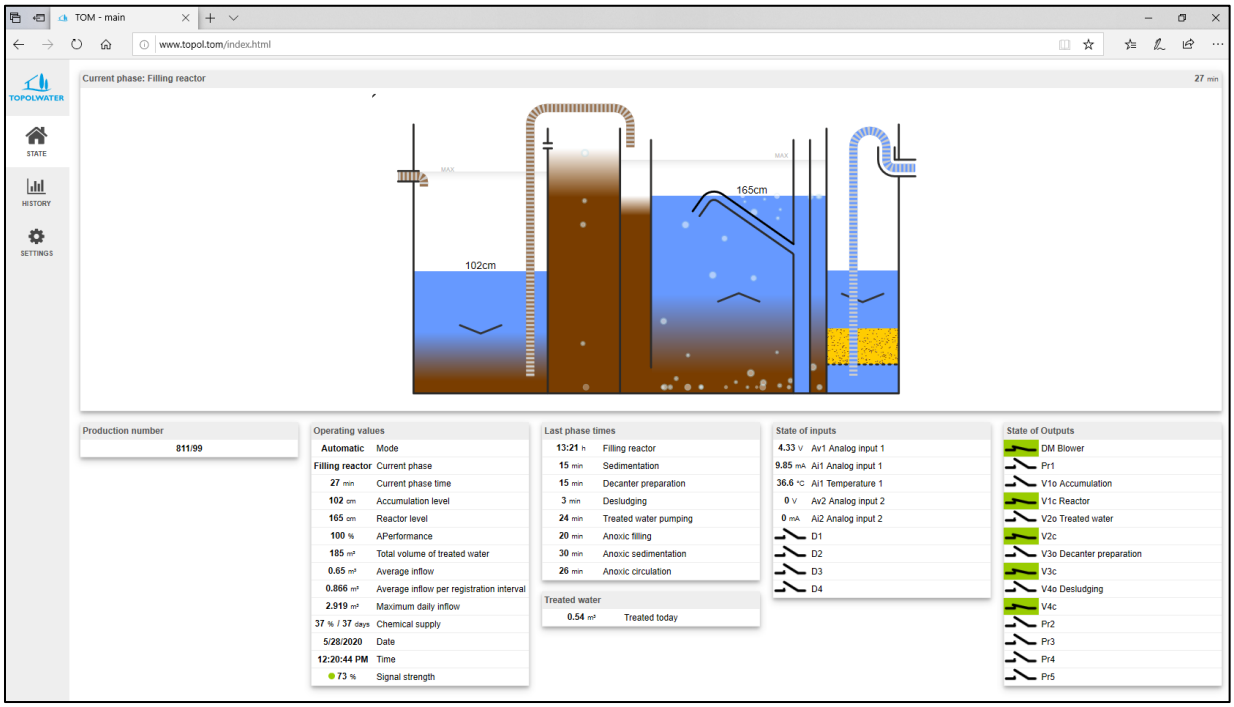


Figure No. 7: Operating information

WWTP SETTINGS

Pressing the WWTP settings are displayed and there is a possibility to change the basic WWTP user parameters.

BASIC SETTINGS

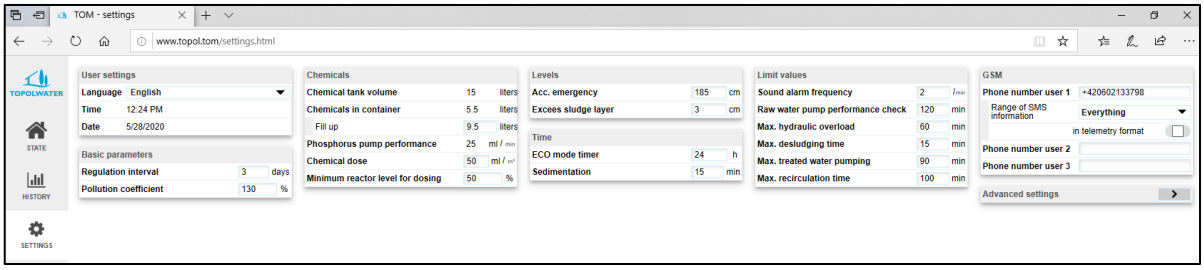


Figure No. 8: Basic WWTP setting

ADVANCED SETTING

You can also set some other parameters, which are used especially for service repairs of WWTP. Such advanced setting is displayed by clicking on the last link at the bottom right. A typical WWTP user does not normally use these settings. The following illustration shows an example of the advanced setting display.

