Status Report

Wastewater Treatment Plant Paide

In the frame of

On behalf of

INGENIEURBÜRO
FRIEDRICH

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Content

1. Background

Within the project outline of CWPharma one of the objectives was to characterise a wastewater treatment plant (WWTP) in Estonia in terms of capability to implement a treatment stage to reduce residuals of pharmaceutical products. To approach this project task the WWTP Paide in the centre of Estonia was chosen as an exemplary WWTP that could possibly be upgraded with an enhanced treatment process to remove residual pharmaceutical products.

2. Focus of this report

In this study the WWTP Paide was analysed in terms of influent characterisation, treatment processes of the main pollutants, sludge treatment processes as well as energy efficiency and capacity reserves for further industrial influents. Furthermore, obvious issues that affect the wastewater treatment processes were discussed and suggestions for an improved process performance were presented.

3. Location and classification of WWTP Paide

Paide is a municipal settlement located in the middle of Estonia with more than 8,000 inhabitants. WWTP Paide was newly built next to an existing plant and commissioned in 2015. Its design capacity represents 40,000 PE. In the past there was a dairy company producing more than half of the total wastewater load. Since this company has closed the WWTP is not fully loaded.

Figure 1: Location of Paide in Estonia

4. Configuration of WWTP Paide

The wastewater of Paide and surrounding communities is transported via pressure mains to the inlet chamber of the WWTP and passes a combined screen and aerated grid chamber. Screenings and sand are separated and deposited in containers for further disposal.

At high influent flow rates wastewater flows from the inlet chamber directly into a storm water tank (volume 2500 m³). This tank is emptied via pumps back into the inlet of the WWTP.

The pre-treated wastewater flows into a storage tank with a volume of 1000 m³. There it is equalized, mixed and pumped into one of the three Sequencing Batch Reactors (SBRs) (Volume each 3000 m³). These reactors contain activated sludge. The aerobic wastewater treatment is performed by mixing and aerating activated sludge and wastewater. After the biological treatment mixing and aeration is switched off and the activated sludge settles to the bottom whereas the treated water can be removed as a supernatant from the surface with floating decanters. After withdrawing the effluent water from the SBRs a treatment cycle is finished and the SBRs are ready for the next cycle start with filling, mixing and aerating, respectively.

Figure 2: Influent construction

Figure 3: Screen and grit chamber

Figure 4: SBR with mixer and decanter

Figure 5: sludge thickening tank

The effluent water leaves the SBRs in a relatively short time (1 hour) with a high flowrate (1200 m³/h). To save the receiving water body's channel from damages the effluent water stream is equalized and therefore the flowrate reduced by a hydraulic equalization tank with a volume of 1500 m³.

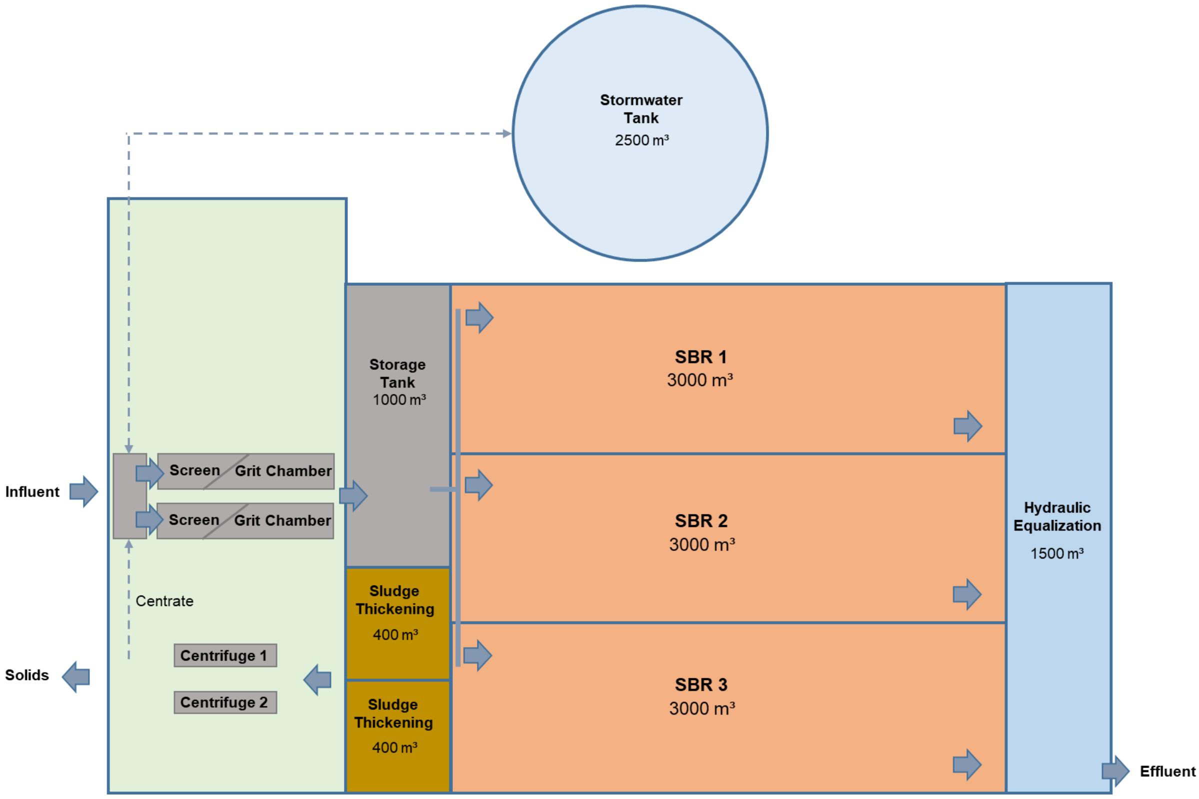

Figure 6: Flow chart of WWTP Paide

During aerobic treatment, organic compounds are transferred into active biomass. Furthermore, particulate material from the influent is adsorbed to the activated sludge floc. The magnitude of both processes can be observed as an increase of total suspended solids (TSS) in the SBRs forming the waste activated sludge (WAS). The WAS is removed at the end of a cycle and pumped into one of two sludge thickening tanks (each 400 m³). To homogenize the sludge and to prevent odour emission these tanks are sequentially aerated.

