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OPERATION MANUAL

for owners

Packaged Wastewater Treatment Plants AT75 – AT250

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SPSC-8819	
AT-150	
Hydraulic daily load:	22,5 m^3/d
Material:	polypropylene
Watertightness (water test):	passed
Crushing resistance:	passed
Daily load with contaminants:	BOD_5: 9,0 kg/d SS: 10,5 kg/d
Concentration:	BOD_5 400 mg/l SS: 466 mg/l
Efficiency:	BOD_5: 98,5 % SS: 98,7 % ChDS: 95,0 % N: 78,3% P: 71.9%
Energy consumption:	27,7 kWh/d

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INTRODUCTION

The "August ir Ko" site-assembled wastewater treatment plants VFL® AT75 to AT250 for 75 to 250 PE serve for the treating of sewage wastewater from group of residental houses or appartments, hotels and pensions, restaurants, schools, caravans and camping sites, small enterprises, small villages or parts of villages, etc. before discharging into a receiving water, rainwater sewer, infiltration into the ground water or reuse of the treated water after a tertiary treatment step.

To ensure trouble free operation, it is essential that the following materials are not present in the influent wastewater:

- **Oil and fat in high concentrations (using of fat separators is necessary if can not be avoid the production of such a wasewater)**
- **Toxic or dangerous materials (oils, paints and paint thinners, acids and alkalis, antiseptic agents in high concentration and large amounts, etc.)**
- **Not decomposable materials (plastics, rubber, textiles, sanitary napkins, wood, etc.)**

There is not allowed to discharge rainwater, drainwater, water from swimming pools, hot water with temperature over 35°C, wastewater from farming and animal breading into the biological reactor.

THE VFL® PROCESS TECHNOLOGY DESCRIPTION

The treatment technology is based on a continually operated modified activated sludge process. The biological reactor comprises of a non-aerated chamber (anaerobic-anoxic – AN), aerated chamber (oxic - O), final clarification chamber (FC) and an integrated retention chamber (R).

The chambers are connected by internal circulation and recirculation conduits between the compartments of the non-aerated chamber,

between the non-aerated and final clarification chamber and between the aerated chamber and final clarification chamber.

The non-aerated chamber is divided by a series of overflowed and underflowed baffles into compartments creating a so called „Vertical Flow Labirynth" (VFL). The baffles form in the non-aerated chamber twelve compartments.

In the final clarification chamber, a flow control device is incorporated, which enables the usage of the volume of the integrated retention chamber in all the compartments and tanks of the wastewater treatment plant during peak flows and thus protect against the overloading of the plant.

The aeration and the maintaining of the activated sludge in suspension within the aerated chamber is ensured by fine-bubble diffusers. Mixing, circulation and re-circulation of the activated sludge is provided by compressed air introduced by a blower via an air distribution system, it being possible to regulate the flow of compressed air.

The operation of the individual air-lift pumps and the aeration is controlled by a control unit. The air blower is placed in plastic tank. The tank of the wastewater treatment plant is made completely from plastic material (polypropylene) and delivered as a compact unit including cover.

TREATMENT PROCESS

The raw wastewater flows into a pumping station. In the pumping station an inflow basket is installed for coarse screening of the raw wastewater and for protecting of the pumps. The inflow basket can be pulled out with a lifting mechanism.

The mechanically pretreated wastewater is pumped into the biological reactor(s). The wastewater is pumped into the first compartment of the non-aerated chamber (anaerobic zone) of the biological reactor. Under the water level in the first compartment, there is an opening of the air lift (air lift No.1), which pumps the activated sludge from the bottom of the last compartment and thus create an internal recirculation within the non-aerated chamber.

The mix of the recirculated sludge from the last compartment of non-aerated chamber and the wastewater flows into the 1th compartment of anaerobic zone. In the 1th compartment, the mixture of the

activated sludge and wastewater is mixed with the recirculated sludge from the bottom of the final clarification chamber. The alternating arrangement of the underflowed and overflowed baffles in the anaerobic chamber provides for an ascending and descending flow of the wastewater and activated sludge mixture and ensures that the anaerobic zone is mixed, resulting in the fermentation and dissolving of the organic substances and an effective denitrification.

The wastewater flows from the anaerobic chamber into the aerated, oxic chamber through an overflowed baffle. In the aerated nitrification zone take place the activation of the sludge, nitrification and biological combining of phosphorus in the activated sludge and a simultaneous sludge stabilization. The aeration and the maintaining of the activated mixture in suspension within the zone is ensured by fine-bubble diffusers.

The wastewater-activated sludge mixture flows from the oxic chamber to the final clarification chamber over the connecting gap in the partition wall between the oxic chamber and final clarification chamber. The connecting gap is situated above the bottom of the reactor. The suction aperture of the air-lift pump No.2 is situated at the bottom of the final clarification chamber and ensures the recirculation of the settled activated sludge partially to the 2nd compartment of the anaerobic zone and partially to the aerated chamber.

In the final clarification a flow-control device is incorporated, which ensures the flow of effluent through a calibrated opening dimensioned for the average flow to the biological reactor. For periodic cleaning of the effluent screen, there is an air lift pump for the self-cleaning of the flow-control device.

The biologically treated wastewater flows through the flow control device into the outlet.

If the concentration of sludge is too high in the system, the excess sludge should be pumped away from the biological reactor(s) to a sludge tank. The sludge tank serves for the thickening and storage of the sludge. The supernatant from the sludge tank flows back to the biological reactor(s). The thickened sludge from the sludge tank is taken away by a lorry or sludge pump. The excess sludge is aerobically stabilized and can be reused in agriculture as fertilizer, or using for composting.