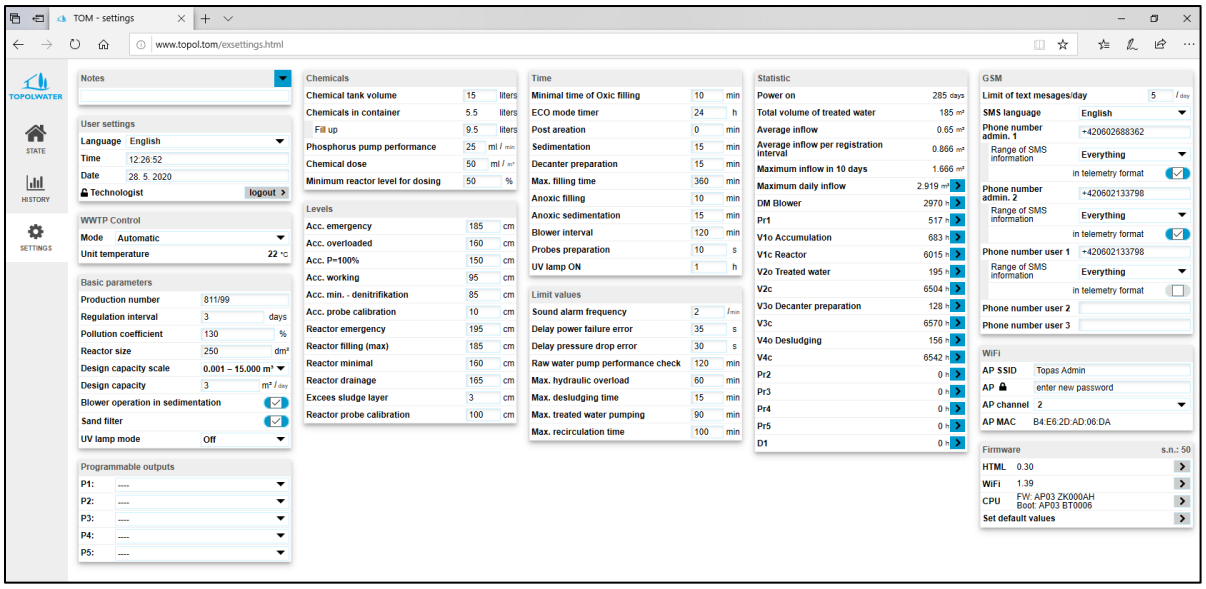


Figure No. 9: Advanced WWTP setting

BASIC AND ADVANCE SETTING

The user of the WWTP can set the parameters of the WWTP and the warning signaling according to the specifics for the installation site. The following table explains each of the adjustable items:

User settings		
Language	English	Set the required language version
Time	11:22:33	Set the current time
Date	28.05.2020	Set the current date

WWTP control		
Mode	automatic	When the automatic mode is set, the WWTP regulates the operation of the blower depending on the quantity of pumped water. When the manual blower mode is set, it works without switching off
Unit temperature	22°C	Temperature in the control unit

Basic parameters		
Production number	868/22	WWTP production number
Regulation interval	3 days	The basic regulation interval indicates for how many last days of operation of the WWTP the average daily inflow is calculated
Pollution coefficient	120%	It is set according to the actual wastewater pollution at the WWTP, which may differ from the standard values
Activation surface	111	The reactor area is entered by producer according to the design of the WWTP
Designed capacity range	0,001-15m3	Range of application of the given type of control unit

Designed capacity	1	Specifies the size type of the WWTP
UV lamp mode	Off	On, off, run with blower

Chemicals		
Chemicals tank volume	0 liters (off)	
Chemicals in container **Fill in**	33 liters 2 liters	Enter the number of liters of chemical added to the container
Phosphorus pump performance	25 ml/min	
Chemical dose	50 ml/m3	Required chemical dosing in ml/m^3
Minimum reactor level for dosing	80 %	The parameter indicates at what stage the reactor is filled with chemical