Figure 7: Hydraulic equalization

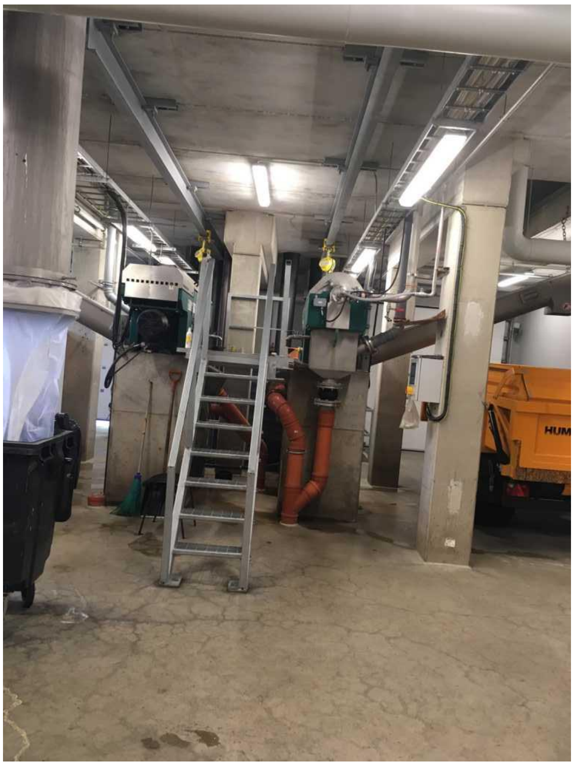

Figure 8: Decanter centrifuges

From the sludge thickening tanks the WAS is pumped directly to one out of two centrifuges, where the sludge is dewatered by increasing the TSS concentration from 1.4% to 20%. The centrate is fed into the inlet of the WWTP and subsequently treated with the wastewater.

Figure 9: Dewatered sludge

Figure 10: Composting plant

The dewatered sludge is further treated by composting on the nearby composting plant. Here the sludge is mixed with an organic material that improves the structural properties and composted for 6 – 8 weeks. The compost is used as fertilizer on agricultural land.

Figure 11: Storm water tank

Figure 12: Receiving water

5. Cycle program of SBRs

The cycle program is the routine a SBR runs throughout the treatment process. WWTP Paide has a dry weather (12 h/cycle) and a storm weather (8 h/cycle) mode. Consequently, at dry weather conditions one SBR performs 2 cycles per day and in storm weather mode 3 cycles per day.

Table 1: Cycle program of SBRs for dry weather

Cycle-time	Step-time	Process	Action 1	Action 2	Action 3
h	min				
3.4	205	Denitrification	Filling		Mixing
4.3	55	Nitrification	Filling	Aeration	Mixing
9.8	330	Nitrification		Aeration	Mixing
11.0	70	Sedimentation			
12.0	60	Decant	Outflow		
12.3	20	Sludge harvesting	Outflow		

6. Influent Data

6.1.1 Hydraulic Data

Figure 13 shows data from the daily influent flow as a monthly mean value from 2014 to 2017. It is evident, that the influent flow has a maximum in winter (5000 - 6000 m³/d) and a minimum in summer (1500 – 2000 m³/d). Since only monthly mean values could be used these seasonal ranges can be even more extreme. Therefore, it is questionable whether a calculated variance of values of 35% is characteristic or a much higher value has to be assumed. The normal range of variance of daily influent flows on a yearly basis in Germany is rather 25% in an area with separated sewer systems.

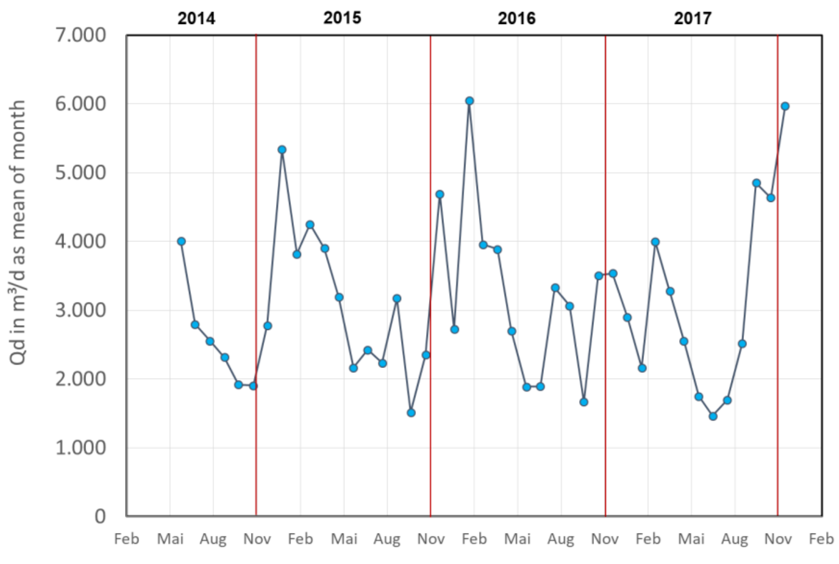

Figure 13: Daily influent flow as a monthly mean

However, for an SBR plant working discontinuous in a cycle mode the hydraulic influent characteristic is a real challenge.

6.1.2 Pollutants

Since there is not much migration in Paide over the year, it can be expected that a high variance of influent flow causes a high degree of dilution of the pollutants. In fact the influent COD concentration is characterised by a relatively low average value und all values show an even higher variance of 67% compared to the influent flow. However, from the data it cannot be concluded that in summer there is less dilution than in winter (see Figure 14). By using the influent concentration of COD and the influent flow the COD load can be calculated (Figure 15). The characteristic statistic values are summarised in Table 2. The mean value of the COD concentration is 739 mg/l and the load 2218 kg COD/d.

The ratio of 85%-quantile to mean value is 1.6 for the COD concentration, but is only 1.3 for the COD load.

