Environmental Engineering and Management Journal May 2018, Vol.17, No. 5, 1069-1078
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

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SUSTAINABILITY ASSESSMENT OF THE WASTEWATER TREATMENT PLANT IN THE BALTIC SEA REGION: A CASE STUDY IN LITHUANIA

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Abstract

According to EU Strategy for the Baltic Sea Region, Lithuania has to ensure sustainable growth, gain and maintain good condition of marine environment until 2020. In accordance with the sustainability approach, every potential cost and energy cutting as well as social sustainability measure for wastewater treatment should be explored. Nonetheless, Lithuania wastewater treatment plants (WWTP) in the sustainability context have never been evaluated before. A comprehensive set of 30 sustainable development indicators (SDI) (9 functional, 11 environmental, 5 economical and 6 socio-cultural) in connection with functional unit were applied to medium-sized Jurbarkas WWTP (with a capacity of 2,540 m^3/d). Sustainability evaluation involved life cycle of WWTP maintenance phase as well as water inlet, outlet and manufacturing. Results revealed that in the general context of sustainability the stability of plant varied greatly. Nine SDI haven't reached the sustainability approach. Graphically plotted results in the four sustainability categories have shown that relatively highest environmental impact regarding the maximum covered plot is caused due to an economical unsustainability. Operational and maintenance costs per volume of wastewater treated were approximately 2.23 higher than the cost to consumers per one cubic meter of wastewater treated, therefore depreciation, repairs, material costs and wastewater treatment costs accounted to 87%. Methodology by using SDI for estimating sustainability of WWTP is adaptable to different capacity or technology of WWTP, comparable, simple to develop and improve.

Key words: sustainable development, sustainability indicators, wastewater treatment plant

Received: January, 2014; Revised final: June, 2014; Accepted: July, 2014; Published in final edited form: May, 2018

1. Introduction

1.1. Political factors promoting sustainable development of WWTP in Lithuania

Lithuania is a part of the Baltic Sea Region (BSR), therefore is committed, according to European Union (EU) BSR strategy, to seek to preserve the sea, consolidate the region and increase the welfare of its population, while the main goal is to ensure sustainable development of neighboring states (Strategy of the BSR, 2009). The Baltic Sea is one of the most alive with densely populated coasts and herewith most polluted seas in the world, where insufficient treated wastewater consists of eutrophication stimulating compounds is discharged from big river-basins. The Baltic States pledged to reduce phosphorus and nitrogen amounts flows into the Baltic Sea by 2016 (HELCOM Baltic Sea Action Plan, 2007). The nitrogen amount will have to be reduced to 11,750 t (i.e. about 30 %), phosphorus to 880 t (i.e. about 40 %) (Ruminaitė, 2010).

In 2012, more than 90% of wastewater produced in Lithuania was fully treated, while in 2002 only 21% met the treated wastewater requirements (SL, 2014). Wastewater treatment plant (WWTP) of Jurbarkas fell into the group (with the people equivalent (PE) greater than 2000), whose had the

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opportunity to be updated and/or reconstructed by effectively using EU structural support, national, regional, international institutions funds or private capital. Effective use of economic instruments allowed increasing treatment effectiveness, in some cases energy and costing savings. However, it should be noted that more recent and sophisticated means of treatment come at a cost of higher resource consumption (e.g. energy of higher capacity equipment, better infrastructure) and increased environmental emissions (e.g. biosolids to landfill). Moreover, in these cases it wasn‘t revealed the social side, the importance and benefits for consumers, where a comprehensive evaluation of reconstructed WWTP is required.

Furthermore, because of unfavorable sponsorship conditions in smaller agglomerations, where PE is less than 2000, the issue of sustainable water consumption and sanitation systems raises difficult questions concerning choices of technology and conflicts of interests. In the period of 2014-2020, in the EU long range financial plans, great attention will be paid to wastewater treatment processes and potable water quality improvement in small settlements. By these means the arrangement must be made in advance by applying the best environmental management tool that contributes making decision of selecting the most optimal treatment technology and the best sustainable solution of a small WWTP that could be designed in particular case.

