

## QUALITY OF TREATED WATER IN CĂLĂRAȘI MUNICIPALITY

Cecilia NEAGU

University of Agricultural Sciences and Veterinary Medicine Bucharest, Faculty of Management, Economic Engineering in Agriculture and Rural Development, Calarasi Branch, 1 Nicolae Titulescu Street, Călărași City, Romania, Phone/Fax: +40242332077, E-mail: cecilianeagu2005@yahoo.com

**Corresponding author:** cecilianeagu2005@yahoo.com

### Abstract

*The wastewater, insufficiently treated, affect negatively the quality of emissary reached. Poorly treated urban wastewater discharge to surface water has serious consequences for the natural phenomenon of self-cleaning the waters of the Danube and Borcea branch is currently at the limit of the natural opportunities to restore natural biogeochemical balance. In the present study it was discussed about the wastewater with major contribution in pollutants that reach the terminal basin of the Danube, derived from the Wastewater Treatment Plant in Calarasi municipality. The quality indicators of wastewater monitored in the study were: chemical oxygen consume, biochemical oxygen consume, total nitrogen, total phosphorus. The best results were seen in the treatment in case of biochemical oxygen consume (over 96%). Among the main problems recorded in the Wastewater Treatment Plant, it is remarked lower efficiency in removing phosphorus and total nitrogen in the cold season, due to malfunctioning of biological stage, meaning a weak process of eutrophication in the emissary, Borcea Branch.*

**Key words:** emissary, quality indicator, wastewater treatment, treated water, treatment plant.

### INTRODUCTION

The effective management of wastewater is essential for recycling the nutrients, in order to maintain healthy ecosystems and to improve the environment through proper disposal of drainage and wastewater to preserve water quality [10]. The general objective of water management is to ensure a high standard of living, in terms of water for all citizens. This means improving water resources by increasing the quality of water resources, ecological rehabilitation of rivers, etc. [4]

Despite significant investments were made in the sewerage network and modernization of the Wastewater Treatment Plant Călărași, wastewater currently represents also a threat to the public health and natural ecosystems [8].

Călărași county has a varied hydrological potential, a great importance having the water surface of the Danube river and Borcea branch- considered to be a bird protection area [1]. The discharge actions of untreated or poorly treated wastewater into surface waters produce adverse effects on the natural

phenomenon of self-purification [5]. As a result, the Danube and Borcea branch water reached today, in Călărași municipality, to the limit of natural abilities to recover the biogeochemical balance, imposing such control and sewage water discharged as efficiently as possible [7].

The main weaknesses of the collection system and wastewater treatment plant in Călărași county are represented by numerous damage in the sewage system, by breaking collectors and collapse, and the population benefiting from the service of wastewater collection represents 75% of the municipality population [3].

### MATERIALS AND METHODS

In this paper, it is identified the current situation of the wastewater reaching Borcea branch and the Danube basins and the way of treating it. Călărași County Agency for Environment Protection makes analyses for the wastewater reaching the emissary.

Since 2012, following the implementation of the European project “Extension and rehabilitation of water supply and sewerage

systems in Călărași County”, co-financed by the Cohesion Fund under the Sectoral Operational Programme “Environment”, Călărași municipality has a performing wastewater treatment plant complying with the European Union standards [2].

Călărași Wastewater Treatment Plant is designed to operate with a maximum water flow daily from 21,800 m<sup>3</sup>, respectively 7,957,000 m<sup>3</sup>/year [3].

The balance of the quantities of wastewater influential daily in Călărași Wastewater Treatment Plant in 2015 was as follows: population - 5,965 m<sup>3</sup>/day, public - 1,010 m<sup>3</sup>/day, economic agents - 2,087 m<sup>3</sup>/day, losses - 4,750 m<sup>3</sup>/day, infiltrations - 684 m<sup>3</sup>/day [11].

In the dry periods, an abnormal situation occurs, the lack of adequate sewerage system facilities [9].

This situation is given by the high levels in Borcea branch, that through the channels of discharge from the Pumping Plant Jirlău and Pumping Plant Siloz, enter into their suction basins so as to the treatment plant, an additional flow of 100 - 140 l/day is pumped [11].

The main indicators of interest of the quality of treated water and wastewater analyzed in this paper are: CBO<sub>5</sub> (biochemical oxygen consume in water), CCO-Cr (chemical oxygen consume), N<sub>tot</sub> (total nitrogen) and P<sub>tot</sub> (total phosphorus). They were compared with the maximum permissible value under NTPA001 [6].