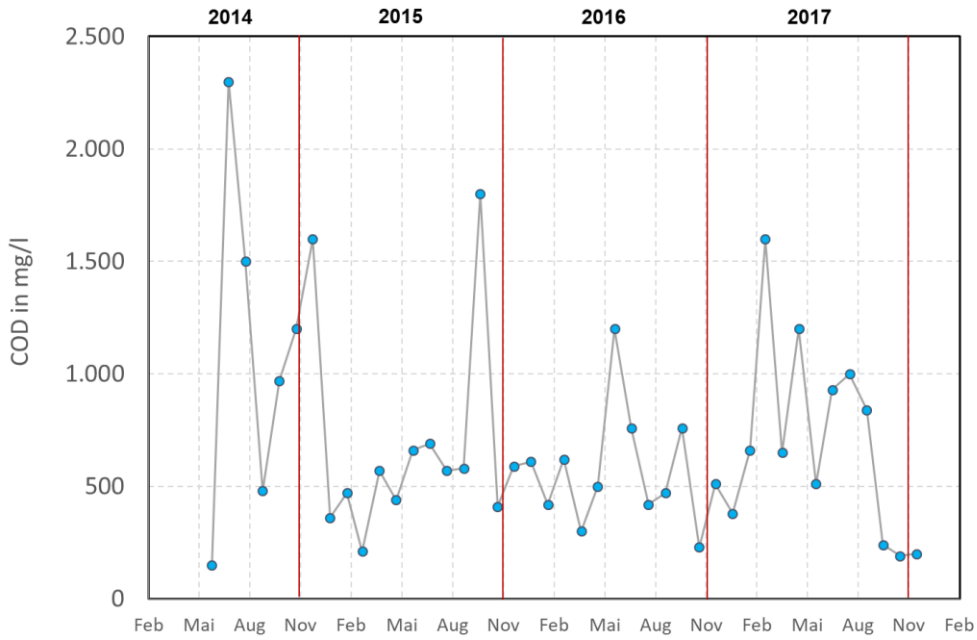

Figure 14: Influent COD concentration as a monthly mean

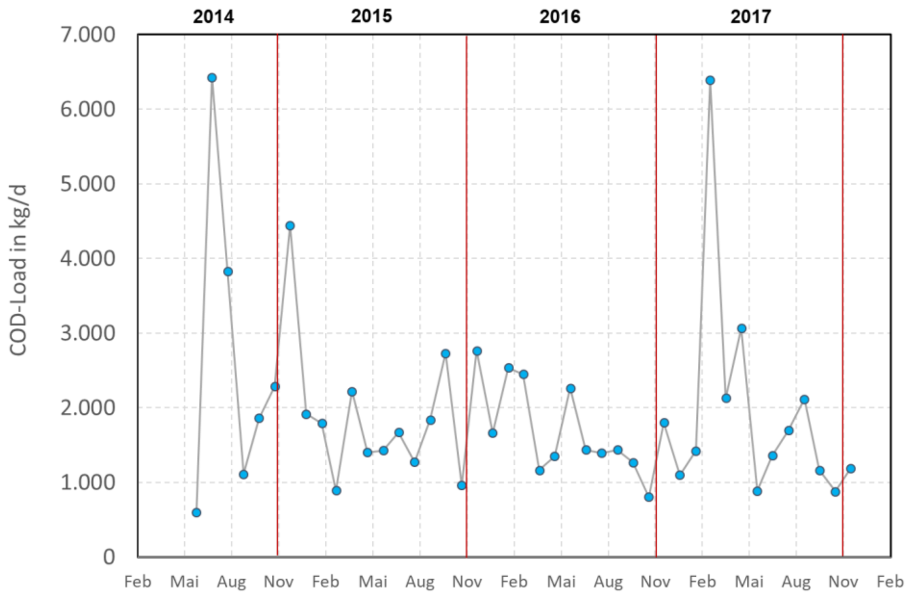

Figure 15: COD influent load as a monthly mean

The BOD_5 corresponds roughly to the degradable COD fraction. The yearly BOD_5 profile as shown in Figure 16 has a high variability. However, the variance of values is 71% and thus more than double of the variance of influent concentrations in northern Germany. The mean value is 364 mg/l and the load corresponds to 1091 kg/d.

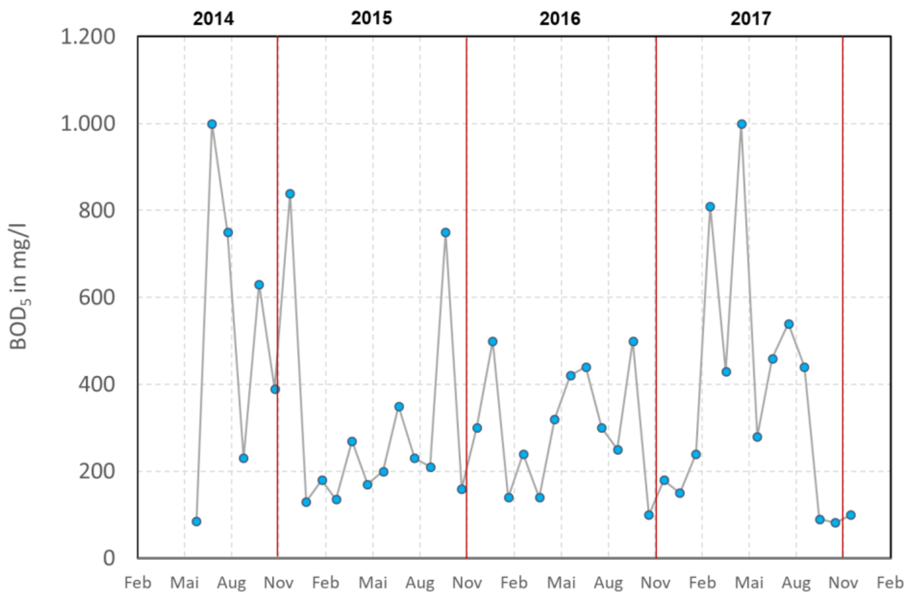

Figure 16: BOD_5 influent concentration as a monthly mean

The TSS concentration in the influent shows a similar pattern as for the parameter COD and BOD_5. The mean value for the concentration is 455 mg/l and the load is calculated to 1364 kg TSS/d. High TSS concentrations of more than 800 mg/l are basically possible but can only be caused by non-municipal wastewater origin.

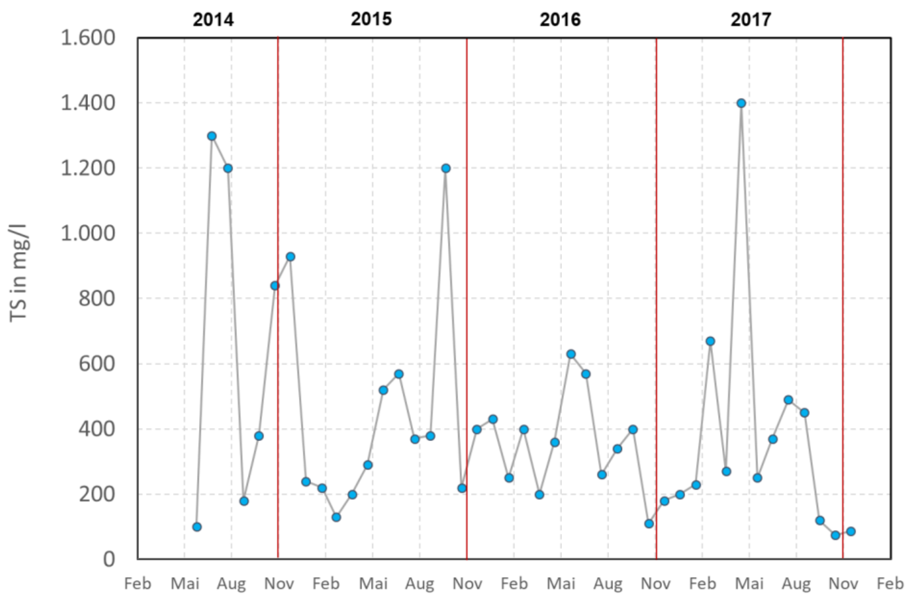

Figure 17: TSS influent concentration as a monthly mean

Nitrogen and phosphorus influent concentrations have both rather low values. The mean of N_{tot} is 43 mg N/l and of P_{tot} is 7 mg P/l. The yearly profile does not allow~~s~~ to derive an explanation for the variability of these parameters.

