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THE FINANCIAL COST OF TREATMENT OF POLLUTED WATERS IN THE IN THE MUNICIPALITY OF PRIZREN

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ABSTRACT

The purpose of this study is the identification of financial cost of wastewater treatment technology/plant prior to discharge into river Lumbardh of Prizren municipality

The identification of actual condition of the sewerage (Canal network) of the municipality of Prizren, calculation of the quantity and the quality of the waters of the (sewerage) before discharging it in the river Lumbardh, is the essence of this study. So that later it can be possible to plan the different locations for putting the equipment and the technology for treating the polluted waters in this municipality.1

The definition of the polluted waters, their quality, the level of the access of citizens in percentage in the canalization (sewerage) network are some of the essential parameters for projecting the quantity of equipment and proposing the adequate techniques and technology for treating the polluted waters.

To come to the definition of these determining parameters for analysis three points are chosen for taking the samples in the municipality of Prizren; Zone 1: The zone of the southern basin (pond) in the new pipe installed DN 1000 / DN 1200 the main collector along the main road to Landovica, Zone 2: The Old municipality in the left bank of the river and Zone 3: The centre of the city in the main canal on the right bank of the river Lumbardh. The costs for Option 2 and Option 3 are quite similar in having the same capacity and treatment processes.

Investments costs for Option 1 are 3,5 Mio. EUR (10 % higher than for Option 2 & 3). Operational costs are also higher (+ 4 %) for Option 1. Option 1 may be considered and recommended as the most economical choice. The results taken from these points are compared with European standards of parameters which are determining for the level of pollution of polluted waters before discharging them in rivers.

Keywords: financial cost polluted waters, the treating of polluted waters, the equipment for cleaning

INTRODCUTION

In this transitional period of general developments, treating the wastewater in Kosova in compliance with European Union's sanitary requirements and provisions as well as in accordance with Kosovo Water Law will be one of the most serious standards to be met, which is a condition for regional and wider integrations.

Based on population growth during the last decades the settlement of Prizren has developed rapidly.

Urban development is delimited in South-east with a rough mountainous relief. A new overall urban plan has recently been approved which foresees future town development towards North and West.

Due to existing settlement and future town development there are two general options to determine wastewater treatment equipment in Prizren. Most of the existing settlement belongs to the Lumbardhi river basin. Based on the relief the drainage system can be connected to the Lumbardhi River [2].

The northern part of Prizren residential area is located on a plain with low slope towards north-west. The northern part of Prizren and its possible future development may be connected to the „Prroni i Tupecit“ stream to the north of Atmaxha village and south of Tupec village. Both rivers are tributaries to Drini i Bardhe which is impeded by dams in Albania thus creating artificial lakes [3].

By general financial costs the following is implied; repair costs for the existing sewerage network, construction costs for accumulating stations, costs of equipment for wastewater treatment, cost of operation and maintenance, etc. These are essential financial parameters for the design of equipment size and for the proposal of adequate wastewater treatment methods and technologies. These financial calculations are based on the feasibility study for the sewerage network and options for construction of a wastewater treatment plant in the municipality of Prizren.

The need for a proper approach to this issue by the government institutions is undoubtedly of great necessity. Our determination to start with the research for the quality of discharging waters from the system of canalizations (sewerage) with particular emphasis in the Municipality of Prizren will be only the start to the contribute very much needed in this field

1.1. Objectives of the study

Through the evaluation of parameters that follow is is aimed to estimate costs, quantity, and pollution level of waste waters in Prizren municipality, which is a precondition for defining of locations and selection of methods and technologies for polluted water treatment in Prizren. Evaluation of important parameters for reaching the goals of the study is:

• Defining the necessary rehabilitation works of the existing sewerage network which will serve as basic parameters for the design of equipment for of new sewerage and polluted water treatment equipment in Prizren municipality with its surroundings.

• Repair costs for the existing sewerage network, construction costs for the accumulating stations, cost of wastewater treatment equipment.

• The assessment of general physical – chemical characteristics of polluted waters in relation with the effect in the environment and the proposal for equipment’s and techniques of treating conform the flow and the level of pollution of polluted waters before discharging in the river.

• The calculation (assessment) of the level of pollution for citizens, and comparison of results with the level of pollution for a citizen with the standards of Southern European countries.