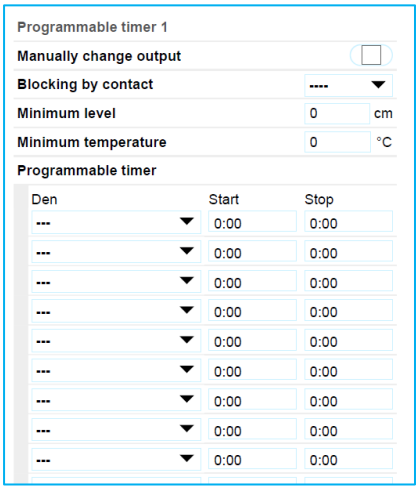
Levels		
Acc. emergency	163 cm	Fault signalling. The level in the accumulation has reached the level of safety overflow
Acc. overloaded	145 cm	The level in the accumulation is close to the emergency level
Acc. P=100%	130 cm	When this level is reached, the WWTP starts 100% regime, within 24 hours of the given day
Acc. working	100 cm	It ends the recirculation phase as well as the denitrification phase
Acc. min. denitrification	70 cm	Initiation of the denitrification phase. Change the discharge level
Acc. probe calibration	10 cm	Height of the sensor above the bottom of the WWTP
Reactor emergency	186 cm	Valve fault signalling V1
Reactor filling (max)	180 cm	Completion of the filling phase
Reactor drainage	170 cm	The discharge phase is complete if the accumulation level is lower than minimal level
Reactor minimal	160 cm	The discharge phase is complete if the accumulation level is higher than minimal level. The recirculation phase is complete
Exceed sludge layer	5 cm	Specifies the layer of sludge and water that is pumped from the reactor to the sludge tank during each cycle
Reactor probe calibration	100 cm	The end of the probe is above the bottom of the reactor

Time		
Minimal time of Oxic filling	5 min	Min. aeration time after power failure
ECO mode timer	50 h	Setting the time to switch to ECO mode from the end of the last drain phase

Post aeration	0 min	Aeration time after filling the reactor to the filling level
Sedimentation	20 min	Setting the length of the sludge sedimentation phase in the bioreactor before sludge removal
Decanter preparation	0 min	Set decanter filling time
Max. filling time	200 min	In regulated mode, it is the sum of the times when the blower is switched on
Anoxic filling	5 min	Min. aeration time after turning on the blower in maintenance mode
Anoxic sedimentation	10 min	Sedimentation before the recirculation phase
Blower interval	120 min	In regulated mode, the blower is switched on and off at the set interval. Always at the beginning of the interval, the blower is switched on for the calculated time and is then switched off until the end of the interval
Probes preparation	30 s	The pressure is always checked after the interval has elapsed
UV lamp ON	10 h	Max. UV lamp on time without switching off

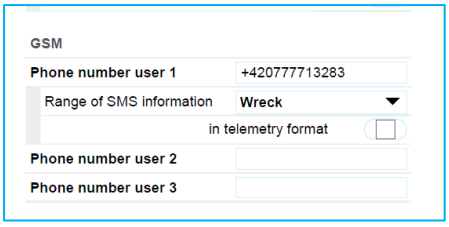
Limit values		
Sound alarm frequency	30 min	Number of audible fault signals per minute
Delay power failure error	30 s	Time limit for sending SMS after a power failure
Delay pressure drop error	30 s	After the set time from switching on the blower, the pressure starts to be measured, or a blower fault is signalled
Raw water pump performance check	300 min	Max. set time when the air-lift pump of the raw water is to increase the level in the reactor by 3 cm - signalling the malfunction of the raw water air-lift pump
Max. hydraulic overload	60 min	The set maximum time for which the level of overload in the accumulation can last without reporting a failure of the air-lift pump of raw water.
Max. desludging time	20 min	Supervision of the function of the desludging air-lift pump. During the given time, it must drain the set layer of water from the reactor, otherwise a fault signal
Max. treated water pumping	60 min	Supervision of the decanter function. Purified water must be pumped out of the reactor at the set time - fault signalling.
Max. recirculation time	90 min	Supervision of the function of the desludging air-lift pump. If the recirculation phase does not end within the given time - reporting the failure of the desludging air-lift pump

Programmable timer (programmable, interval)



It is used to set the timer of connected external devices, e.g. for watering, draining, etc.

GSM



The telephone number (1-3) for the WWTP user checks is entered. From the entered numbers, the WWTP can be controlled and made user setting.

Entering the lowest level of non-standard activity of the WWTP for sending an information SMS.

Messages are sent in the TLM form.