1.2. Sustainability of wastewater treatment processes and management measures to evaluate them

Guest (2012) identified that recent efforts towards sustainability of WWTP comprises recovery sources from waste, constructions of low energy buildings, low impact development for stormwater management, development of construction materials with lesser environmental impacts. In comparison to engineering disciplines focused on products or production processes, environmental engineering has arguably made less progress in the development and application of sustainable design tools and concepts (Guest, 2012). With a holistic approach of having sustainable performance of treatment processes in all three (*socio-cultural, environmental and economic*) aspects, it is worth analyzing and improving them by applying the best water resource management methods. To identify and evaluate the potential impact of environmental aspects of WWTP there may be applied various different assessment tools, such as environmental impact assessment, life cycle assessment (LCA), strategic environment assessment, cost-benefit analysis, materials intensity analysis, analysis of common demand for all resources, exergy analysis, economic analysis (Ghinea et al., 2014; Héctor, 2011; Muga and Mihelcic, 2008). Gallego et al. (2008) and Molinos-Senante et al. (2008) by applying the cost-benefit analysis and LCA for WWTP sustainability evaluation has determined that electric energy consumption, at the level of wastewater collection and treatment processes, is one of the main issues causing abiotic factors, and according to the WWTP exploitation costs it is one of the most expensive aspects. Some authors (Hong et al., 2009; Houillon and Jolliet, 2005) determined by economic and environmental life cycle assessments that wastewater sludge might be used as fertilizer in agriculture as well as its desiccation cause the formation of acid rain, while putrefaction and burning have a great impact on global warming. By applying sustainability indicators, USA scientists have determined that automated treatment equipment processes compared to other technologies have an influence on equipment aesthetics (e.g. diminishes formation of odor) and they also contribute to saving expenses because of a smaller number of employees (Muga and Mihelcic, 2008). Overall, literature analysis revealed that social barriers have been poorly addressed, as it is difficult to estimate social and cultural indices due to their complicated definition (Cocarta et al., 2017; Héctor, 2011; Molinos-Senante et al., 2008), nevertheless in the literature concerned the key indices of this category are the following: institutional requirements, competence, cultural aspects and stimulation of steady behavior (Balkema et al., 2002; Héctor, 2011). Indicators should preferably be suitable for the case studies locally as well as regionally or nationally, easy to understand, fulfil sustainability ideals, quantifiable and be controlled in number (Balkema et al., 2002; Ghinea et al., 2017; Muga and Mihelcic, 2008).

2. Material and methods

2.1. Goal and scope definition

In Lithuania, WWTP in the sustainability context has never been evaluated. Thus, we intend to assess the recently renovated plant, to overview technical, operational and maintenance, economic and social characteristics of the WWTP in the context of sustainable regional development. Besides, Jurbarkas WWTP is ordinary of its capacity and treatment technology to the majority of Lithuania WWTP, wherefore results may be comparable with other Lithuanian cases as well as used for prospective WWTP at the level of its design. Moreover, in 2013 scientists determined that in the river Nemunas, where locates Jurbarkas city, organic compounds pollution by its extent is the second following the biochemical oxygen demand (BOD_7) study data along the river. The value of BOD_7 was 5 mg O_2/l, which meets satisfactory ecological river state (Public Institution (PI) Rupi, 2013).

Main goal of this research was to specify the overall purpose which in this study is the assessment of the environmental sustainability of the urban wastewater treatment system of the Jurbarkas plant with an objective to improve and support the decision making at the wastewater discharge management level and to indirectly promote more sustainable wastewater management. This study was limited to the evaluation of the WWTP sustainability along the life cycle of the operational phase of the WWTP.

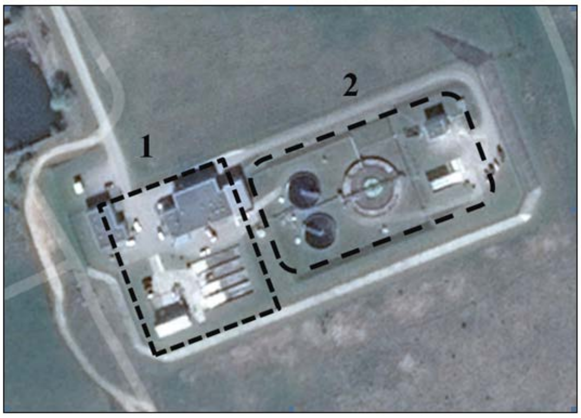
2.2. Functional unit

A functional unit conveys the product and service action evaluating quantitative expressions and is used as a basis for calculations. This reference point is used to express other aspects for each of the compared systems, so that product alternatives are compared on an equivalent basis, reflecting the actual consequences of the potential product substitution (Weidema et al., 2004). The main functional unit which was used in the research for evaluating the quantitative impact on the environment is *the treatment of one cubic meter of wastewater treated*. This choice is directly connected to different technological processes constituting an easier base for comparing the results. Besides, this functional unit is also chosen as a basic unit by other researchers (Dong, 2012; Héctor, 2011).

2.3. Description of the study area

Jurbarkas is a town located in south western Lithuania, on the right bank of the river Nemunas. 10,200 residents of the city are provided by "Jurbarko vandenys"Ltd with cold water supply, wastewater collection and it treatment since 2003. WWTP operates by ordinary biological wastewater treatment with activated sludge processes. The designed capacity of the plant is 2,540 m^3/d, its average wastewater treatment quantity is 1,685 m^3/d. The WWTP occupies 30,000 m^2 area.