In order to achieve P concentration in the outlet, it is necessary to add ferric chloride solution for P-removal by a dosing pump from a chemical agent storage tank.

TREATMENT EFFICIENCY

Tab.1-Effluent characteristics after biological treatment:

COD_{Cr}	**%**	**95.0**
BOD_5	**%**	**98.5**
SS	**%**	**98.7**
Ntot	**%**	**78.3**
Ptot	**%**	**71.9**
Ptot*	**%**	**92.5**

***chemical precipitation with Fe**

BASIC TECHNICAL PARAMETERS

Tab.2 – Technological parameters and dimensions of the biological reactors

	Population equivalent	Average daily flow	Average daily load	Dimensions of the biological reactors		
				Diameter	Height	Number of reactors
Type	[PE]	[m3/d]	[kg BOD5/d]	[mm]	[mm]	[pcs]
AT 75	75	11,3	4,5	3250	3000	1
AT 100	100	15	6	3500	3000	1
AT 120	120	18	7,2	4000	3000	1
AT 150	150	22,5	9	4500	3000	1
AT 200	200	30	12	5000	3000	1
AT 250	250	37,5	15	5300	3000	1

Height of inlet pipe	Height of outlet pipe	Inlet DN/ Outlet DN	Average el.energy consumption
[mm]	[mm]	[mm]	[kWh/d]
2880	2600	50/200	14
2880	2600	50/200	19,4
2880	2600	50/200	22,7
2880	2600	50/200	27,7
2880	2600	50/200	36,9
2880	2600	50/200	45,6

Tab.3 – Technological parameters of the biological reactors – activation chamber

	Volume of the activation chamber			Volume of the retention chamber	Total volume (usable)
	Non-aerated part	Aerated part	Total		
Type	[m^3]	[m^3]	[m^3]	[m^3]	[m^3]
AT 75	12,1	7	19,1	1,8	24,1
AT 100	13,7	8,5	22,3	2,16	28
AT 120	17,2	12,2	29,5	2,85	36,6
AT 150	22,5	15,5	38	3,58	46,4
AT 200	28,4	19,4	47,8	4,39	57,2
AT 250	30,4	23,6	54,1	4,99	64,3

Hydraulical retention time	Concentration of activated sludge	Sludge age	Sludge load	Sludge production
[h]	[kg/m^3]	[d]	[$kgBOD_5/kg.d$]	[m^3/year]
2	6,5	>30	0,04	18,8
1,7	6,5	>30	0,04	25
1,9	6,5	>30	0,04	30

1,9	6,5	>30	0,04	37,5
1,8	6,5	>30	0,04	50
1,6	6,5	>30	0,04	62,5

Tab.4 – Technological parameters of the biological reactors – final clarification

	Maximum hourly flow		Final clarification chamber			
			Surface area	Volume	Hydraulical load	Retention time
Type	[l/s]	[m^3/h]	[m^2]	[m^3]	[$m^3/m^2.h$]	[h]
AT 75	0,74	2,66	1,9	3,2	0,56	3
AT 100	0,92	3,32	2,3	3,6	0,54	3
AT 120	1,07	3,85	3,1	4,3	0,47	3
AT 150	1,27	4,56	3,8	4,8	0,43	3
AT 200	1,53	5,51	4,5	5,1	0,38	3
AT 250	1,76	6,33	5,4	5,3	0,33	3

Tab.5 – Dimensions of the sludge tank (PP)

Type	Dimensions of the sludge tank		Volume of the sludge tank
	Diameter	Height	
	[mm]	[mm]	[m^3]
AT 75	1850	3000	7,5
AT 100	1850	3000	7,5
AT 120	2020	3000	9,0
AT 150	2260	3000	11,3
AT 200	2610	3000	15,0
AT 250	2610	3000	15,0

THE MECHANICAL AND ELECTRICAL EQUIPMENT

The mechanical equipment consists of the submersible pumps in the pumping station, inflow basket in the pumping station, a side channel blower, air pipes, air distributor with controlling valves, air lift No.1 for internal recirculation, air lift No.2 for pumping of recirculated sludge, air lift No.3 for excess sludge removal and fine-bubble

diffusers. The operation of the submersible pumps and the blower is controlled by an el.panel.

Inflow Basket

The inflow basket is installed in the pumping station, at the inlet of the sewer pipeline. It serves for the coarse screening of the raw wastewater – the screened large particles of biologically degradable material (paper, kitchen waste, etc.) are slowly degrading during the bubbling and whirling created by an airlift in the pumping station. Only the non-biodegradable debris (lady pants, textiles, wood, bones, etc.) is accumulated in the basket, which has to be disposed of. The inflow basket can be pulled out by a lifting equipment and in this position is possible to clean the inflow basket. The air for the airlift in the pumping station is ensured by an air pump, which is placed in the tank for blower.

Pumping station

The pumping station is equipped with submersible grinder pumps. The pumps are installed by means of an auto-coupling guide rail system. The pump automatically connects to a base unit fixed to the bottom of the pumping station tank. The pumps are connected with the biological reactor or biological reactors with parallel HDPE or PP pipes DN50.

Tab.6 – Dimensions of the pumping station (PP)

Type	Dimensions of the pumping station	
	Diameter	Heigth
	[mm]	[mm]
AT 75	1000	3000
AT 100	1270	3000
AT 120	1270	3000
AT 150	1500	3000
AT 200	2000	3000
AT 250	2000	3000

Aeration system

The aeration system is composed by a blower, an air supply pipe, air distributing panel, air relief valves, air diffuser pipe and air diffusers.