Journal of Young Scientist, Volume III, 2015
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

WATER QUALITY MONITORING FROM THE LAKES ON COLENTINA RIVER

Claudiu Ovidiu BARBULESCU, Vlad Gabriel CODESCU

Scientific Coordinators: Prof. PhD Ana VIRSTA, Assist. Prof. PhD Mirela SANDU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: +4021.318.25.67

Corresponding authors emails: just.me_claudiu@yahoo.com, codescu_vlad@yahoo.com

Abstract

The aim of this study was to identify a number of physic-chemical parameters of water samples from the chain of Colentina River, to determine the degree of pollution of the lakes. Samples were taken directly from lakes Grivita, Baneasa, Herastrau, Floreasca, upstream and downstream, as required by law, kept at temperatures of 3-50C and analyzed in the same day. The chemical analyses were conducted in the Laboratory of Faculty of Land Reclamation and Environmental Engineering, University of Agronomic Sciences and Veterinary Medicine of Bucharest. Characterization of natural waters was based on the following analysis: pH, conductivity, turbidity, chloride, dissolved oxygen (DO), biochemical oxygen demand (BOD), ammonium, nitrites.

Key words: Colentina River, water quality, surface water

INTRODUCTION

It is well known that the majority of settlements, either villages or cities, were established in the vicinity of water streams, a characteristic which is generally valid along the history of humankind.
The Colentina River has its origins in the Sotanga-Doicesti area, near Targoviste and it flows through the Dambovita and Ilfov counties, "cutting" Bucharest from north-west to east. It finds its end, near Cernica, where meets the Dambovita River.
The river's stream measures 101 Km, with almost a third (37.4 Km) of its length passing through Bucharest.
In the last 60 years, important hydro-technical projects were implemented along the river's stream, projects that transformed the little mosquito infected river with poor neighborhoods along his sides (Figures 1,2,3) into a chain of lakes with multiple and popular recreations areas. (Giurescu, 1979).

Figure 1. Floreasca's pit before development (Caranfil,1963)

Figure 2. Herastrau Lake, 1935 (Caranfil,1963)

Figure 3. The effects of Colentina's drainage on Bucharest and the surrounding areas (Caranfil,1963)

Colentina's water was used in Bucharest for fish breeding, agriculture irrigations and recreational events (Figure 4), (Giurescu, 1979; Caranfil, 1936)

Figure 4. Herastrau Lake, in present

From upstream to downstream, Bucharest is the home of the following lakes : Straulesti, Grivita, Baneasa, Herastrau, Floreasca, Tei, Plumbuita, Fundeni, Dobroesti, Pantelimon and all of them together totalize in a water surface of 1295 hectares.

In the paper we will focus upon 4 lakes, Grivita, Baneasa, Herastrau and Floreasca provinding results and conclusions for different standard tests.

Based on the water analysis documents, carried on by the National Administration of Romanian Waters (N.A.R.A) together with the Administration of Lakes, Parks and Recreation Bucharest (A.L.P.R.B), it was concluded that all the lakes along the Colentina River's stream aren't affected by any serious contamination issues.

As the official results state, the pH and ammonium levels, taken during 2007-2010 in the Grivita Lake were within the accepted limits, as well as the nitrates and nitrites. The only exception was registered in November 2007, when for the nitrates and nitrites, a spike value of 0.42 mg/l was reported (A.L.P.R.B.). In the Baneasa Lake, only the pH has slightly exceed the normal limits; others parameters remained within the accepted boundaries (A.L.P.R.B.). In the Herastrau Lake, the pH, ammonium and nitrates didn't exceed the maximum allowed limits. Isolated, the nitrites went over the norms with a 0.3 mg/l reported value (A.L.P.R.B.). The Floreasca Lake has all the parameters valid according to the standards with only a few isolated cases of an increase pH (8.5), (A.L.P.R.B.).

MATERIALS AND METHODS

For our tests, we collected water samples from the 4 lakes (Grivita, Baneasa, Herastrau and Floreasca), from upstream to downstream, in March 2015 (Figure 5).

Figure 5. Collecting water samples

All the locations from which we gathered the water samples can be found on the Figure 6.

For each lake, all the references to "left bank" and "right bank" will address the direction of Colentina's stream, which is from north-west to south-east (in general).

All the data was registered and listed in Table 1. All the samples were carried in proper conditions that preserved their initial parameters and kept in brown, sterile bottles at 5^{o}C until all the test began.