• Analytic measurement results will be used to study the defining of necessary rehabilitation work of the existing canalization (sewerage) will serve as basic parameters for projecting the equipment for new canalization (sewerage) and the equipment for cleaning the polluted waters in the Municipality of Prizren and the area around

2. THE METHODOLOGY OF WORK

In order to achieve the goal of the study calculations have been made for;

Overall financial cost relevant for a new sewerage, the units for the design of treatment equipment as well as estimates of environmental impact of wastewater treatment facilities in Prizren municipality [5]. In addition, cost for the construction of piping and pumping stations of wastewater treatment facilities.

Cost of design for the wastewater treatment equipment in Prizren such as; cost of preliminary treatment, cost of primary mechanical treatment and necessary processes, cost of secondary treatment which means cost of biological treatment, etc.

Sum of necessary costs for sludge treatment at the wastewater treatment plant in the municipality [6]. In each zone the implementation of the control of the campaign of measurements in the canalization (sewerage) network in order to identify the main entrance of the external waters.

The calculation (assessment) of the level of access according to the flow of water measured and the level of pollution.

The comparison of the discharging level of pollution in municipalities for a citizen with the values of southern European countries as a base for the quantity and projecting of the equipment for treating the polluted waters [8].

2.1. Zones chosen for analysis; Pilot zones

For analysis three points are chosen to take the samples in the city of Prizren [7].

Zone 1: The zone of southern basin (pond) in the new pipe installed DN 1000 / DN 1200 the main collector along the main road to Landovica,

Zone 2: The Old City on the left bank of the river and

Zone 3: The centre of the city in the main canalization (sewerage) on the right bank of the river Lumbardh. Proposal of locations for the treatment of wastewater WWTP-s

Lumbardhi basin has a total area of 279.1 km². The flow depends on the rain precipitations with the average annual precipitation in Prizren being 747 mm/a on relatively regular monthly distribution [9]. Floods occur mainly in autumn and spring.

River flow is very fast due to its mean slope of 4,25%. As a result of extensive erosion, the river has pulling force especially during downpours. In the past the riverbed has changed due to sedimentary processes [1].

Part of the upper catchment area of Lumbardhi up to the Bridge in Prizren has a total area of 158 km². At the Bridge the lumbardhi river has an average water flow of 4.64 m³/s. Highest water flows occur in the month of May (9.46 m³/s), and the lowest flows occur in August (2.47 m³/s) and September (2.42 m³/s). The average water flow of the river at the Bridge reaches 165 (m³/s).

Location for Option 1- South & 2 - the location is used as arable land with good soil condition for intensive food production. Its value as a habitat for flora and fauna is low due to heavy and frequent exploitation (table 2). This location is included within the forecasted areas for town expansion in General Urban Plan. Future town development is foreseen to be carried out in the western area.

Location for option 3 - the location for option 3 is near village Vlashnje, 3 kilometres south of location for options 1-S & 2.

The basin area of Lumbardhis is considerably larger, with an augmented water flow coming from the tributaries on the left side, mainly from the river Poslisht.

Poslisht river has a minimal contribution of 212 (l/s) and a maximum of more than 2,700 (l/s).

Location for option 1-North–Tupec stream-for the north part of Prizren and for the option with to WWTP-s, a location near the village Tupec has been selected. This site is located in a small valley with a small stream (Prroni i Tupecit). Catchment area of the stream is very small with a very low flow. It is estimated that it has a flow capacity of 40 – 50 l/s. During the dry periods in the summer it can be observed that there is no flow. Stream of Tupec can be characterized as a periodical water line with a very low capacity for dilution and self-purification.

Figure 1. Location of the option for WWTP 1North

The area of Option 1 is located in a wide valley west of Tupec (figure 1). Most of the soil is influenced by the underground water and is mainly used for agricultural purposes and as meadows and willows.

The site is below the residential areas at a distance of more than 300 meters.

2.2. Costs of operation and maintenance of the equipment

In principle, operation and maintenance costs for wastewater treatment facilities are formed based on the cost of personal income (salaries), energy costs, and costs of material expenditures (maintenance) and costs of chemical additives (table 3, 4). These prices were used as basis for costs calculation [4].

Operation and Maintenance cost estimation is based on the following assumptions: Staff requirement are based on German standards ATV (German Technical Association for Sewerage. On the other hand the thermal power station option requires additional costs (table 1).