The wastewater collected in the town primarily is treated in the mechanical treatment plants. Coarse, easily floating solids are suspended in the grating, the heavier ones (sand, gravel) are put down in aerated sand traps. Silt is drained by the press, the sand – by the separator. Next stage is the secondary treatment (Fig. 1) involving biological treatment in air tank, 2 secondary clarifiers and sludge handling (Fig. 2 shows simplified wastewater treatment technology) (Project of Jurbarkas, 2007). As it was mentioned before, in 2008 by EU financial support and due to depreciation, in WWTP was installed new (disk) aeration system, which consists of separate sections of aerating, whose in case of repair can be placed sequentially, not stopping the aeration process. It led only to 1% improved treatment efficiency. In addition, the company changed sludge dewatering equipment. Due to new sludge treatment equipment consumption of the reagents decreased 31%.



Explication: 1 - mechanical treatment;
2 - biological treatment.

Fig. 1. Jurbarkas WWTP

2.4. System boundaries

In the sustainability context the assessment requires social-cultural, environmental and economic steady state indicators and these indices are part of information having a deeper point than their direct meaning. To carry on this research a number of proper sustainability indicators have been selected for Jurbarkas WWTP evaluation. System boundaries cover the raw sewage influent to the Jurbarkas WWTP and involve all discharges and effluents to the receiving environment. It includes first-order processes (e.g. Pollutants directly discharged into the atmosphere, effluent discharges) and second-order processes (e.g. use of purchased energy and chemical materials) (Fig. 3) (Héctor, 2011).