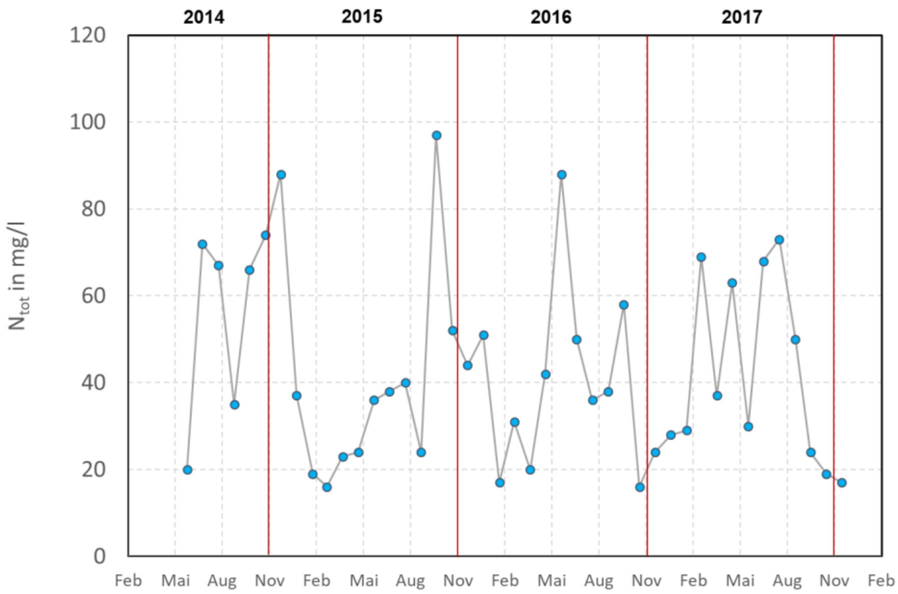

Figure 18: N_{tot} influent concentration as a monthly mean

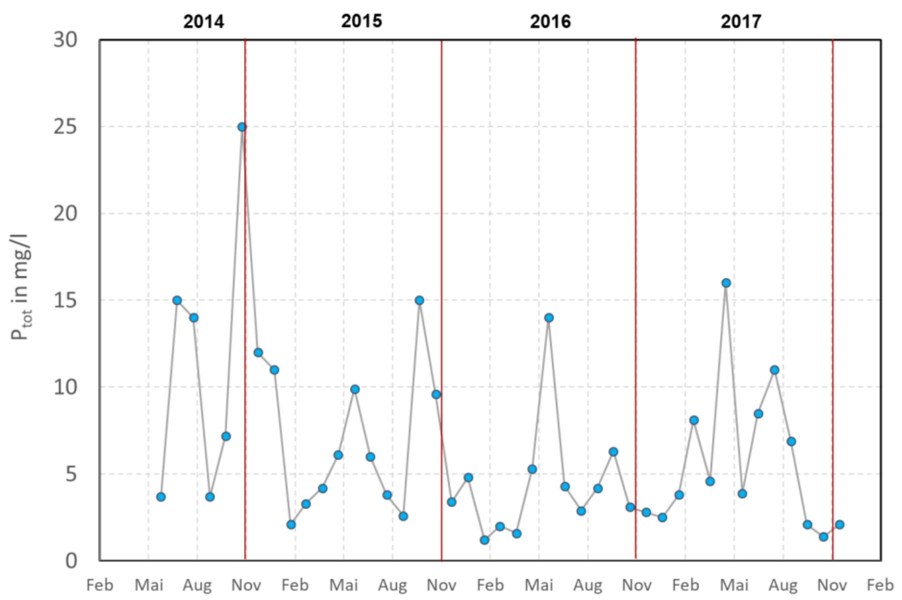

Figure 19: P_{tot} influent concentration as a monthly mean

Table 2 shows a summary of influent concentrations and loads based on means and 85%-quantiles. From this table it can be concluded that:

- Looking at the specific load, there are significant more organics in terms of COD, BOD_5 and TSS relative to nitrogen and phosphorus in the wastewater.
- The ratio of COD and BOD_5 is 2.0 and therefore in the range of typical municipal wastewater.
- The mean wastewater load corresponds to 18000 PE and the relevant load based on the 85%-quantile corresponds to 40000 PE, using COD as a reference parameter

Table 2: Typical values of influent pollutants

	Sp. Load	**Mean**			**85%-Value**		
Q_d		3000 m³/d			4000 m³/d		
	PE Load	Conc.	Load	Capacity	Conc.	Load	Capacity
	g/(PE*d)	mg/l	kg/d	PE	mg/l	kg/d	PE
COD	120	739	2218	18000	1200	4800	40000
TSS	70	455	1364	19000	772	3088	44000
BOD_5	60	364	1091	18000	702	2808	47000
N_{tot}	11	43	130	12000	68	273	25000
P_{tot}	1.8	7	20	11000	13	53	29000

To illustrate the difference of the wastewater characteristics in Paide to the typical conditions in northern Germany even more the mean values of Table 2 are set into relation of mean values of DWA statistics.

From this comparison it is obvious that the higher specific wastewater production explains the lower pollutant concentration sufficiently. However, the mismatch of organic (COD, BOD_5, TSS) to nutrients (N, P) cannot be explained.

Table 3: Comparison of typical northern German and Paide wastewater characteristics

	Germany	**Estonia**	**EST/GER**
spec. Q	120 l/(PE*d)	167 l/(PE*d)	
	Conc.	Conc.	
	mg/l	mg/l	
COD	1000	739	74%
TSS	583	455	78%
BOD5	500	364	73%
N	92	43	47%
P	15	7	45%

7. Effluent Data

The efficiency of wastewater treatment processes are documented by the pollutants effluent concentrations.

The COD as the leading parameter for organic pollution decreased after the commissioning of the new WWTP from 70 mg/l down to 25 mg/l with a variance of 21%. That means COD removal works with high stability over the year which is a main success of operating a WWTP.