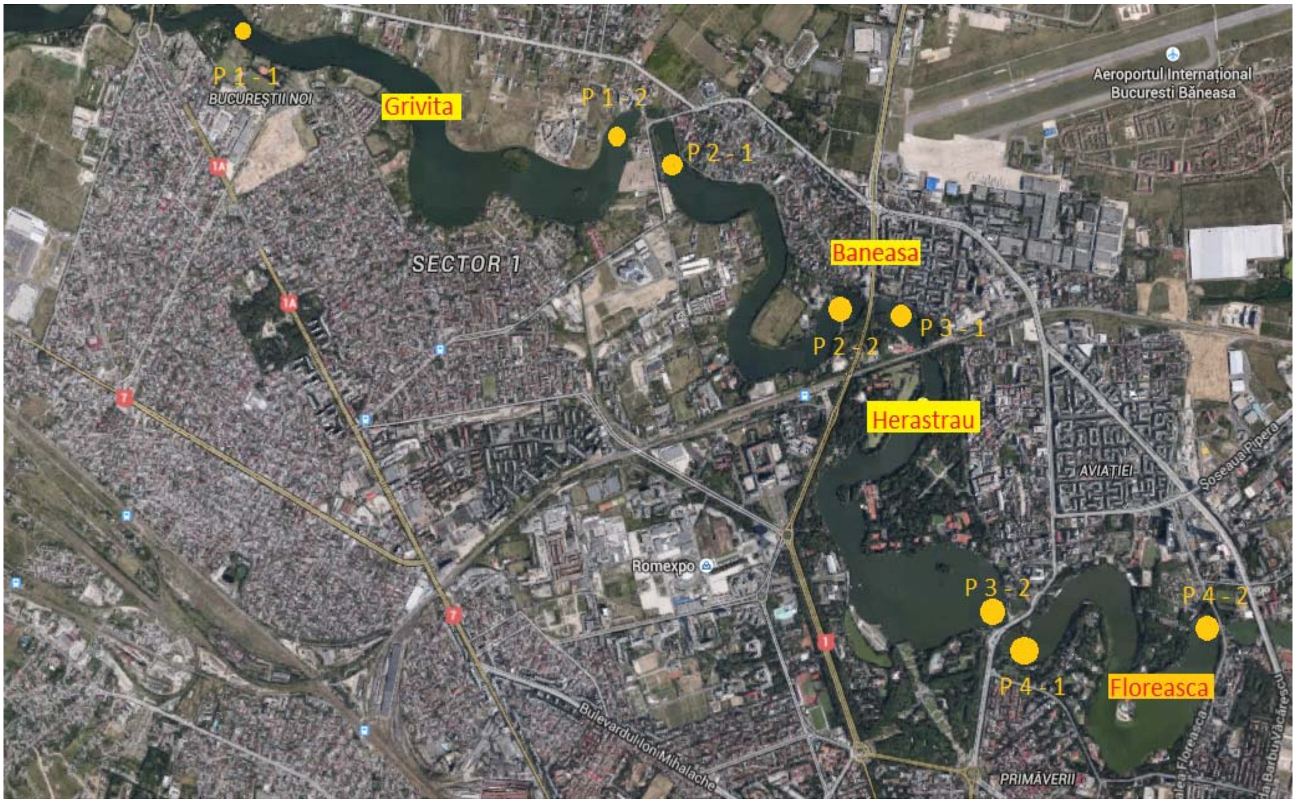

Figure 6. Distribution of collecting points along Colentina River

Table1. Details of sampling points

Lake	Coordinates	Altitude (m)	Point number	Location	Depth (m)
GRIVITA	44.50^0 N 26.02^0 E	84	1-1	Right bank	0.5
	44.49^0 N 26.06^0 E	80	1-2	Left bank	0.5
BANEASA	43.49^0 N 26.08^0 E	76	2-1	Right bank	0.5
	44.47^0 N 25.0^0 E	72	2-2	Left bank	0.5
HERASTRAU	44.47^0 N 26.07^0 E	83	3-1	Right bank	0.5
	44.47^0 N 26.08^0 N	81	3-2	Left bank	0.5
FLOREASCA	44.42^0 N 26.11^0 E	74	4-1	Right bank	0.5
	44.48^0 N 26.10^0 E	60	4-2	Left bank	0.5

All the measurements were done in the Environment Engineering Laboratory, part of the Land Reclamation and Environment Engineering Faculty - U.A.S.V.M Bucharest. The parameters aimed during our tests were: pH, conductivity, turbidity, dissolved oxygen (DO), biochemical consumption of oxygen (CBO_5), chlorine, ammonium and nitrites.

Measurement of pH, conductivity and dissolved oxygen

Using a multi-parameter device called HANNA HI 9828 equipped with a multi-sensor probe with a dedicated microprocessor we determined the pH, conductivity and the dissolved oxygen, important characteristics in assessing the water's quality.
At first, the probe is immersed in the sample, then easily moved in a circular pattern (2-3 times) until the value displayed by the device stabilizes, followed by the data recording (Figure 7).

Figure 7. Laboratory measurements of pH, conductivity and dissolved oxygen

Measurement of the turbidity

The turbidity of the samples was determined using a stationary turbidity meter HI 88713. The device has a high precision, being able to provide accurate values in Nephelometric Turbidity Units (NTU). As steps, we first filled a 10 ml container with one of the water sample and placed it afterwards in the turbidity meter; closed the cover, pressed the "READ" button and after approximately 10 seconds we can record the data written on the display's device (Figure 8).