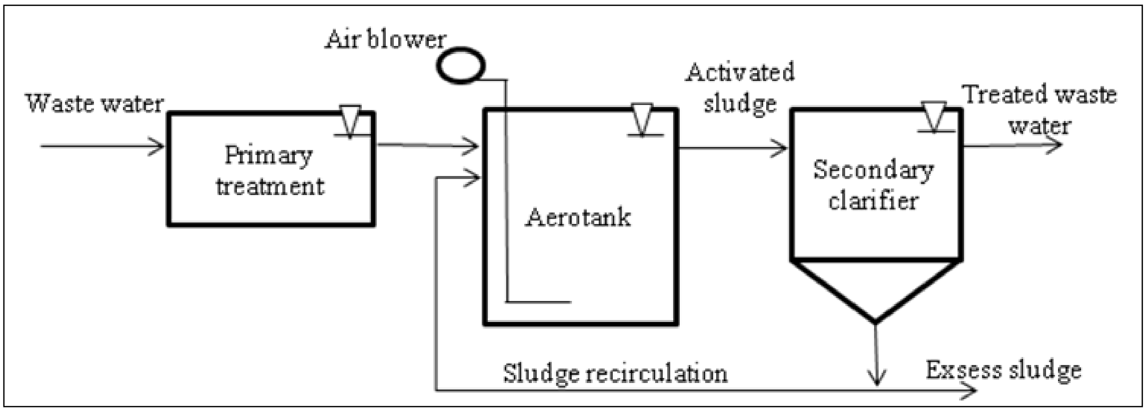


Fig. 2. Wastewater treatment technology of Jurbarkas WWTP

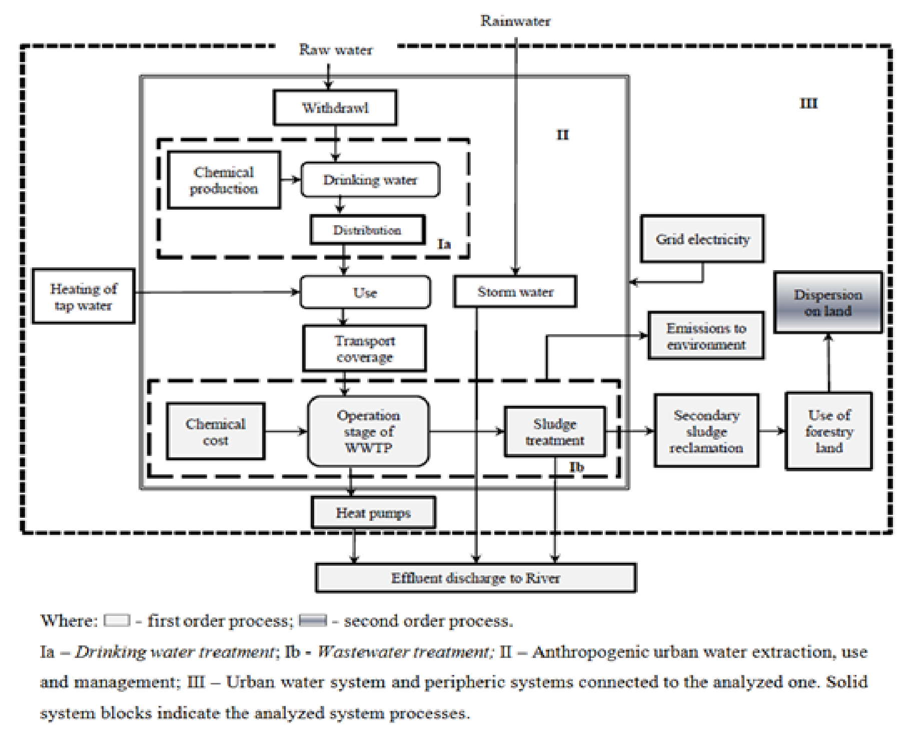


Fig. 3. Overview of the system boundaries for the urban water system used in the development of sustainability indicators

The arrows in the Fig. 3 display materials and energy flows in the system. Seeking more consistent and explicit evaluation of the impact of the processes the WWTP processes have been separated according to the material flows, namely to effluent sludge and water lines. The period of this research lasted for 4 years from 2009 to 2012, the data cover only the WWTP technological operation stage as well as sustainability evaluation involved taking only life cycle of WWTP maintenance and wastewater as a product for the inlet, manufacturing and outlet of the WWTP.

2.5. Inventory data

The selected inventory data for the WWTP evaluation involves 2009-2012 years and is presented in Table 1. Data were used to the sustainability of the WWTP configuration and treatment processes evaluation.

2.6. Applied sustainability indicators

A limited but comprehensive set of indicators was selected to address the most important aspects of the wastewater treatment plant. 9 functional indicators were applied to evaluate the performance of the WWTP with respect to the plants minimal technical requirements. 11 environmental indicators were employed to measure the plant‘s environmental performance with respect to the technical systems. 5 economic indicators were used to evaluate the costs effectiveness of operational and maintenance phase of the WWTP and 6 socio-cultural indicators, where community participation indicators were applied to assess the stimulation of sustainable behavior by increasing the end-user's awareness and concern for the city sanitation (Héctor, 2011) (Table 2).

2.7. Normalization of inventory data

All inventory data of analysis was normalized to increase the coherence of different indicators. Normalization is an optional step in the weighting between impact categories, also assists reducing and eliminating data redundancy. It was used to bring the inventory data to a common scale of 1 to 100 indicating increasing or unsustainable impact by applying data average, maximum and minimum values for the parameters evaluated (Eq. 1) (Héctor, 2011):

$$d_{score} = \left|1 - \frac{(d - d_{min})}{(d_{max} - d_{min})}\right| \cdot 100 \qquad (1)$$

where:
d_{score} – normalized value;
d – average value from data analysis;
d_{max} – maximum value from inventory data analysis;
d_{min} – minimum value from inventory data analysis;
$| \, |$ – absolute value.

3. Results and discussion

3.1. Sustainability evaluation

3.1.1. Functional sustainability

The wastewater treatment plant cleans on the average about 85% of the wastewater generated per normal day within the catchment area. This means that 15% of wastewater generated remains untreated and as such is discharged into the Nemunas River.

Table 1. Summary of average data for the water and sludge lines of Jurbarkas WWTP

Item	***Value***
Influent water	
TSS	338 mg/L
BOD_7	462 mgO_2/L
COD	845 mgO_2/L
Nitrates (NO_3^-)	0.04 mgN/L
Nitrites (NO_2^-)	0.15 mgN/L
TP	10.7 mgP/L
Chemical used (polyelectrolyte)	0.51 g/m^3
pH	7.8
Effluent water	
Total suspended solids (TSS)	3.7 mg/L
Biochemical oxygen demand (BOD_7)	25 mg O_2/L
Chemical oxygen demand (COD)	25.6 mg O_2/L
Nitrates (NO_3^-)	0.13 mg N/L
Nitrites (NO_2^-)	2.63 mg N/L
Total photosphorus (TP)	6.3 mg P/L
Energy use	
Average annual consumption	671,700 kW/y
Average consumption	76 kW/h
Average annual cost of electricity	7,1802.33 €/y
Average cost of electricity	8.14 €/h
Total emissions	124 kg CO_2 eq/d
Sludge	
Volume flow rate of biosolid	350 t/y
Amount of dry matter	18 %
Humidity	29 %
Total organic matter	53 %
Total nitrogen concentration	56,300 mg/kg
Total photosphorus concentration	22,800 mg/kg
Chemical use	
Total chemical used	1,200 kg/y
Cost of chemical used	7,325.58 €/y