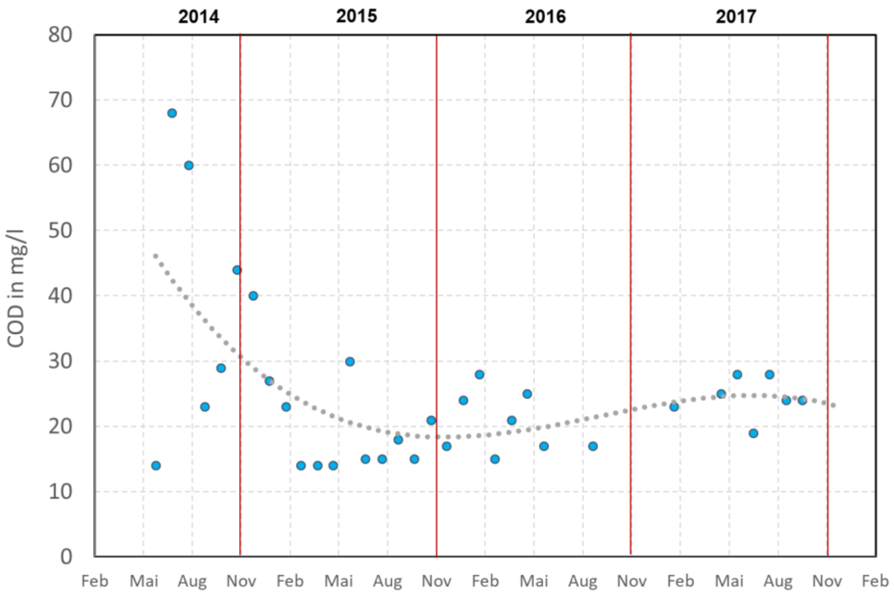

Figure 20: COD effluent concentration as a monthly mean

The TSS in the effluent is a measure for the successful separation of activated sludge flows and effluent water. This can be a real challenge in particular when the settleability of sludge is poor. From 2015 onwards the effluent TSS concentrations have a mean value of less than 4 mg TSS/l.

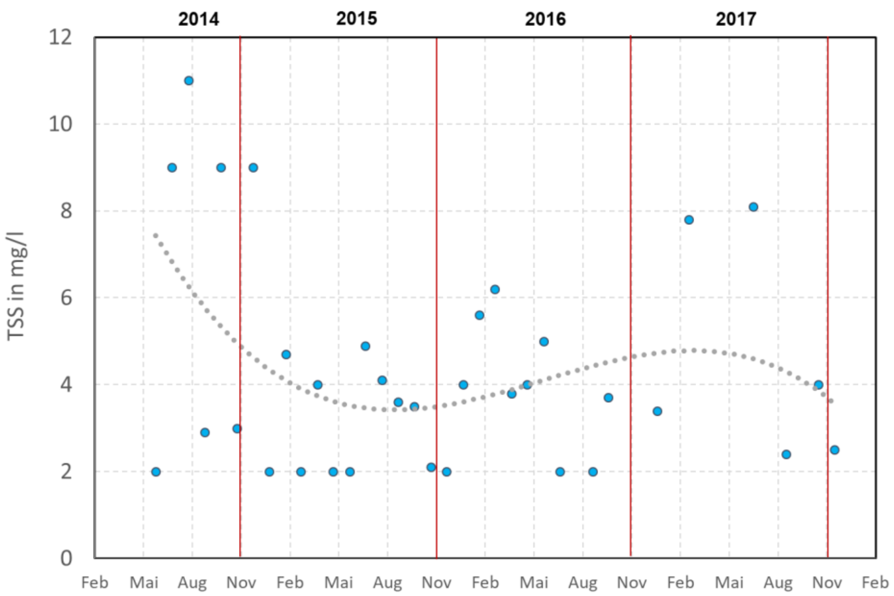

Figure 21: TSS effluent concentration as a monthly mean

The effluent nitrogen concentration is measured as N_{tot}. There is no information about the other species of nitrogen. However, it is assumed that most of the effluent nitrogen is nitrate. Because of a relative high sludge retention time (SRT) in the SBRs nitrifier are likely to oxidize all the available reduced nitrogen to nitrate in most of the time of the year. The mean N_{tot} effluent concentration is 6.0 mg N/l.