Table 1 Total estimated costs of investments for Options of WWTP-s

	Option 1: Two WWTP-s		**Optioni 2**	**Option 3**
	WWTP 1 North	WWTP 1 South	WWTP 2	WWTP 3
Wastewater treatment equipment	11,300,000	27,000,000	33,973,000	33,973,000
Site development	58,000	18,000	18,000	-
Total cost	11,358,000	27,018,00	33,991,000	33,973,000
Total	**38,376,000**		**33,991,000**	**33,973,000**

Table 2 Basis of percentage for costs calculation during operation

Expense unit	Unit	Cost [Euro]
Engineer	€/year	7,000
Technician / skilled worker	€/year	5,000
Unskilled worker	€/year	4,000
Electrical Energy	kw/hour	0.09
Drinking water	m^3	0.20
Transport cost (average distance of 10 km)	Ton	2.00
Disposal at a sanitary dump	Ton	12.00
Drying of sludge overflow per ton	Euro/ton	155
Sludge transport away from plant for reuse in agriculture	Euro/ton	45
Kostot administrative		5 % of operation cost

Table 3 Estimated Costs for Operation and Maintenance of WWTP options

	Option 1: Two WWTP-s		Options 2 & 3
	WWTP 1 North	WWTP 1 South	WWTP 2 & 3
Personnel costs	30,000	90,000	100,000
Energy cost	223,020	225,000	284,706
Maintenance costs	107,800	278,000	364,500
Treatment, removal of residue and resuse	441,481	1,261,488	1,703,009
Administrative costs	44,666	112,736	149,508
Costs of chemical additives	59,500	170,000	229,500
Other costs	31,522	230,225	308,452
Total costs	937,989	2,367,449	3,139,675
Comparison	3,305,438		3,139,675

Table 4- Cost for Operation and Maintenance of main collectors

	Description	**Costs of O & M**
Option 1	**Costs of O & M for the main collector at WWTP 1 V (0,9% of cost investments)**	1,740
	Total cost for O & M for option 1	1,740
Option 2	Energy costs	14,100
	Operation and Maintenance costs for the pumping station (0,9% of investments cost for construction works + 1,5% of investment costs for the electrical-mechanical equipment (EME)	13,500
	Costs of O & M for Option 2	27,600
Option 3	Energy costs	14,100
	Operation and Maintenance costs for the pumping station (0,9% of investments cost for construction works + 1,5% of investment costs for the electrical-mechanical equipment (EME)	13,500
	Costs of O & M for the main collector at the WWTP 3 (0,9% of investment costs)	3,380
	Total costs for O & M for Option 3	**30,980**

2.3. The analysis of polluted waters of canalizations

Since there is lack of capacities needed, local laboratories and particularly analysis of waters of canalizations (sewerage), we have contacted the Laboratory of environmental analysis in Radstatt in Germany, a certified laboratory. The samples were taken from 18 October, 20:00 to 20 October 21:00. Physical-Chemical parameters were analyzed in each 24 hour sample of polluted water (6 samples): The chemical spending of Oxygen (CSO), The Biochemical spending of Oxygen (BOD), Suspended particles (GS), N-Kjeldahl (TKN) = Norg + NH4+, Ammonium Ion (NH4+), total phosphorus (P-tot) and the value pH.

Moreover, in each sample that corresponded to the minimal flaw of the night also these parameters have been analyzed: The chemical spending of Oxygen (CSO) and Ammonium Ion (NH4+). The measuring of the minimal flow during the night has been done in order to calculate (assess) the level of softening (reducing) of external waters. The results of the analysis of polluted waters are shown in the following table 5.

Table 5. Polluting parameters of dates 18-19.10.2006 from the Laboratory of Radstatt in Germany