Table 2. Sustainability indicators selected for WWTP inventory

Parameter	***Unit***
Functional indicators	
Effectiveness	
Quantity of treated wastewater as a percentage of total quantity of wastewater	%
Percent of energy consumption per volume of treated wastewater	kWh/m
Total chemical use per day per volume of treated wastewater	g/d/m^3
Load of pollutants entering the WWTP per inhabitant connected, per catchment area, per population density	g/d/inh., g/d/m, g/d/inh. m^2
Efficiency indicators	
Pollutants removal efficiency in WWTP	%
Energy recovered from the WWTP	kWh/inh./d
Actual people equivalent (PE) as a percentage of design PE	%
Ratio of pollutants in wastewater	coefficient
Number of system breakdowns for maintenance per day	No/d
Environmental indicators	
Effluent quality	
Ratio of total pollutants in the receiving water compared to the WWTP effluent	Coefficient
Sludge quality	
Ratio of solids sent to landfill compared to land application	%
Phosphorus (P) and nitrogen (N) recycling through the reuse of biosolids	coefficient
Discharge of selected heavy metals to soil (Cu, Zn, Cr, Pb)	kg/d
Global warming	
Gas emission in kg CO_2 equivalent per day	kg CO_2-eq/d
Public health risk	
Odor	-
Noise and Traffic	-

Pathogens removal	%
Economic indicators	
Total costs per volume of wastewater treated	€/m^3/d
Operational and maintenance costs per volume of wastewater treated	€/m^3/d
Energy costs per volume of wastewater treated	€/m^3/d
Chemical costs	€/m^3/d
User cost	€/m^3
Socio-cultural indicators	
Community size served	inh./m^3/d
WWTP footprint compared to wastewater treated	m^2/m^3
Labor required to operate the WWTP	staff/m^3
Aesthetics - measured level of nuisance from odor	-
Community participation	
Ratio of total population served to total visits to the WWTP	coefficient
Ratio of total staff to staff from WWTP community	coefficient

In general, the concentrations of total suspended solids (TSS), BOD_7, total phosphorus (TP) and total nitrogen (TN) in the influent wastewater can be characterized as moderately concentrated (Table 3).

The ratio of COD / BDS_7 (1.6-2.2) in influent of wastewater shows that the wastewater may be treated by the biological processes, contamination of the influent is not toxic and resembles to average values of municipal wastewater. The plant efficiency in TSS and BOD_7, COD, and TP removal met the plant's objectives (all 98%) but it was low with regard to the TN removal (88 %) (Fig. 4).

Denitrification process consumed more than half (60%) of the energy required for the operation of the wastewater treatment plant. Wastewater collection and biological treatment consumed 18% each. The least of energy was required by mechanical cleaning and the administration – 0.6 and 3.4 respectively (Fig. 5).

Table 3. Average and the range of water quality parameters of WWTP, 2009-2012

Parameters		***Average***	***Minimum***	***Maximum***
Influent	BOD_7 (mg/L)	462	386	565
	COD (mg/L)	845	742	908
	TSS (mg/L)	338	321	352
Effluent	BOD_7 (mg/L)	5.1	4.7	5.7
	COD (mg/L)	42.5	39	48
	TSS (mg/L)	5.6	5.1	5.9