Statistic

Power on	10 min	Number of days since the start of the WWTP
Total volume of treated water	24 h	Amount of treated water since WWTP installation
Average inflow	0 min	The average daily inflow from the start of the WWTP to the present day
Average inflow per registration interval	5 min	Average daily inflow in the set registration interval
Maximum inflow in 10 days	15 min	Max. daily inflow for the last 10 days
Maximum daily inflow	350 min	Max. daily inflow from the start of the WWTP
DM Blower	0 min	Operating hours of machines since the start of the WWTP
Pr1	30 min	
V1o Accumulation	120 min	
V1c Reactor	10 s	
V2o Treated water	1 h	
V2c		
V3o Decanter preparation		

V3c		
V4o Desludging		
V4c		
Pr2		
Pr3		
Pr4 Dosing pump		
Pr5 UV lamp		

Figure No. 10: Description of basic WWTP settings

7. SANITARY REQUIREMENTS

VENTILATION

Air from outside is drawn inside the WWTP and it is expected that venting will go through the sewerage inflow pipe to the area above the roof of the building. If the sewerage system is not vented (in old buildings or when a vacuum valve is used on the last floor of the house), the WWTP is vented to the outflow piping or to the surroundings, which is not an appropriate solution. During a regular operation the WWTP does not smell bad, because anaerobic processes are not in progress there.

NOISE

Noise levels of blowers are listed in the operating manual of each blower. The blower is under the insulated lid of the WWTP, therefore the running of the WWTP with membrane blowers is almost noiseless.

8. PUTTING THE WWTP INTO OPERATION

PRINCIPLES FOR THE WWTP CORRECT INSTALLING, COMMISSIONING AND RUNNING-IN

When installing the WWTP, instructions must be observed that are specified in the Technical Sheet of the respective WWTP, particularly with regard to the necessity to place the WWTP on an adapted ground and filling it with water when backfilling the plant.

At the commissioning of the WWTP water in the activation tank must be between the minimum and maximum level, i.e. it must be at least 10 cm above the movable connection of the decanter arm and the vertical plastic pipe. The decanter arm must be released from the fixed transport position.

After connecting to the electricity and to the sewage inflow piping, the WWTP starts its normal operation. Unless the activation tank is implanted with activated sludge from another WWTP, the running-in period of the WWTP is about 1 month long. The initial fine sludge, mostly light-brown coloured, appears after approx. 10 days of operation and after that time improvement of out flowing water can be already seen. Subsequently, the sludge in the activation tank becomes thicker and usually turns darker, even to a dark-brown colour.

Further improvement is both in treatment and quality of outflowing water. After the running-in period, the water out flowing from the plant is absolutely clear and odourless.

Until the sludge in the activation becomes thick enough (14–30 days), can be a considerable amount of foam in the activation tank. It is caused by use of detergents in the household. With the growing concentration of sludge in the activation tank the foam gradually disappears.

During the running-in period of the WWTP (approx. 1 month), using detergents in the household should be reduced and most importantly, using the washing machine and dish-washer should be reduced, as it utilizes chemicals increasing pH of wastewater.

To speed up the running-in period of the WWTP, the activation tank is implanted by an activation mixture from another wastewater treatment plant. Sludge needs to be slowly poured into the accumulation tank from which it is gradually drawn to the activation tank through the primary dirt filter. If the sludge is active (live), its processing will take several days only.

Sometimes it may happen that imported sludge cannot adapt to a composition of sewage different from that in which it had been formed, and then it dies and the processing lasts for rather a long time. This situation does not happen frequently; however, it can be neither avoided nor foreseen.

The run-in WWTP is then sufficiently resistant against all chemicals used in households in usual quantities, including all types of washing powders. In principle, the usually marketed should be only such products which are fully biologically degradable.

Bigger types of plants are activated by imported activation mixture from another plant. But the imported sludge must not be dead sludge from a sludge tank but always activation (live) mixture.

The end of the running-in period and proper functioning of the plant are checked by an activation-tank sample taken at the moment when the activation tank is filled up.

CHECKING THE SLUDGE VOLUME IN THE ACTIVATION TANK

If the sludge occupies less than 1/3 of the volume of the vessel, the processing in the WWTP has not ended yet. If the sludge quantity is larger, desludging does not run correctly or the sludge tank is already filled up. It means the WWTP is overloaded and requires desludging.

After taking the sample

After 5 minutes

After sedimentation

A sample of the activated mixture should be taken to a transparent vessel of 0.2 to 1 litre and let resting for about 30 minutes. After this time the activated sludge remains settled at the bottom with a layer of clear water above. The line between clear water and sludge must be distinctly visible. The volume of sludge should be of about 30% of the content of the vessel and clear water makes up about 70%.

Figure no. 11: Checking the sludge quantity in the activation tank

9. WWTP OPERATION AND MAINTENANCE

Operation, cleaning and maintenance of the WWTP is made as simple as possible. At normal wastewater, the WWTP does not require any adjustment and works in the automatic mode depending on the actual volume of wastewater. All potential defects, except for excess sludge in the WWTP, are signalled by the control unit. If a defect occurs, instructions in the Chapter no. 20 is to be followed (Chart of potential defects, their causes and methods of their removal). Standard preventive maintenance of the WWTP can be recommended in the intervals specified in the table below.