	Symbols	Unit	Point 1		Point 2		Point 3	
Parameters			***18-19. October***		***19-20. October***		***18-19 October***	
Mixed samples in 24 hours								
Chemical consuming (spending) of Oxygen	COD	mg O2/l	183	210	112	94.5	103.6	106
Biochemical consuming (spending) of Oxygen	BOD	mg O2/l	32.6	35.6	32.3	47.8	29.54	34.6
Suspended particles	GS	mg /l	242.8	320.6	245.8	258	282.32	311.1
Precipitaed particles	GF	mg /l	84.5	81.45	65.5	99.6	105	102
Total Nitrogen	Ntot	mg N/l	7.85	20.34	11.2	13.2	9.82	11.5
Ammonium Ion	NH4*	mg N/l	9.97	10.4	9.99	8.6	5.99	5.59
Total phosphor	P-tot	mg P/l	2.27	2.07	2.48	1.76	1.98	2.54
pH			7.76	8.06	6.97	7.65	7.73	6.87
Specific conductivity		µS/cm	432.32	448	532.2	487.32	457.76	505.34
The samples of minimal flow during the night								
Biochemical consuming (spending) of Oxygen	BOD	mg O2/l	39.4	45.4	41.4	37.7	34.6	42.2
Ammonium Ion	NH4*	mg N2/l	8.65	9.05	9.5	4.76	6.9	3.48
Report BOD/COD			0.18	0.17	0.29	0.5	0.32	0.27
Report COD/ BOD			5.61	5.87	3.4	1.99	3.16	2.93

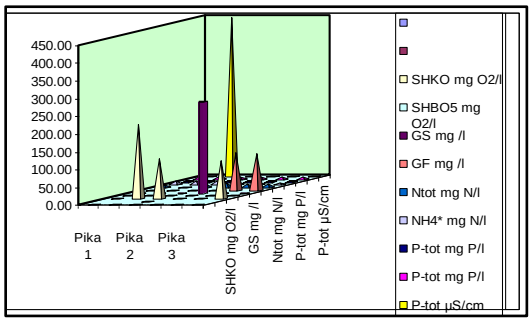

Figure 2 Graphical presentation of polluting parameters of different points

2.4. Discussion of financial costs and the results of wastewater analyses:

• Option 2 and Option 3 have the same capacity for treatment; therefore their costs are very similar.

• The only difference is the extra costs of the main collector in WWTP 3:

• Investment costs for Option 1 are 3,5 Mio. EUR (10 % higher than for Options 2 & 3).

• Costs of operation are also 4 % higher for Option 1. As a result, Option 1 cannot be considered as an economical choice and cannot be recommended [4].

Comparing with the usual values of the concentration of defining parameters for the waters of urban canalizations (sewerage), the values achieved of the results taken during the measuring are obviously lower, as a result of reducing (softening) through external water:

• The report of BOD /COD is extremely low (0.17 to 0.50), if it is compared with the "normal" values of the report BOD /COD for urban waters which move around the value 0.6.

• As for COD, the analyzed samples of the minimum during the night are less concentrated than the mixed 24 hour samples, which clearly show the connection of the external water with the canalization (sewerage) network. Among the 24 hour samples there is no significant change in the results of defining parameters of the pollution level.

• The results of analysis between German and Kosovar laboratories are quite similar.

3. CONCLUSIONS

Based on the calculation of financial costs and results obtained from the analyses these conclusions can be drawn (1,2): the proposed Option I for wastewater

treatment with two pieces of equipment for treatment is the most expensive in investment and operation. Location proposed for WWTP-s I-North, near village Tupec, has the highest impact on the environment therefore is cannot be recommended.

Option II and Option III of WWTP-s are very similar regarding costs in investment and operation. Considering the environmental impact of the second option then it must have the second priority, mainly because of its WWTP site within the forecasted are for urban development and expansion of Prizren.

Option III, is located 3 km downstream the town of Prizren and offers a perspective for long-term development of the city and the wastewater treatment plant. Consequently, Option 3 is proposed for the construction of Plant with proper wastewater treatment equipment. In comparing to usual values of European Community upon the concentration of determining parameters in the level of pollution of the waters in urban canalizations (sewerage), the concentration of polluted waters in the canalization (sewerage) of the city of Prizren is very low, as a result of gathering of all the waters in the same pipe of canalization (sewerage), therefore external waters.

According to the results taken, the report of BOD/COD; varies the values from 0.17 to 0.50. These reports of BOD/COD are very low for urban waters comparing to normal values of the report of BOD/COD which is (0.6) in the developing European Community.

The analysis has been made in the laboratory of the Hydrometeorology Institute of Kosovo and the laboratory for medical analysis from the city of Radstatt in Germany. The report BOD/COD; (0.17 to 0.50) of our measurements is extremely low for urban waters if compared with "normal" value from (0.6). This is probably because of the conserving conditions and the delay between the sampling and the analysing.

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