## RESULTS AND DISCUSSIONS

For the more accurate evaluation of the impact of wastewater discharge, at the level of Călărași municipality, there were analyzed from a chemical point of view both the influent of wastewater and the effluent resulted from Călărași Treatment Plant.

In 2015, the main indicators of wastewater and treated water quality have the values presented in Table 1 [3].

We note that in Table 1, during the entire studied period, the efficiency of Wastewater Treatment Plant as regards the bio-chemical consume and chemical consume of treated

water was over 83% treatment efficiency.

Table 1. Annual averages of the quality indicators CBO<sub>5</sub> and CCO-Cr of wastewater and treated water in Wastewater Treatment Plant Călărași, in 2015

Period	CBO <sub>5</sub> (mg/l)		CCO-Cr (mg/l)	
	Infl.	Efl.	Infl.	Efl.
01.2015	166.94	6,63	213.42	32.11
02.2015	164.62	9,82	213.10	34.65
03.2015	148.06	6,14	210.32	37.02
04.2015	129.67	6,00	177.56	36.15
05.2015	132.87	5,04	171.55	30.31
06.2015	135.23	5,53	187.87	30.73
07.2015	145.90	4,55	194.11	31.34
08.2015	124.90	4,79	176.92	31.12
09.2015	126.31	3,88	156.77	32.63
10.2015	144.65	6,11	200.31	31.69
11.2015	169.10	5,83	233.00	32.05
12.2015	140.50	5,81	191.40	30.51
<b>Annual average</b>	<b>144.06</b>	<b>5.84</b>	<b>193.86</b>	<b>32.53</b>
<b>Plan efficiency</b>	<b>95.90%</b>		<b>83.20%</b>	

Source: [3].

Table 2. Annual averages of quality indicators N<sub>tot</sub> and P<sub>tot</sub> of the wastewater and treated water in Călărași Wastewater Treatment Plant, in 2015

Period	N <sub>tot</sub> (mg/l)		P <sub>tot</sub> (mg/l)	
	Infl.	Efl.	Infl.	Efl.
01.2015	40.59	10.33	3.21	1.42
02.2015	41.57	17.73	2.95	0.71
03.2015	41.38	10.13	3.66	1.22
04.2015	40.35	10.45	3.85	1.44
05.2015	40.60	8.28	3.91	1.37
06.2015	37.28	10.04	4.09	2.21
07.2015	39.28	9.83	4.83	1.88
08.2015	35.25	9.00	4.49	2.40
09.2015	34.74	7.40	4.09	1.42
10.2015	39.16	7.66	3.42	0.53
11.2015	38.49	7.11	3.29	0.55
12.2015	39.31	10.06	3.84	1.33
<b>Annual average</b>	<b>39.00</b>	<b>9.83</b>	<b>3.80</b>	<b>1.37</b>
<b>Plant efficiency</b>	<b>74.80%</b>		<b>63.90%</b>	

Source: [3].

Analyzing the values in Table 2, we can deduce that the loading of nutrients (nitrogen and phosphorus) of the wastewater discharged in Borcea branch is quite low due to the treatment efficiency (of 74.8% for N<sub>tot</sub> and respectively 63.9% for P<sub>tot</sub>)

The variation of biochemical oxygen consumption (CBO<sub>5</sub>) of water discharged into the environment in 2015, in Calarasi Treatment Plant is presented by month in Fig.1. [11].

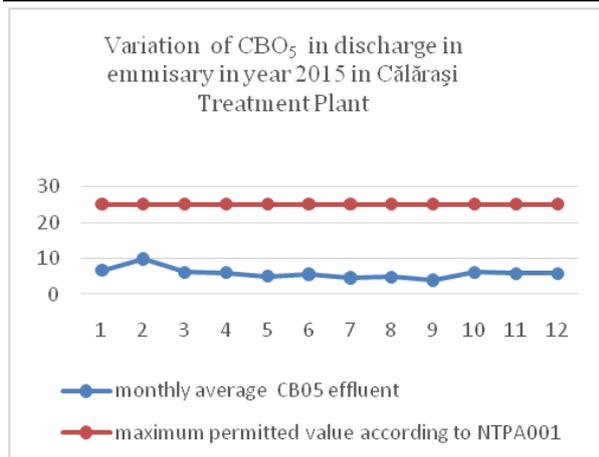


Fig. 1. Variation of CBO<sub>5</sub> in discharge into emissary in 2015, in Călărași Treatment Plant  
 Source: [11].