Once a day	- Check of sound or light signalling of the proper operation of the WWTP
Once a week	- Visual check of quality of treated water and of the overall functioning of the WWTP – by uncovering the lid
Once in 6 months	- Cleaning the dust filter of the blower - other actions as per manufacturer's operating manual - Checking the sludge concentration, or desludging of the sludge tank - Checking, or cleaning the primary dirt filter with the raw sewage air-lift pump
As needed or once in 2 years	- Cleaning the calibrated nozzles in the air-lift pumps and air supply to the pressure probe - Cleaning air-lift pumps - Cleaning the decanting system - Cleaning the surface of the accumulation tank from plastics and fat
Once in 2 years	- Preventive replacement of membranes in the membrane compressor
Once in 3 years	- Emptying the inflow and activation tank entirely and cleaning them from mineralized sludge
Once in 10 years	- Replacement of aeration elements (carried out by a service engineer)

Table no.6: Intervals of WWTP maintenance

In terms of maintenance and servicing it is generally applicable that all the technological components of the WWTP can be easily removed and cleaned outside the plant (except for the aeration system in larger types of the WWTP). When mounting them back, it is necessary to keep the original location, connection and position of all the removed and maintained components.

Any handling of the decanting system requires the decanter as well as the treated water container to be filled with clean water!

The WWTP operation is fully automatic and does not require any adjustment or setup. Occasionally the proper WWTP operation should be checked visually by uncovering the lid. Operators of the WWTP are obliged to keep records about maintenance actions. Table no. 11 is designed for keeping these records. Activities described as maintenance do not fall under the warranty duties of the manufacturer.

DESLUDGING THE WWTP

The WWTP is equipped with a separate sludge tank. The sludge tank can be emptied periodically or when the sludge concentration in the activation tank exceeds 40 – 50% of the volume after 15-minute sedimentation. When the sludge tank is full, sludge returns back through the accumulation tank to the activation tank and consequently the sludge concentration in the activation tank increases. Desludging of

the sludge tank is carried out by a sludge pump, in larger WWTPs by a septic truck preferably. During the desludging process, the sludge tank is emptied entirely. If the sludge tank is aerated, the sludge drawn from the sludge tank is aerobically stabile (biologically inactive) and it can be used as an excellent fertilizer for trees or a similar type of vegetation or poured into the compost. However, it is not secure bacteriologically. If there is a requirement for the sludge to be bacteriologically safe, it must be mixed with lime (lime powder preferably) still in the sludge tank. Disinfection is carried out by increasing pH. At desludging by a septic truck which has a larger capacity than that of the sludge tank, it is useful to desludge the equalizing (accumulation) tank too, where a sludge layer is usually approx. 0.5 m above the bottom. This will extend time until next desludging.

10. EVALUATING THE WWTP FUNCTIONING BY QUALITY OF OUTFLOWING WATER

When the WWTP is operated correctly, the out flowing water is clear, transparent and odourless. If these criteria for the out flowing water are not fulfilled, it may imply the following defects.

TURBID OUTFLOWING WATER

In such case water is incompletely treated (cleaned).It usually occurs during the running-in period before sufficient amount of activated sludge is created. It may take up to 1 month. Another reason may consist in the worsened chemical quality of wastewater, e.g. decreased pH, temperature drop, or chemical contamination by e.g. use of strong washing powders, or by wastewater from the dishwasher.

This trouble will gradually disappear if everything works technically in a standard manner. Permanently turbid out flowing water is a sign of material overload of the WWTP, or a lack of oxygen in the activation tank which may be caused by leakage in the air distribution or excessive reduction of the plant capacity due to incorrect setting of the contamination coefficient. Typically, a lack of air manifests itself by bad smell.

FOAM FORMING ON THE SURFACE OF THE ACTIVATION TANK

DETERGENT FOAM

Such foam is thin, in most cases white and is caused by detergents in cleaning agents. Biological degradation of these chemicals is relatively rapid. The pre-requisite is that there is enough biological sludge in the WWTP.

Occurrence of detergent foam is a consequence of either a small amount of sludge, or an immense amount of detergents used in the household. The small amount of sludge is usually reason for the foam forming soon after the WWTP has been put into operation or during a prolonged low material load of the WWTP and the 100% running mistakenly manually set, when the biological sludge is suffering a lack of nutrients and gradually becomes mineralized.

