

# SMALL WASTEWATER TREATMENT PLANTS, PROBLEMS, RELIABILITY AND MAINTENANCE

Cristian Staniloiu<sup>1</sup>

**Abstract:** In this paper are presented the main technologies that are suitable for small wastewater treatment plants (facilities used for local capacity than isolated or individual households), options for beneficiaries in choosing types of plants and their reliability. The case study concerns a total of 360 small wastewater treatment plant, located around Stuttgart (Germany). The different treatment technologies are presented and the operating and maintenance problems that occurred. The conclusions summarize the main advantages and disadvantages that a user of a small sewage treatment plant has, the disorders that appear in operation as well as the possibility of their remedy. As a potential beneficiary of a small sewage treatment plant, you can choose a system that, in addition to the purchase price, also involves operating and maintenance work. It was pointed out that the beneficiaries of such systems are often able to carry out interventions themselves in order to rectify malfunctions or avoid major damage, (DIY!).  
**Keywords:** small wastewater treatment plants, defects, disturbances

## 1. INTRODUCTION

The problem of isolated communities that do not have a centralized system of collection, transport, treatment, and evacuation of wastewater is still topical in our country. Attempts are being made to implement fast and efficient but sustainable solutions from a technical and economic point of view, to create an infrastructure in the rural environment that ensures hygienic conditions for the population, [1].

Small wastewater treatment plants are plants that serving a total of 50-60 residents. Thus, they are a good solution for remote communities (family houses, hotels and motels, parks, nursing homes), [4], [5].

When choosing the location of such a wastewater treatment plant, care must be taken to ensure that the impact on the environment should be minimal (especially smell and noise). The location is chosen so that water resources and household comfort conditions are not affected. If it requires a location near residential buildings, the use of noise protection systems and ventilation systems is required.

For above-ground systems, protection against frost must also be ensured. Due to their construction, wastewater treatment plants require large areas of land and must be integrated into a more pleasant landscape, [2], [4].

For ordinary small treatment plants (commercially available) there are the following technologies: plants with aeration tanks (classic), biofilters, rotating

biological contactors, aerobic biofilters with immersion bodies and sewage technologies with plants (grass beds), [2], [3], [4], [5]. The systems can be prefabricated (container) or built on site, the author must prepare the paper in A4 (metric) format (29,7x21 cm). The required format for pages, columns, tables, and figures is presented in the next section.

## 2. CURRENT TRENDS IN CONSTRUCTION AND OPERATION OF SMALL WASTEWATER TREATMENT PLANTS

For this study were evaluated 360 test reports with findings and records from some small wastewater treatment plants near the city of Stuttgart. These were divided into six categories, according to the number of residents connected and depending on the used wastewater treatment technology, Table 2.1, Table 2.2. The total number of small wastewater treatment plants that were analysed for a specific size is listed in brackets.

Tab. 2.1 Classification of facilities according to connected residents (size)

Number of connected residents	Number of analysis reports
4-6	64
8-10	164
12-24	91
25-60	39
80	1
100	1
Total	360

## 3. DEFECTS, DISTURBANCES AND OTHER PROBLEMS FOUND ON SMALL WASTEWATER TREATMENT PLANTS

The main defects and disturbances of the purification process are shown in the following tables.

The size of the wastewater treatment plant and the treatment technology used were considered. The analysis reports were drawn up for an average period of eight years.

<sup>1</sup> I Politehnica University Timișoara, Faculty of Civil Engineering, Department of Hydrotechnical Engineering, Splaiul Spiru Haret no. 1/A, 300022, Timișoara, Romania, e-mail: c\_staniloiu@yahoo.com