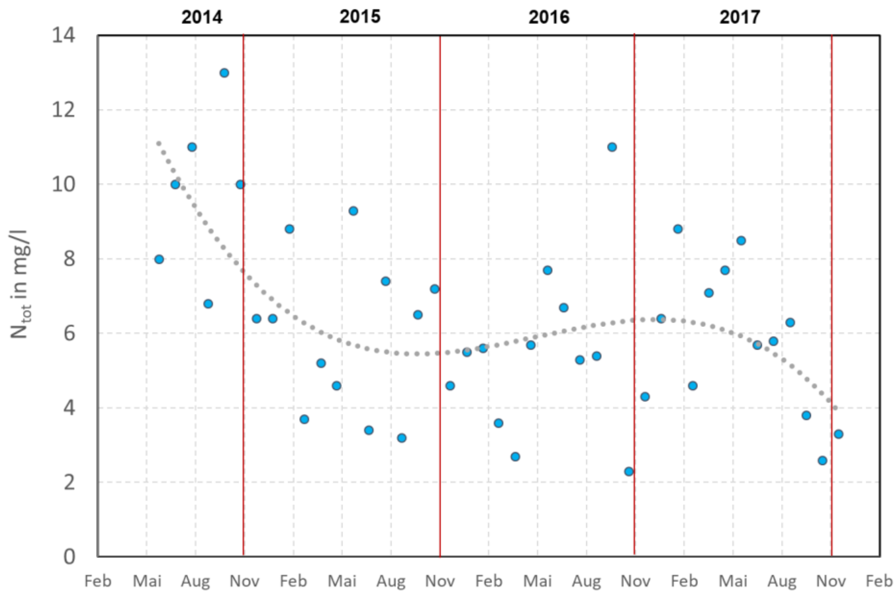

Figure 22: N_{tot} effluent concentration as a monthly mean

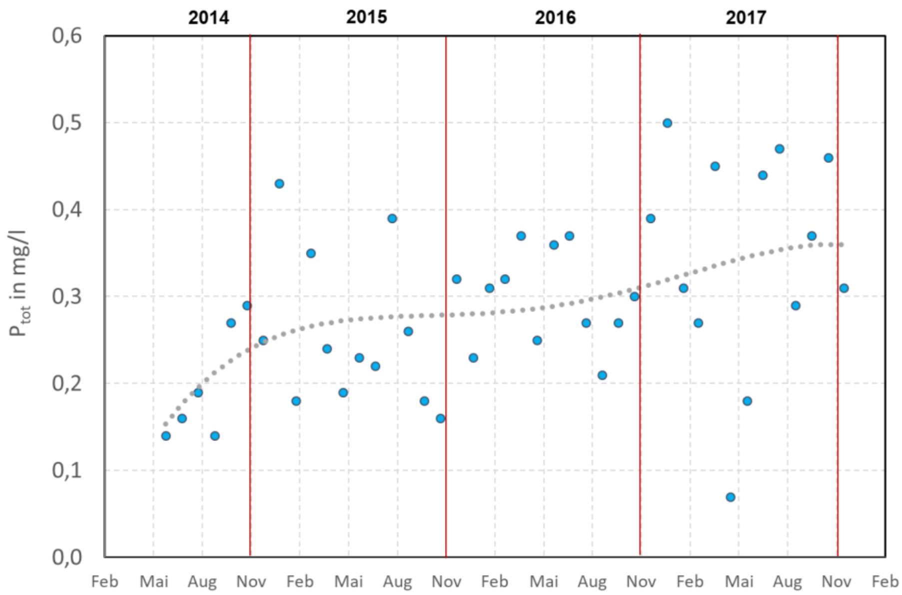

Figure 23: P_{tot} effluent concentration as a monthly mean

Phosphorus removal is the result of P incorporation into active biomass as well as precipitation of P with iron. The latter is known as chemical P-removal. Figure 23 shows a profile of P_{tot} effluent concentration that documents an efficient P-removal process with a mean value of less than 0.3 mg P/l.

In summary it can be stated, that based on the available data the wastewater treatment processes run with a very high efficiency and create an effluent quality that is suitable for the installation of a fourth treatment stage in terms of the removal of residual pharmaceutical products.

8. Biological wastewater treatment

8.1 COD Removal

8.1.1 Sludge production

Records of WWTP Paide show a sludge production of 121 t TSS/a. That corresponds to a specific sludge production of 9 kg TSS/(PE*a), which is a rather low value compared to 13 – 15 kg TSS/(PE*a) in northern Germany. The reason for this low sludge production is the extremely high SRT of 109 d in the SBRs. The SRT is a measure for the reaction time of the simultaneous aerobic digestion in the biological state of a WWTP. If aerobic stabilisation is a treatment goal, it would be sufficient to maintain a SRT of 25 d. Everything above this design SRT causes a further aerobic reduction of TSS in the SBRs and therefore would consume electrical energy for extended aeration.

8.1.2 Oxygen consumption and aeration

The oxygen consumption is the result of the aerobic activity of active biomass due to the oxidation of biodegradable COD and reduced nitrogen components (mainly ammonia).

In Table 4 the necessary airflow based on the wastewater characteristics is calculated and displayed together with the available air flow of the blower. From this calculation there is a blower capacity reserve of 33% for scenarios with mean oxygen consumption.

Table 4: Calculation of airflow from wastewater load

	Parameter		**demand**	**available**	**Unit**
		Mean	**1 x SBR**	**1 x SBR**	
Q	Influent flow	3031	1010		m³/d
COD	Influent COD	739	739		mg/l
	Inert soluble 5% of total COD	37	37		mg/l
	Inert particulate 14% of total COD	103	103		mg/l
	Biodegradable	599	599		mg/l
	Biodegradable COD Load	1815	605		kg O_2/d
N	Oxygen consumption for Nitrification	241	80		kg O_2/d
	Oxygen consumption C+N mean	2056	685		kg O_2/d
Aeration	Time of Aeration	12	12		h/d
	Oxygen consumption C+N peak	171	57		kg O2/h
	α-Value	0,65	0,65		
	Temperature	20	20		°C
	O_2-Saturation	8,9	8,9		mg/l
	O_2 Setpoint	1,5	1,5		mg/l
	O_2 Saturation Deficiency	1,20	1,20		
	Medium depth of aerator	4	4		m
	specific oxygen transfer of aerator	18	18		g O_2/(Nm³*m)
	Required air flow	4403	1468	2.056	Nm³/h
	Reserve			588	Nm³/h

8.1.3 COD Balance

A COD balance is a good indicator for the overall loading situation and energy efficiency of a WWTP. The balance itself is very simple to perform. The influent and effluent COD loads are known from measurements of COD concentration and flow rates. The COD of WAS can be calculated with volatile suspended solids (VSS =

organic TSS) and a factor for the COD content of VSS. This factor is a constant for activated sludge with a value of 1.45 g COD/g VSS. In the case of WWTP Paide the VSS/TSS ratio is assumed to be a low value of 0.65 g VSS/g TSS.

The balance is open to oxidized COD within the treatment process and calculated as the difference of influent COD minus effluent COD minus COD of WAS. The result is shown in Figure 24.

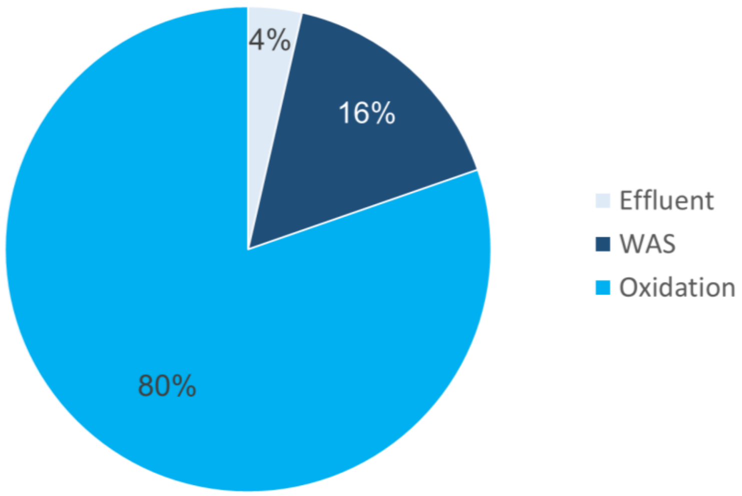

Figure 24: COD balance of WWTP Paide

The portion of influent COD that is oxidized dominates the balance with 80% in a significant way. A WWTP with an SRT of 25 d has a portion of influent COD that is oxidized to ca. 60% and a WWTP with primary settler and anaerobic digestion (SRT ca. 15 d) has only 40%. The higher the oxidized portion of influent COD the higher the energy consumption for aeration and the less the WAS production. Therefore, it is not surprising to observe a rather low sludge production (see chapter 8.1.1). In that way, the WWTP can be characterized as an extensive aerobic sludge stabilisation plant.

8.2 Nitrogen Removal

The N balance is based on the assumption that NH_4-N and NO_2-N effluent concentrations are very small and the organic N effluent concentration is assumed to be 1.0 mg/l. The rest of effluent N_{tot} is NO_3-N (see Table 5). For the incorporation of nitrogen into WAS it is assumed that 7% on a TSS basis is removed via this path.