BIOLOGICAL FOAM

When biological foam appears in some WWTPs, it does not represent a technical trouble of the WWTP that is covered by the manufacturer's warranty. The foam is caused solely by the nature of wastewater. The foam is usually thick, light to dark brown (of whipped cream consistency) and forms in the process of aeration of the activation tank. The foam represents biologically active sludge which treats water efficiently; however, its negative property is that it is lighter than water. The principle of biological treatment using hovering activated sludge is based on the fact that sludge is heavier than water and settles at the bottom after aeration is interrupted. If “filamentous” bacteria multiply, they make clumps (foam)

which are, on the contrary, lighter than water, rising to the surface. When flowing to the outflow pipe, it worsens the quality of treated water and causes serious operating problems.

In some WWTPs a biological foam actually does not occur, in some only in certain seasons of the year – usually when temperature changes (spring, autumn) and some have problems of rather perennial nature. Nevertheless, those WWTPs differ neither in design, nor in the method of operation. Instructions for removing biological foam is never unambiguous and hundred percent effective.

What usually makes filamentous bacteria prosper?

- Fats in general, especially burnt plant oils;
- Very old sludge in the activation tank;
- Aerobic environment with enough oxygen.

Therefore, efforts should be made to set such environment that does not suit filamentous bacteria:

- To reduce the amount of fat in wastewater;
- To desludge the WWTP frequently – significantly more often than recommended in this Operating manual.

Provided these measures are not efficient enough, chemical or biological agents can be used against the biological foam. The WWTP manufacturer will send you these agents and application instructions upon your request.

TOPAS S has no settling tank; therefore, treated water is drawn from the layer approx. 20 cm below the water level in the activation tank. Therefore, unlike in other systems (with a settling tank) biological foam mostly does not worsen effluent parameters, because when treated water is drawn out, biological foam remains on the surface and sludge at the bottom of the activation tank. Water drawn to the outlet is from the layer which is not contaminated with foam or sludge.

CHEMICALS HARMFUL TO THE WWTP

With regard to the market variety and regular innovations, we do not have, de facto no one can have, an exact list of chemicals which are harmful to the WWTP. In general, we can however state that the less chemicals, the better for the WWTP. In a small amount almost everything what is available in the market can be used the WWTP can normally cope with it. Water quality can worsen temporarily at an increased inflow of chemicals (e.g. extensive laundry on weekends), which evens out within 1–2 days. However, beware of two types of chemicals:

First, **purely biocidal and disinfectant chemicals;** if they were used in a large quantity, there would be a risk they may get into the activation tank in such concentration which may destroy microorganisms there. In usual concentrations, such as those used for household floor washing or toilet disinfection, they become neutralised without any problem in the first tank of the WWTP, in the accumulation tank, where water is still not treated by means of bacteria. It protects processes in the other parts of the WWTP. They are chlorine-based chemicals, sodium hydrochloride etc., and also purely biocidal chemicals.

The second type includes **chemicals that change pH significantly**, either to alkalinity, or acidity. Again, these are detergents for cleaning waste pipes, etc. They are based on e.g. sodium hydroxide, or hydrochloric acid. The rule of "everything in moderation" applies here again. Detergents are usually alkaline and could change the pH. It is irrelevant whether they contain phosphorus or not. The colour of sludge in activation tank changes to light brown or even to yellow and the sludge loses structure (it is as a mud). It is recommended to stop the work of washing machines and dishwasher to measure pH in activation tank and adjust the pH on 7. For pH measuring and adjusting use the same resources as for treatment of water in swimming pools where is also necessary to keep pH on 7. It's also possible to raise the inflow to WWTP then

water will be diluted and subsequently the pH will be reduced. If the sludge becomes black it means that pH is reduced lower then 7.

WHAT SHOULD NOT DEFINITELY GET INTO THE WWTP?

- Rainwater or other sinking waters
- Petroleum and oil substances;
- Medicaments and poisons;
- Plastics (including condoms);
- Sanitary towels;
- Wet wipes from nonwoven
- Newspapers and magazines.

WHAT CAN GET INTO THE WWTP ONLY IN A LIMITED QUANTITY?

- Dishwasher water during the running-in of the WWTP;
- pH-changing chemicals (acids and lyes);
- Disinfectants;
- Fats and oils (only in the amount corresponding to a usual washing up).