According to Fig. 1, it is found out that the highest biochemical consume of oxygen of water discharged into the environment was recorded in February 2015, when it exceeded the value of 9 mg/l. The biochemical oxygen consume variation from month to month was largely due to weather conditions or registered influent flow. However, during the entire period that was studied, we note that the values of biochemical oxygen consume of treated water were much lower than the maximum permitted NTPA001 namely 25 mg/l.

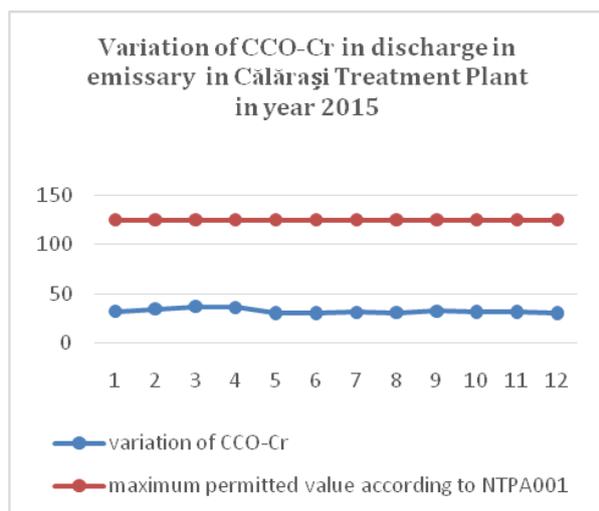


Fig. 2. Variation of CCO-Cr in discharge into emissary in 2015 in Călărași Treatment Plant  
 Source: [11].

The monthly variation of the chemical oxygen consume (CCO-Cr) of water discharged into the environment in 2015 is presented in Fig.2.

[11].

As regards the variation of chemical consume of oxygen existing when entering the emissary [11], we note that in 2015 its value varied, the highest value of over 37 mg/l being recorded in March 2015. However, it was not exceeded the limit imposed by NTPA001, of 125 mg/l.

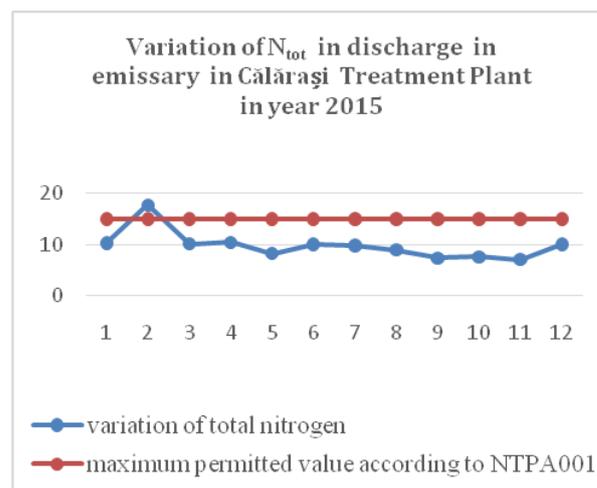


Fig. 3. Variation of N<sub>tot</sub> in discharge into emissary in 2015, in Călărași Treatment Plant  
 Source: [11].

From Figure 3, it is found out that during the studied period, the values of total nitrogen discharged into the environment [11] exceeded in February 2015 the maximum permitted value according to NTPA001 (15 mg/l) by 2.66%, and respectively by 18.2%. This was due to the low temperature of wastewater from entering the wastewater treatment plant in winter (minimum temperature of 4<sup>0</sup>C, the average temperature of 7<sup>0</sup>C) resulting in a difficult operating of the biological stage, low speed of the biological processes, lowering the rate of biodegradation of organic compounds and thus increasing the concentration of nitrogen and of compounds in the effluent. In 2015, total phosphorus concentration recorded the following variation:

As regards the concentration of total phosphorus discharged into emissary [11], we note that, in June and August 2015, it exceeded the maximum permitted values according to NTPA001 (2 mg/l), by 10.5%, and respectively by 20%.