Table 5: Calculation for N balance

Parameter	**Conc.**	**Load**
	mg/l	kg N/a
N Influent	43	47815
NH_4-N Effluent	0,1	111
NO_3-N Effluent	4,8	5296
NO_2-N Effluent	0,1	111
N_{org} Effluent	1,0	1106
N total Effluent	6,2	5518
N in WAS		8144
N nitrified		39671
N denitrified		34374

Graphically the N balance is displayed in Figure 25. The overall degradation rate for N in the WWTP is 88%.

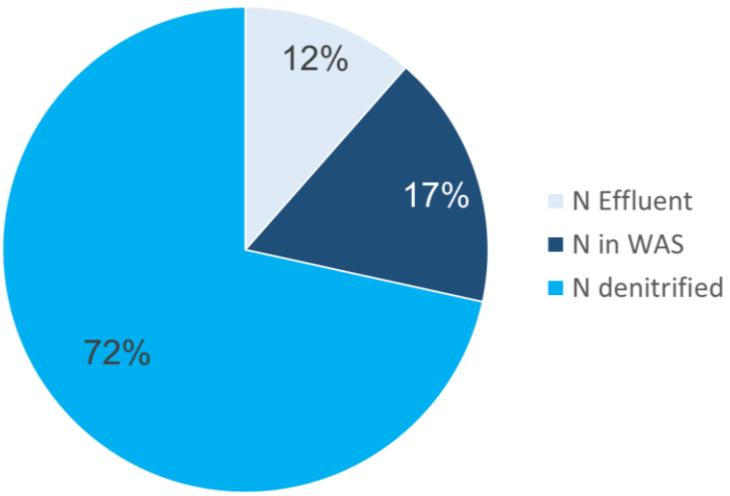

Figure 25: N balance of WWTP Paide

8.3 Phosphorus Removal

Similar as in the case of nitrogen, a portion of the influent phosphorus goes into the effluent, another portion is incorporated into active biomass and the balance corresponds to the phosphorus that has to be removed technically. At WWTP Paide a chemical P-removal is applied. To calculate the P fraction that is incorporated into active biomass a specific P content of 2.5% on TSS basis is used.

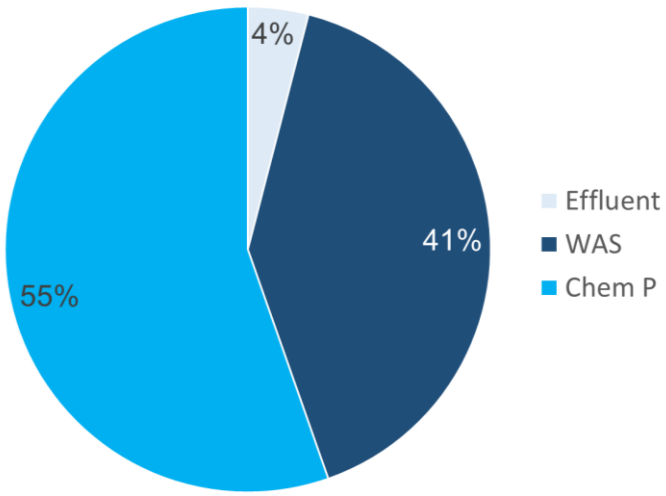

Figure 26: P balance of WWTP Paide

From Figure 26 it can be stated, that the degradation rate with respect to influent P is very high and has a value of 96%. However, only 55% of the influent P has to be removed chemically, because 41% are incorporated into active biomass.

9. Sludge treatment

The sludge treatment of WWTP Paide comprises a simultaneous aerobic stabilisation (degradation) due to a high SRT, as it was already discussed in chapter 8.1.1. In another treatment stage the sludge is stored, equalized with respect to TSS and statically thickened to ca. 1.4 % TSS. From the thickener the sludge is pumped into a decanter centrifuge and dewatered to 20% TSS. This process works fully automatic and yields into a high quality sludge.

To reduce the organic contend further and improve the product properties the sludge is treated in a composting plant, that is outside but nearby the WWTP.

10. Energy efficiency

The efficiency of energy consumption in wastewater treatment has mainly to do with energy efficient machinery, efficient electrical drives and of course with optimal process control. However, from the above calculations it is obvious that the WWTP Paide is underloaded in a significant way. If design and load does not match sufficiently, it is impossible to control a process to an optimum. Although here on one hand a multi lane SBR system has a certain flexibility, the disadvantage of SBR on the other hand is the ultimate need to bring the wastewater through the plant in cycles.

In terms of energy efficiency the challenge is therefore to find a compromise between (1) a beneficial SRT, (2) a save and flexible hydraulic performance and on this basis (3) an optimal process control.

From the plant data an energy consumption of 1.0 Mio kWh/a is reported. To classify this consumption it is related to the actual COD load expressed as population equivalents (PE) with a specific COD load of 120 g COD/(PE*d). From Table 2 the mean load is 18000 PE and that yields a specific (and therefore comparable) energy consumption of 55 kWh/(PE*a), which is a very high value. For this type of WWTP (simultaneous aerobic digestion) and this magnitude of capacity the specific energy consumption of 30 – 40 kWh/(PE*a) is a normal value.

11. Issues of wastewater treatment processes

The WWTP Paide is relatively new, well designed and properly operated. The results of wastewater treatment show that no severe deficiencies influence the overall plant performance negatively.

However, from the influent characterisation it is obvious that the hydraulic influent variances have extreme periods. Since the exchange volume of SBRs has fixed limits, only the frequency and length of cycles can be controlled to avoid hydraulic problems.

Table 6: Hydraulic demand depending on SBRs in operation and number daily cycles

In operation	**SBR**	**1**	**2**	**3**	**Unit**
	SBR Volume	3000	6000	9000	m³
	Max. exchange fraction	40	40	40	%
	Max. exchange Volume	1200	2400	3600	m³/Cycle
Dry Weather	**Cycles per day**	**2**	**2**	**2**	
	Hydr. Capacity	2400	4800	7200	m³/day
Mean	Hydr. Demand 2 Cycle	126%	63%	42%	
85% Value	Hydr. Demand 2 Cycle	166%	83%	55%	
Max	Hydr. Demand 2 Cycle	252%	126%	84%	
Storm Weather	**Cycles per day**	**3**	**3**	**3**	
	Hydr. Capacity	3600	7200	10800	m³/day
Mean	Hydr. Demand 3 Cycle	84%	42%	28%	
85% Value	Hydr. Demand 3 Cycle	111%	55%	37%	
Max	Hydr. Demand 3 Cycle	168%	84%	56%	

Table 6 shows a theoretical approach, where the utilisation of the exchange volume of 1, 2 or 3 SBRs in operation are calculated for 2 and 3 cycles per day. A hydraulic demand of more than 100% means hydraulic overload. However, a value that is less than 100% does not necessarily mean that there is a reserve in terms of hydraulic safety, because this approach is based on the (unrealistic) assumption that the wastewater influent comes ideally distributed over the stretch of a day.