SAMPLE TAKING AND EFFICIENCY EVALUATION

TAKING SAMPLES OF TREATED WATER

Samples of treated water are taken at the outflow of the treated water inside the plant into a clean, closable jar or another vessel. **There is definitely no need to make a special point (well) behind the WWTP for taking samples.** Samples are taken directly from the SF air-lift pump which is in operation for most of the day.

TAKING SAMPLES OF SEWAGE

It is not usual to take samples of sewage. If required for an evaluation of wastewater quality at malfunctioning of the WWTP, the process of taking the sample is as follows:

1.	Switch off the WWTP at the moment when the water level in the accumulation tank has dropped to the minimum.
2.	The WWTP remains off until the accumulation tank fills up with inflowing sewage up to the emergency water level, i.e. approx. 5 cm below the emergency overflow.
3.	Then switch on the WWTP and set the valve no. 1 manually to mix the content of the accumulation tank (for about 2 minutes).
4.	After approx. 10 minutes after changing the valve no. 1 to the activation tank, when the accumulation tank is no longer being mixed, take a sample of the mixture from the accumulation tank.

The TOPAS S WWTP has a sufficient reserve capacity both in the activation system and in volumes, so that it can work efficiently at various loads. Essential is the quality of out flowing water.

11. MEASURES FOR WINTER OPERATION

The WWTP is designed for a sectional sewerage system, i.e. only for sewage waters temperature of which usually suits the WWTP operation in winter months. Generally, nitrification efficiency becomes significantly lower at temperatures below 11°C. In terms of elimination of organic contamination (BOD_5) the plant works reliably if the temperature of water in the plant ranges from 5°C to 8°C. When temperature drops below 5°C, it impacts the operation and it takes a certain time before microorganisms adapt to the decreased water temperature. The WWTP is equipped with a thermally insulated lid and the whole plant is installed underground. If ambient temperature does not drop below -25°C and at least 20% of sewage flow in, the WWTP does not require any special winter measures. When long-term heavy frost, it is advisable to set the 100% manual operation, i.e. the blower does not switch off so as to ensure a stable recirculation of water in the plant.

12. WWTP RUN AND OPERATION IN CASE OF EMERGENCY

ELECTRICITY FAILURE

At electricity failure wastewater accumulates in the equalising tank temporarily and the WWTP user must reduce wastewater production to avoid an overfilling of the equalising (accumulation) tank and an outflow of untreated water via emergency overflow. The volume of the equalising tank is usually 30% of average daily volume of wastewater. After the power supply is restored, the WWTP starts always working in the automatic mode. The WWTP must be changed to the manual mode manually.

INFLOW OF WASTEWATER INTERRUPTED IN THE LONG TERM

At interrupted inflow of wastewater, the WWTP in the automatic mode reduces its capacity gradually to 10% of the design capacity, which is the "stand-by mode". Under the stand-by mode, nutrients from the sludge tank are added, in a controlled manner, to the system, so that the flow stage lasts for about 50 hours, always followed by the backward stage, when organic substrate from the sludge tank is transferred to the accumulation tank. Through this process the WWTP remains biologically functioning for up to 3 months and is ready to restore its operation immediately. At an interrupted inflow of wastewater longer than 3 months or always when the WWTP is not supplied with electricity for a rather long time and sewage may decay and hydrogen sulphide may generate, it is necessary to remove the control unit from the WWTP. Both the blower and electric valves should also be removed.

INFLOW OF TOXIC SUBSTANCES

TOPAS WWTPs are designed primarily for a sectional sewerage system and only for municipal wastewater; therefore, the risk of contamination by hazardous substances is minimal. At any inflow of a toxic substance to the WWTP it is necessary to switch off the WWTP, prevent an outflow of contaminated water and call a dedicated company to liquidate the content of the WWTP safely. At the same time, the place of toxic substance leak to the WWTP must be secured and further contamination of wastewater prevented.

FIRE OR FLOOD

In case of fire, flood or at any similar cases of emergency, follow these steps:

- Switch off the circuit breaker of the WWTP first, i.e. disconnect the power supply from the network!

- If there is time available and if you are not in imminent danger of life, dismantle from the WWTP such components that can be damaged by water, fire or another element and put them to a safe place.

This applies particularly to blower, valve and control unit. (If in danger of your life, switch off the circuit breaker of the WWTP only.)

LONG-TERM TEMPERATURE DECREASE

If the WWTP is long exposed to frosts (with temperatures of -20°C or lower), switch it to the 100% manual operation, i.e. the blower does not switch off in order to ensure continuous water recirculation in the plant. If, however, some tanks have partly got frozen, it is recommended to supply lots of hot water from the house to the WWTP via the waste pipe or to pour hot water directly into the frozen tank. Try to melt ice or at least to break it into pieces in order to prevent expansion of the tank by ice pressure. Once the water circulation in the plant is resumed, set the 100% manual operation via the control unit.