Tab. 2.2 Classification of facilities according to size and treatment technology

Wastewater treatment technology	Number of small wastewater treatment plants				% of total
	total for technology	connected residents (size)	total for size and technology (total for size)	% total technology	
Aeration tanks BA	274	4-6	43 (64)	15.69	76.111
		8-10	142 (164)	51.82	
		12-24	62 (91)	22.62	
		25-60	26 (39)	9.48	
		80	0 (1)	0	
Biofilters, (with drip) FB	73	100	1 (1)	0.36	20.277
		4-6	19 (64)	26.02	
		8-10	16 (164)	21.91	
		12-24	27 (91)	36.98	
		25-60	11 (39)	15.06	
Rotating biological contactors CBR	9	80	0 (1)	0	2.500
		100	0 (1)	0	
		4-6	1 (64)	11.11	
		8-10	4 (164)	44.44	
		12-24	1 (91)	11.11	
Aerobic biofilters with immersion bodies CAS	0	25-60	2 (39)	22.22	0.000
		80	1 (1)	11.11	
		100	0 (1)	0	
		4-6	0 (64)	0	
		8-10	0 (164)	0	
Sewage technologies with plants SEP	4	12-24	0 (91)	0	1,111
		25-60	0 (39)	0	
		80	0 (1)	0	
		100	0 (1)	0	
		4-6	1 (64)	25.00	
Total	360	X	X	X	100

#### 4. CONCLUSIONS AND FINAL RECOMMENDATIONS

The following table shows the ratios between the total number of defects per technology and the total number of analyzed plants for each technology. It is interesting to note that this ratio is approximately equal. Ten percent of the plants for each technology experienced disturbance and defects during the observation period.

We can also conclude that these defects are not related to the size of the treatment plant. The same problem can occur at a small plant but also at a large one. Large plants show better stability in operation, but troubleshooting requires the same kinds of interventions as small capacity plants.

Wastewater treatment plants with activation tanks (activated sludge) continue to be the first choice for users. This is due to the following aspects:

- Extensive experience in the field of design and operation of large treatment plants.
- The plant can be dimensioned for any size, for any number of users.
- Buildings are underground and integrate well into the ambient decor.

- Plants have a simple geometry that occupies a minimal space.

- The most of manufacturers offer prefabricated facilities, made of light materials.

- Emanations of smell are rare and usually generated from primary sludge fermentation.

Biological filters, the second option, compared with treatment facilities with activation basin:

- Is increasingly based on wide experience gained with large capacity filters.

- Occupied space is greater than the first and the buildings are above ground.

- For a small number of residents stability problems may arise.

Treatment plants with rotating biological contactors:

- Is a less common technology, experience in this area being less than the first two technologies.

- This treatment plants are developed horizontally; usually have large facilities suitable for many residents.

- If they are not tightly covered, unpleasant odors may occur.

- The mechanical rotation system must be very well maintained to avoid stiffening.

Tab. 3.1 Problems found at small wastewater treatment plants for 4-6 residents

	Type of disturbance	Number of problems	Obs.
A	Small wastewater treatment plants with aeration tanks		
1	Fault timer, (automation)	1	Disrupting the entire process
2	Clogged air filter	1	Negative influence on the aeration tank and activated sludge Blocking the gas-lift
3	Inlet valve blocked	1	Input flow not possible
4	Clogged sludge recirculation circuit	2	Malfunctioning of the aeration tank, or sludge settling
5	Damaged partition of the compartments	1	Affecting the proper functioning of the entire plant, unwanted interference between water in different compartments
6	Process software problem	1	Full lock of the treatment plant
B	Small waste water treatment plants with biofilter		
1	Clogged siphon pump (transfer pump)	2	Disrupting the entire process or sludge settling

Tab. 3.2 Problems found at small wastewater treatment plants for 8 - 10 residents

	Type of disturbance	Number of problems	Obs.
A	Small waste water treatment plants with aeration tanks		
1	Auto disconnect from the fuse panel	2	Disconnection is caused by overloading a consumer, usually the electric motor of the pump and lead to stopping the whole process
2	Defective ventilation system	9	Defect resulting from clogged air filters, clogged aeration, damaging pipelines connections or blowers (compressors)
3	Defective valve	1	Defect resulting from rusting or mechanical wear of the valve
4	Defective sludge pump, (for sludge recirculation)	3	Defect leading to malfunction or stop functioning aeration tank or sludge settling
B	Small waste water treatment plants with rotating biological contactor		
1	Defective electric drum drive motor	1	The defect leads to the interruption of the whole process and the drying of the biomass on the discs

Tab. 3.3 Problems found at small wastewater treatment plants for 12 - 24 residents

	Type of disturbance	Number of problems	Obs.
A	Small waste water treatment plants with aeration tanks		
1	Fault timer, (automation)	2	Disrupting the entire process
2	Defective aeration system	1	Defect resulting from clogged air filters, clogged aeration, damaging pipelines connecting or air compressor (blower)
3	Clogged sludge recirculation circuit (sludge pump and pipe clogging)	3	Malfunctioning of the aeration tank or sludge settling
4	Purified water discharge pump defect	1	Purified water cannot drain away
B	Small waste water treatment plants with biofilter		
1	Defective sludge pump	2	Disrupting the entire process or sludge settling
2	Clogged sludge pump	1	Disrupting the entire process or sludge settling
3	Fault timer, (automation)	1	Disrupting the entire process