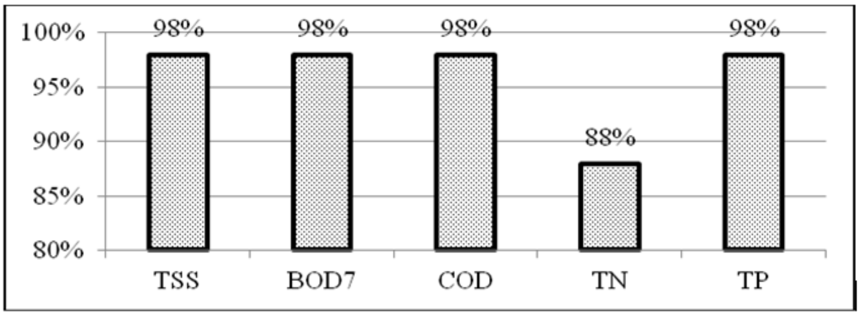


Fig. 4. Efficiency of pollutant removal in percent

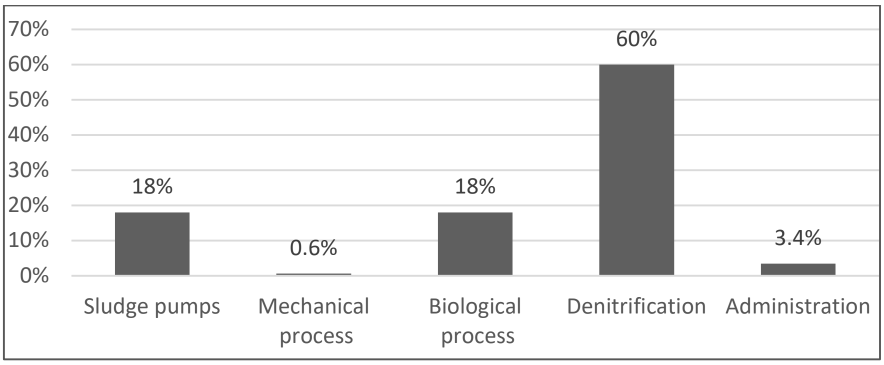


Fig. 5. Energy consumption by operation units at Jurbarkas WWTP

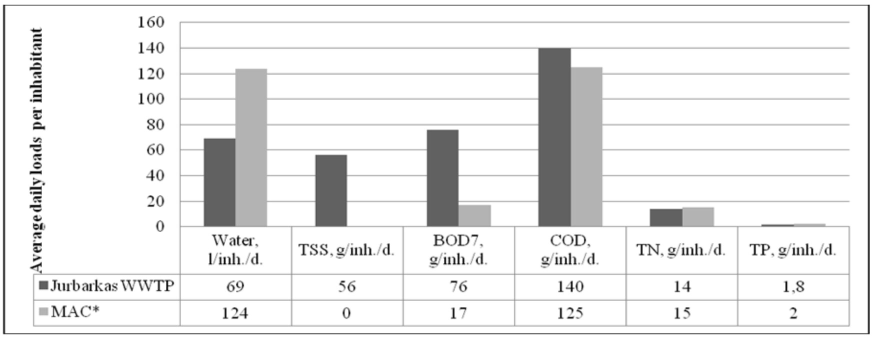


Fig. 6. Average daily loads of water, TSS, BOD_7, COD, TN, TP per inhabitant entering WWTP and set by legal requirements (*The maximum allowable concentration (MAC) set by legal requirements in Lithuania)

On the whole, 2% of the total energy was needed for the treatment of each cubic meter of wastewater generated from the consumers. With reference to the total chemical use per day and per volume of treated wastewater, composing 1,950 g/m3/d, it has been concluded that the chemical need for the plant's treatment process is relatively high. It caused more effective elimination of photosphorus (P). However, worse impact on the whole environment with increased burden on synthetic chemical use.

The average loads of TSS, BOD7, COD, total nitrogen and total phosphorus entering the wastewater treatment plant in grams per inhabitant per day exceeded norms set by legal requirements (Fig. 6). This indicates that influent is residual with industrial discharges. Currently the WWTP of Jurbarkas is working at 70% capacity with respect to the designed capacity of the treatment plants. Considering that the present population growth rate in Jurbarkas is decreasing (based on 2013 data from the Department of Statistics data) in the next 4-5 years the plant will not be working at full capacity.

With reference to the data provided by operators of the wastewater treatment plant, there is no system breakdown recorded. The plant is given a high score on the assessment scale. Also, an emergency diverting channel, used to control the amount of the influent wastewater, has never been opened.

3.1.2. Environmental sustainability

The quantities (kg) of nitrogen (N) and phosphorus (P) recycled through land application compared to the total daily sludge production by the plant were 12% and 2% respectively. This indicates that the phosphorus and nitrogen recycling through the reuse of sludge is effective. 98% (about 5,300 kg/d) of wastewater sludge was processed or stabilized. The sludge produced at the plant has been used for the improvement of degraded soil and land in the area of Lemantiškiai forest.

It has been noticed that the concentrations of Copper (Cu), Zinc (Zn), Chromium (Cr), and Lead (Pb) are fairly high in the wastewater sludge – 1.8 mg/kg, 10.7 mg/kg, 4.1 mg/kg and 6.37 mg/kg respectively. Zinc (Zn) was the major heavy metal component in the biosolids, which constitute 82% (Fig. 7). The emission of methane (CH_4) from the wastewater treatment processes was high over the all study period and constituted 87% of all the evaluated greenhouse gas emissions (Fig. 8). The contribution from the process related emissions was the highest and reached 99%. Fuel expenditure was 1%.

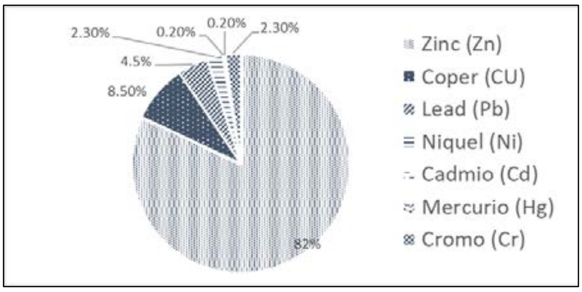


Fig. 7. Percentage of heavy metals in biosolids generated daily from WWTP

Odor is an aesthetic problem that usually evokes public involvement, especially for mechanical systems, where the odor varies from moderate to low (1-2 points) in the neighborhood of Jurbarkas wastewater treatment plant. Considering that the currently installed treatment system at Jurbarkas wastewater treatment plant corresponds to a primary and secondary treatment plant type, the public health risk of the wastewater generated is relatively high. Moreover, pathogenic organisms are not examined in this wastewater. Pathogens comprise a rather big threat due to their contact with the treated wastewater or sludge.