13. SAFETY, FIRE AND SANITARY INSTRUCTIONS

At each and every work related to the maintenance and operation of the WWTP please follow general occupational health and safety instructions to protect not only your own health but also health of people being near the WWTP.

In particular, observe these rules:

- At each and every work related to the maintenance and operation of the WWTP please follow general occupational health and safety instructions to protect not only your own health but also health of people being in the vicinity of the WWTP.
- In particular, observe these rules:
- Always use adequate work clothes to prevent a direct contact with wastewater.
- Always use protective equipment at work, especially rubber gloves, or goggles.
- At exposure of your skin to wastewater from the WWTP disinfect the contaminated spot.
- In case of ingestion of water from the WWTP seek medical attention.
- In case of occurrence of an infectious disease follow instructions and orders by sanitary authorities.
- Do not eat, drink or smoke when working on the WWTP and after work, always wash your hands with water and soap.
- Prevent children from access, especially when the WWTP is open.
- Never leave the WWTP with its lid open!
- After opening the lid of the WWTP always make sure that the lid is secured by a safety catch against unwanted closing.
- Enter the inside of the WWTP only when absolutely necessary and in presence of another person (all the technological components of the WWTP are removable; therefore, their standard maintenance can be done only after their removal).
- Prevent slippage and subsequent fall to the inside of the WWTP!
- Any action on the WWTP wiring can be carried out only by an authorized person with necessary electro technical qualification!
- Wash and store safely all the tools used for maintenance of the WWTP and sludge sample taking.
- Do not store samples taken in the fridge that you use for food storage.

14. PRODUCT LIFETIME AND DISPOSAL

The WWTP is made of plastic (polypropylene) with almost unlimited lifetime. Lifetime of the aeration component is 5–10 years. Lifetime of the membrane blower is approx. 10 years. Lifetime of membranes in the blower depends on the type and manufacturer of the blower. Membranes must be usually replaced within 18,000 operating hours. Lifetime of the electric valves is long, approx. 1 million of operations.

Required service and spare parts are supplied by respective dealers!

At disposing and recycling the WWTP or its components, use waste collection points or other recycling facilities for a disposal of hazardous and bulky waste.

15. TECHNICAL DATA

DESCRIPTION OF THE WWTP OPERATION DURING THE FLOW STAGE

Nitrification stage	**The valve V1 regulates air into:**	**In operation:**
A. ACTIVATION TANK FILLING	Activation tank	• Central blower (potentially with interruption) • Raw sewage air-lift pump • Aeration of the activation tank • Aeration of the sludge tank
B. SEDIMENTATION **approx. 10 minutes**	Inflow tank	• Central blower– continuously • Aeration of the inflow chamber
C. DESLUDGING **a decrease in the water level by 4 cm** **max. 10 minutes**	Inflow tank	• Aeration of the inflow chamber • Desludging air-lift pump
D. EMPTYING OF THE ACTIVATION TANK (DECANTING)	Inflow tank	• Treated water air-lift pump • SF air-lift pump

Table no. 7: Nitrification

DESCRIPTION OF THE WWTP OPERATION DURING THE BACKWARD STAGE

Denitrification stage	**The valve V1 regulates air into:**	**In operation:**
DENITRIFICATION	Inflow tank	
0 - 10 minutes		Central blower - continuously
after the 10th minute		Central blower – continuously Desludging air-lift pump

Table no. 8: Denitrification

16. OPERATING RECORDS ON WWTP MAINTENANCE

Date	**Maintenance performed (mark with a cross)**												
	Desludging of the sludge tank –by a pump, by a septic truck	Cleaning of the dust filter of the blower	Cleaning of the desludging air-lift pump	Cleaning or replacement of nozzles in air-lift pumps	Cleaning of the decanting system	Cleaning of the surface of the inflow tank and activation tank	Reconfiguration of the control unit	Replacement of membranes (lamellas) of the blower	Removal of mineral. sludge from inflow and activ. tanks	Blower replacement	Electric valve replacement	Replacement of sand*	Replacement of aeration elements
Interval	6 months	6 months	6 - 36 months	6 - 36 months	6 - 36 months	6 - 36 months	As needed	2 years	3 years	As needed	As needed	As needed	10 years

Table no. 9: Records on WWTP maintenance – mark the action performed with a cross

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