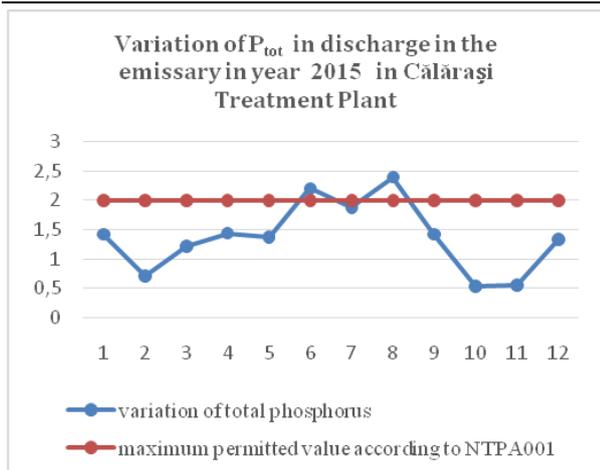


Fig. 4. Variation of P<sub>tot</sub> in discharge in emissary in 2015, in Călărași Treatment Plant

Source: [11]

## CONCLUSIONS

In order to evaluate the accuracy of the impact of wastewater discharge, at the level of Călărași county, there were analyzed from chemical point of view, both wastewater influent and effluent resulted from Călărași Treatment Plant.

Based on the analyzes made, there were drawn the conclusions presented below.

The actual load of the treatment plant is lower than the projected as follows: CBO<sub>5</sub> 61%; CCO-Cr by 60%; Total nitrogen (N<sub>tot</sub>) by 20%; Total phosphorus (P<sub>tot</sub>) by 50%.

By making the difference of the values from influential and effective effluent, we estimated the efficiency of Călărași Wastewater Treatment Plant during 2015 to 79,45%.

In 2015, the highest possible degree of purification was found in the case of biochemical oxygen consume (over 96%), obtaining good rate in the case of chemical consume of oxygen.

The low temperature of wastewater from entering the wastewater treatment plant in the winter season (minimum temperature of 4<sup>0</sup>C, the average temperature of 7<sup>0</sup>C) lead to an a difficult use of the biological stage, low speed of the biological processes, lowering the rate of biodegradation of organic compounds, increasing the concentration of nitrogen and of compounds in the effluent.

So, the main problem identified in this study, within the wastewater treatment plant is lower

efficiency in removing the phosphorus and total nitrogen in the cold season due to the malfunctioning of the biological stage, this bringing nutrients in the emissary and causing a process of eutrophication in much lower percentage compared to the previous period (the amounts reached the emissary are not high).

In order to solve the problems identified in Călărași Wastewater Treatment Plant, we propose to ensure the optimal conditions for the use during the cold periods by increasing the water temperature by providing the necessary energy from unconventional sources and facilitating some water heating installations using unconventional energy sources: heat pumps, solar energy.

## REFERENCES

- [1] Buzău-Ialomița Basin Administration (database).
- [2] Călărași County Agency for Environment Protection – Annual report on environment factors situation in Călărași in 2014.
- [3] Călărași County Agency for Environment protection – Annual report on environment factors situation in Călărași in 2015.
- [4] Code of agricultural best practices, Vol. I, 2003, Bucharest, pp.45.
- [5] Dima Mihai, 2005, Urban wastewater treatment, Tehnopress Publishing, p.65.
- [6] Directive 91/271/CEE on urban wastewater treatment.
- [7] Neagu Cecilia Violeta, Mușat Rodica Elena, 2003, Nitrate pollution of the Danube Basin, The National symposium with international participation, USAMV Bucharest, Cartea Universitară Publishing, 284-289.
- [8] Neagu Cecilia Violeta, Constantin Dumitra, 2012, Wastewater treatment in city Călărași, Scientific Papers: „Management, Economic Engineering in Agriculture and Rural Development, Volume 12, Issue 1:161-164.
- [9] Neagu Cecilia Violeta, 2013, Sources of eutrophication of the waters in Calarasi county, Scientific Papers Series “Management, Economic Engineering In Agriculture And Rural Development”, Vol. 13, Issue 1, 257-262.
- [10] Neagu Cecilia Violeta, 2014, Degree of Water Eutrophication in the Terminal Basin of the Danube. Case Study, The 13<sup>th</sup> International Symposium Prospects for the 3<sup>RD</sup> Millennium Agriculture, Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca – Agriculture 71 (2), 274-281.
- [11] Treatment Plant, Calarasi, (Database).