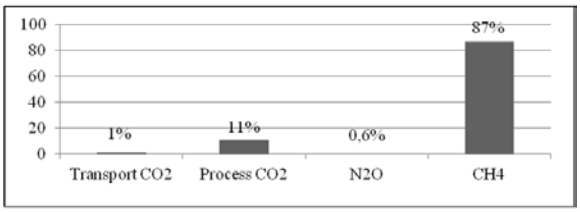


Fig. 8. Comparison of the contribution of selected greenhouse gas emissions from WWTP

3.1.3. Socio- cultural indicators

In densely urbanized areas the environmental foot print of the plant is considered a critical factor when selecting the treatment system. The low value of

0.1 m^2/m^3 obtained showed that the impact from land occupation on the plant operations was minimal. Based on the number of staff required to operate and maintain a wastewater facility with respect to the plant capacity, Jurbarkas wastewater treatment plant has an average staff of 30. 97% of the workers are from Jurbarkas district, 3% come from the surrounding community. During the research period one out of 56 persons within the catchment area has visited the plant, it corresponds to 1% of the total catchment population.

3.1.4. Economic indicators

Treatment technology, efficiency and an employee payment system usually condition expenditure on wastewater treatment. Our analysis has shown that the expenses of the plant for a treated cubic meter of wastewater were twice higher than the cost paid by consumers. The application of other economic indicators has revealed that energy required for wastewater pumping makes about 12% of the total unit cost. This is equal to 0.12 € for a cubic meter of treated water in wastewater treatment plant per day. Chemicals consumption has been 2% of the total energy used and this equals to 0.01 € per cubic meter of treated wastewater in the wastewater treatment plant per day.

All costs, including maintenance and operational costs, pumping energy costs and the cost of chemicals needed to clean the wastewater make about 2.66 €/m^3 per day. The cost to consumers per one cubic meter of wastewater treated comprises 1.19 €. Depreciation, repairs, material costs and wastewater treatment costs account to 87%. Labor costs comprise 7.6%. Economic sustainability assessment results of Jurbarkas WWTP are shown in Table 4.

3.2. Overall sustainability evaluation

The categorisation system for sustainability evaluation based on the normalisation range from 0 to 100 "Very good" (0-25) - the indicator is sustainable (Muga and Mihelcic, 2008):

- "Good" (26-50) - the indicator is sustainable but can be improved;
- "Acceptable" (51-75) - unsustainable and needs to be improved;
- "Undesirable" (76-100) - unsustainable and needs immediate intervention.

Table 4. Results of economic sustainability of Jurbarkas WWTP

Economic inventory parameters	***Costs, €/m^3/d***
Operational and maintenance cost	2.54
Energy cost	0.12
Chemical cost	0.01
Total cost	**2.66**
User cost	*1.19 €/m^3*

To have the results clearer and more explicit they have been systematized and presented in a spider-web type graph. In this way functional, environmental, economic and socio-cultural indicators of all four dimensions will be plotted on a single space. The target plot displays the four dimensions of indicator categories used to assess sustainability of the WWTP and the impact scale in the four dimensions (Fig. 9). The lower the impact value the closer to the center they are, i.e. the smaller the area limited by a graph the more positive result is obtained, thus 0 is the most acceptable grade.

With reference to the normalized data, the target plot has revealed that the plant is characterized by a varying degree of sustainability and adaptation capacity, thus the improvement needs to be made in all four selected indicator categories (Fig. 10).

Sustainability development indicators (SDI) are frequently used in reports when evaluating either sustained efficiency of WWTP or its work conformity to certain requirements, but they are not used in planning or decision making when preventive measures are taken in the equipment designing stage which is of great importance and stimulation in seeking sustainable WWTP development.