Tab. 3.4 Problems found at small wastewater treatment plants for 24 - 60 residents

	Type of disturbance	Number of problems	Obs.
A	Small waste water treatment plants with aeration tank		
1	Electromagnetic contactor is defective	1	Stops the whole process
B	Small waste water treatment plants with biofilter		
1	Defective sludge pump	2	Disrupting the entire process or sludge settling

Tab. 3.5 Type and number of problems and defects:

Type and number of disturbance and defects		
	Type	Number
1	Defects related to ventilation system	11
2	Pump malfunctions	10
3	Defects of electrical and electronic actuators	7
	Automatic electrical decoupling of the plant following damage	2
4	Defects of the connection and transfer pipes (sludge recirculation, wastewater supply, clarified water discharge, gas-lift and others)	6
5	Deterioration of plant construction	1
6	Drive motor faults	1
7	Process software problem	1
Total		39

Tab. 4.1 The ratio of the number of defects for each technology and the total number of plants per technology

Number of defects on technology / total station technology					
Technology	BA	FB	CBR	CAS	SEP
Nb. defects	30	8	1	-	0
Nb. plants.	274	73	9	0	4
Ratio	30/274 (0.109)	8/73 (0.109)	1/9 (0.111)	-	0

Defects are usually repaired by a specialized service, 7/7, 24/24, based on a service contract. It is not recommended that the user intervene, except in situations where he knows very well the operation process of the treatment plant and his health and safety is not endangered. He will always respect the rules of protection and safety at work. The treatment plant will be disconnected from electricity to avoid electrocution and closed spaces will be well ventilated to avoid poisoning. Appropriate work clothing will be used. It is important for the user to familiarize him with the operation and maintenance regulations of the small treatment plant. That way he will know how to avoid problems that may arise from improper use.

Some troubleshooting that the user can do could be:

- Cleaning the inlet to the treatment plant, that means checking and cleaning the screen.

- Checking the level of sludge in the settling tank, in this way the clogging of the pump or of the recirculation or discharge of purified water circuit is avoided.

- Intervention on a blocked or clogged valve is also possible, but with caution.

- Replacing an air compressor (or blower) can also be done by the user. These components are visibly placed near the aeration tank and the connections are simple. But first, the cause that led to the failure of the compressor must be checked.

- Replacing an air filter.

- Emptying the tank with mineralized sludge.

- Problems with the process software. Maybe there is a possibility to "return to the original settings".

This can solve problems until the intervention of a specialist.

Other recommendations for the user for the proper operation of the sewage treatment plant:

- Study the user manual!

- Make visual inspections of connecting pipes and hoses. Wastewater treatment plants are attractive to rodents.

- Keeping a log of electricity consumption. The sudden increase in electricity consumption may mean a malfunction of the timer (or soft) or of an electricity consumer (pump motor, compressor).

- Keeping the area around the plant clean and checking the ventilation holes, gas accumulations are very dangerous.

We hope that with this paper we have reduced the reluctance that exists towards small wastewater treatment plants. They represent a viable alternative solution to classic sewage and contribute to a clean environment.

## REFERENCES

[1] *M., Giurconiu*, "Construcții și Instalații Hidroedilitare", 2002, Editura de Vest, Timișoara.

[2] *B., Goldberg*, "Kleinkläranlagen heute", Hoss Media, Verlag Bauwesen GmbH, 2004, Berlin.

[3] *H., Kainz, P., Kauch, H., Renner*, "Siedlungswasserbau und Abfallwirtschaft", Editura Manz, 2002, Viena.

[4] *C., Stăniloiu*, Teză de doctorat „Contribuție la optimizarea proceselor de epurare la instalațiile de capacitate mică”, Universitatea Politehnica din Timișoara; 2006;

[5] \*\*\*\* "ÖNORM B 2502-1, Kleinkläranlagen (Hauskläranlagen) für Anlagen bis 50 Einwohnerwerte, Anwendung, Bemessung, Bau und Betrieb", Wien, 01.01.2002