Therefore, the message of Table 6 is that maximum hydraulic influents cannot be handled with two SBRs in operation.

Furthermore, with 2 cycles per day and 3 SBRs in operation a maximum hydraulic influent flow that reaches the WWTP in a short time of the day will certainly overload the storage tank. Depending on the magnitude of a particular storm event this can even happen in storm weather mode with 3 cycles per day.

If there is a bottleneck in the plant operation, it can be addressed to peak influent flow, storage capacity, filling periods in SBRs and the free exchange volume in SBRs.

12. Suggestions for process optimization

To meet the challenge of hydraulic shortage in periods of storm weather it is suggested to change the cycle program in a way that results in an automatic increase of the hydraulic throughput according to Table 7.

First, a cycle program with more than one filling step is highly recommend. This particular feature helps a lot to keep the water level in the storage tank low.

Second, each filling step has only a time but not a volume limitation. That means, as long as wastewater is in the storage tank the filling pumps are running, which all together leads to a minimization of the water volume in the storage tank.

Third, if the maximal water level in a SBR is reached in an early filling step, the cycle jumps to step 4.4 and in that way reduces the cycle time and therefore increases the number of cycles per day.

Table 7: Optimized cycle program

Cycle-Time	Step-time	Step	Step	Process	Action 1	Action 2	Action 3
h	min						
0,5	50	1	1.1	Denitrification	filling		mixing
0,9	5		1.2	Denitrification			mixing
2,1	70		1.3	Nitrification		aeration	mixing
2,6	50	2	2.1	Denitrification	filling		mixing
3,0	5		2.2	Denitrification			mixing
4,2	70		2.3	Nitrification		aeration	mixing
4,7	50	3	3.1	Denitrification	filling		mixing
5,1	5		3.2	Denitrification			mixing
6,3	70		3.3	Nitrification		aeration	mixing
6,8	50	4	4.1	Denitrification	filling		mixing
7,2	5		4.2	Denitrification			mixing
8,3	70		4.3	Nitrification		aeration	mixing
9,3	60		4.4	Nitrification		aeration	mixing
10,5	70	5	5	Sedimentation		idle	
11,7	70	6	6	Emptying	outflow		
12,0	20	7	7	Sludge wastage	outflow		

The sub-steps 1.2 to 4.2 are options for an enlarged denitrification process, if that should be necessary.

For the implementation of this cycle program and to gain from the flexibility of the underlying approach at least one of the two filling pumps has to be upgraded to suit the flow rate. Presently, both pumps together have a flow rate of 260 m³/h. The actual filling time is 260 min (4.3 h) so that only a volume of 1126 m³ can be filled in the respective time. However, the total exchange volume is 1200 m³. In other words, in storm water periods with extreme high influent flows into the storage tank the flow rate out of the storage tank is comparable small with respect to the storage tank volume.

To improve the situation in terms of the recommended cycle program, it is necessary to increase the flow rate from the storage tank into the SBRs. It is recommended to replace one of the existing pumps for each SBR and increase the flow rate from 130 m³/h to at least 300 m³/h. In the line of replacement it is necessary to replace the corresponding pipes as well and increase the dimension from DN 100 to DN 200.

13. Capacity reserves

13.1 Influent load

The design of WWTP Paide was focused to match a capacity of 40,000 PE. The mean wastewater load was determined to 18000 PE and the relevant load was found to be 40000 PE. The meaning of “relevant” is based on the common practice to use the 85%-quantile of all available values.

As a matter of fact, from this approach the WWTP Paide is already fully loaded, although the mean load is less than half of the relevant load.

There are two aspects that are important to evaluate the free capacity:

Using monthly mean values means to work with a very low depth of focus. It is close to illegitimate to produce any statistical values based on this data. Consequently, there is lack of certainty which doesn't allow to calculate a free capacity from the wastewater load.

Irrespective of the data quality, the available data point to a very high variance of influent flow rate and pollutant quality. That is the reason why the relevant load is much higher as the mean load in the influent of WWTP Paide. It is necessary to describe this variance further in detail, which is only possible if the data gets a higher density. Data (influent flow rate and pollutant concentrations) should be recorded on a daily basis. It is important to combine the actual amount of wastewater with the respective wastewater quality to determine the true load.

13.2 Plant performance

Looking at the overall plant performance it is obvious that a SRT of more than 100 days offers a huge free capacity in the biological stage of the plant. In chapter 8.1.2 a theoretical free blower capacity of more than 30% was calculated. This is not in contrast to the high relevant wastewater load, because the SRT is a mean SRT and the blower capacity is only theoretical and based on mean pollutant concentrations.

13.3 Conclusion

Keeping these aspects in mind, it is not the plant size that is limiting the treatment capacity rather than the dynamic of the influent that restricts the free plant capacity. The dynamic is mainly caused by the influent hydraulics and can be handled sufficiently because of the multi lane concept and the storm water tank.

The bottleneck is the interface of storage tank and SBRs. An accelerated filling of SBRs, would help to keep the storage tank empty and allow running shorter cycles. In that way it would be possible to increase the number of cycles per day and thus increase the hydraulic throughput significantly.

14. Existing educational skills of stuff

WWTP Paide as any other plant of this size is a complex arrangement of concrete tanks, pipes, machinery, electrical devices, control strategies, operating routines and lots of unexpected daily challenges for the operator.

The plant has a clear structure and all the treatment facilities and treatment processes are well documented. From the general plan condition, the wastewater and sludge treatment results as well as the personal contact with the operator, it is obvious that the operating stuff has a high knowledge and already good experience in running the WWTP Paide. In particular, the endeavour to preserve and to improve the existing construction and equipment could not be overlooked.

15. Summary

The WWTP Paide, Estonia was commissioned in 2015. The standard of the overall plant performance corresponds to today's state of the art in wastewater treatment. The plant is designed for simultaneous aerobic stabilisation. The size of the plant is 40000 PE. However, the mean degree of capacity utilisation is low and corresponds to 18000 PE. Due to high variances of influent characteristics, mainly hydraulics, the relevant wastewater load corresponds to 40000 PE.

The efficiency of wastewater treatment processes with respect to COD, TSS, N and P is very high.

The multi lane biological stage consisting of 3 SBRs is characterised by an SRT of more than 100 days. Therefore the energy efficiency expressed as specific energy consumption of 55 kWh/(PE*a) is approximately twice as high as for a fully loaded WWTP.

To determine the plant loading conditions more accurately a higher data density is essential. This knowledge is of importance to estimate the free plant capacity more accurate.

The educational standard of the plant staff corresponds to the overall plant performance.

From the perspective of CWPharma project, there is no basic obstacle to implement a treatment stage removing residuals of pharmaceutical products from the plant effluent.

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