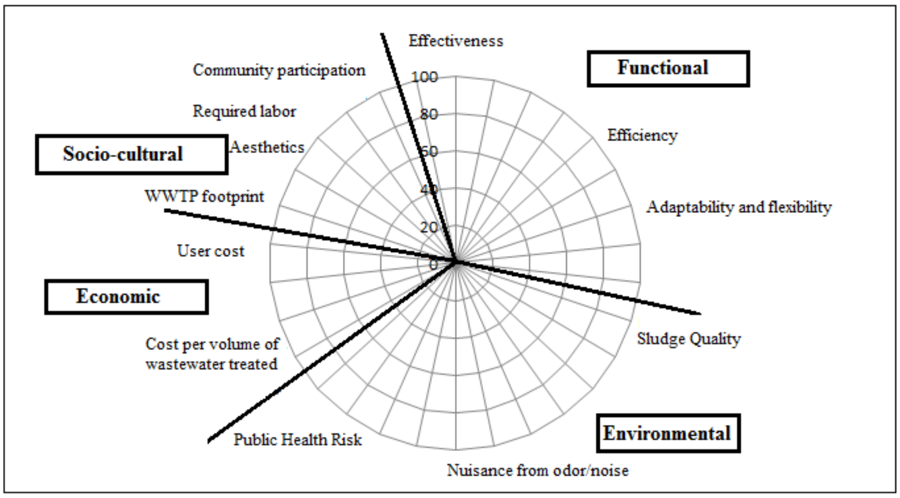


Fig. 9. Target plot showing the four dimensions

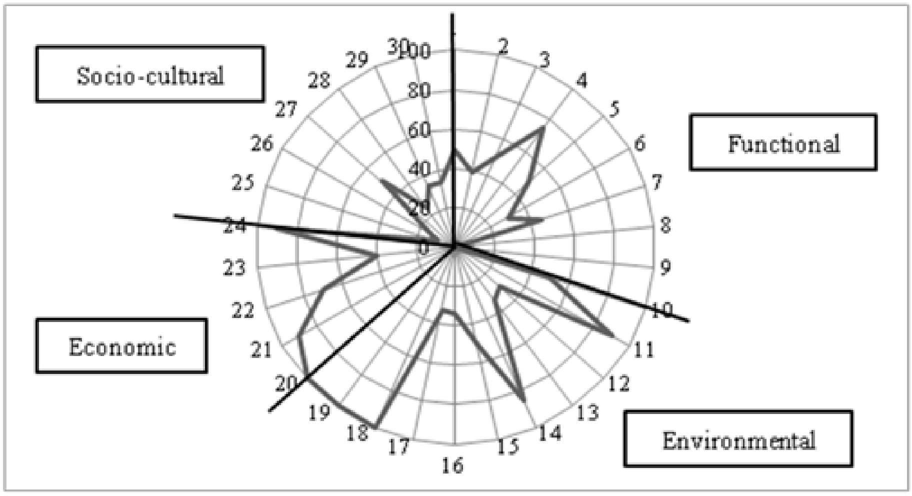


Fig. 10. Data generalization of Jurbarkas wastewater treatment plant

4. Conclusions

Research has shown that Jurbarkas wastewater treatment plants may be described to possess more sustainable than unsustainable features. According to the established categorization of sustainability evaluation 9 indicators, where values were equal or higher than 50, covered Jurbarkas WWTP unsustainability:

• Total chemical use per day per volume of treated wastewater indicator exposed relatively high value of chemical consumption (1,200 t/y), which was the result of phosphorus removal efficiency in the plant.

• Discharge of selected heavy metals to soil (Cu and Pb) was unacceptable for application to land. Comparison of selected heavy metals concentration in the wastewater sludge and fertilizers revealed that Cu and Pb quantities in sludge are higher 0.01 and 0.002 respectively.

• Both odors, noise, traffic and pathogens removal indicators showed the highest values of unsustainability. People living in neighborhood were not satisfied with odor from WWTP as well as concerning noise problems caused by heavy duty machinery. Regarding pathogens in effluent the worst-case scenario was adjusted, due to the actual determination absence.

• Operational and maintenance costs per volume of wastewater treated were approximately 2.23 higher than the cost to consumers per one cubic meter of wastewater treated, therefore depreciation, repairs, material costs and wastewater treatment costs accounted to 87%. Thus energy costs per volume of wastewater treated and total costs per volume of wastewater treated indicators were not satisfied with sustainability evaluation, meeting 70 and 90 grades respectively. Therefore economical sustainability evaluation revealed unsustainability of the WWTP case.

• According to social sustainability evaluation only aesthetics - measured level of nuisance from odor was higher and not fulfilled the criteria for sustainability. Determined aesthetic level was 50 in accordance with normalization range.

Improvement options include odor and optimization of operating costs, removal of heavy metals by using the waste of chemically modified plants, bio electrochemical water and sludge decontamination, the use of probiotics for inactivating pathogenic organisms.

Up to now in Lithuania no WWTP studies in the sustainability context have been done. Therefore, this research into „Jurbarko Vandenys“ Ltd. waste water treatment processes done at the national level and the results obtained might be a significant reason for using the SDI assessment method for evaluating the operating WWTP in the sustainability context and for developing and adjusting newly built plants, in this way avoid unsustainable WWTP work in future when decisions are made at the planning stage. In addition, possibility of estimating the coherence of WWTPs demonstrate that SDI might be widely adapted for any capacity of WWTP independently, thus strongly contributes achieving long-term sustainable development goals.

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