Figure 8. Determining the turbidity with a high precision stationary turbidity meter

Measurement of the biochemical consumption of oxygen

The biochemical consumption of oxygen is determined with the help of incubation, in dark, at 20oC with the BDO5 Velp Scientifica device together with the proper accessories (Figure 9).

Figure 9. Determining the CBO of the water samples

Measurement of the chlorine

The chlorine determination was possible by using the Mohr methodology.
The technique uses the titrimetric evaluation of the chlorine content within the water and it's a direct process for finding the chlorine concentrations between 5 mg/l – 400 mg/l. The method is based on the reaction between the chlorinate ions and the silver ions which leads to the appearance of an insoluble silver chlorine (Figures 10, 11).

Figure 10. Determining the chlorine using the titrimetric evaluation

Figure 11. Determining the chlorine using the titrimetric evaluation

Measurement of ammonium and nitrites

In this case, we used the spectro-photo meter US-VIS PG T60 that can be found in the Environment Engineering Laboratory.

The spectrometric method of molecular absorption for determining the amount of nitrites in the water is standardized according to the SRISO 3048-2:1996 standard.

It's a process that uses the spectrometry in a visible spectrum together with α-naphthylamine and sulfanilic acid.

Recipients with a 10 mm optical path are used and the absorbance is measured at a 520 nm wavelength (Figure 12).

The manual spectrometric method for finding the ammonium amount in the water is standardized according to the SRISO 7150-1:2001 standard.

Figure 12. Determining the nitrites from the collected samples

It is a performance procedure which uses the spectrometry in a visible spectrum in recipients with an optical path of 40 mm and a sample of 40 ml analyzed at a 650 nm wavelength (Figure 13).

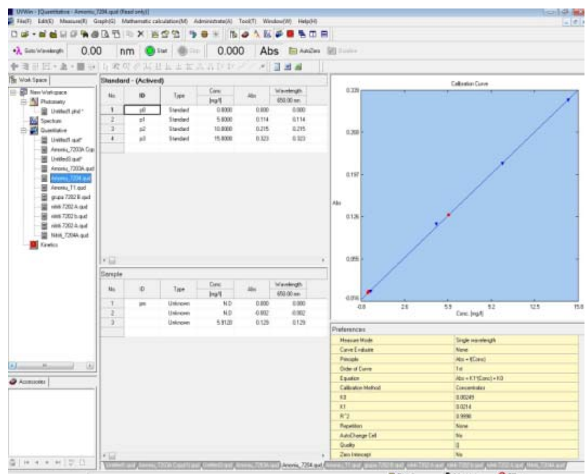

Figure 13. Determining the ammonium in the collected samples

RESULTS AND DISCUSSIONS

For an accurate review of the water quality we selected 4 lakes to analize: Grivita, Baneasa, Herastrau and Floreasca.

The relevant chemical parameters for our study and the values resulted after testing was pointed out in Table 2.

From a pH perspective, the water from Colentina River is weak alkaline, but the values are normal for surface water (Table

2). The pH values are ranging between 7.24 and 8.15.

The dissolved oxygen is the most important parameter of water quality from rivers and lakes, because oxygen has a vital importance for the aquatic ecosystems.

The oxygen level in natural water has to be at least 2 mg/l. A decreased level of oxygen leads to eutrophication in lakes.

For the oxygen quality indicator we observe the fitting of all the samples analyzed in the IIIrd class of quality according to OM 161/2006 with values between 5.21 and 5.93 with the exception of the samples collected from Grivita Lake where these values are between 4.59 and 4.73 which put it in the IVth class of quality.

The biochemical consumption of oxygen (CBO) represents the oxygen quantity in mg/l needed to oxidize the organic substances with the help of bacteria.

From lab testing we concluded that it's enough to determine the oxygen consumption after 5 days of preserving the samples (CBO5).

CBO5 values from the analyzed samples fit into the IIIrd class of quality pointing to a weak ecological state of water (Table 2).

Chlorine is found in nearly any type of natural water. The concentration can vary from few mg/l to higher concentration in residual water, in marine water and saline water. In the samples we collected from these lakes, chlorine was found in small amounts, normal for the first class of quality.

The values for ammonium ions, determined from the analysis are in range, except the sample from Baneasa Lake, with a value of 0.82 mg/l.

Ammonia occurs after water pollution by organic substances that undergo decomposition, the first step of degradation nitrogenous substances. Its presence indicates recent pollution.

From the perspective of the nitrites, the quality of water in the samples is in the limits of the first class of quality, presenting no sources of nutrients impurities. A slightly increased value is obtained in samples from Grivita Lake, with a value of 0.032 mg/l (Table 2).

Nitrites are found due to the pollution of water with organic matter, or by partial oxidation of the amino radical or by reducing nitrate.

The occurrence of nitrates in lakes is a bad sign, being observed in low concentration of oxygen. It's dangerous, especially for fishes and can cause eutrophication of lakes.

Turbidity is caused by solid particles that make the water less transparent. In our samples the turbidity had low values from 3.86 to 15 NTU.

Water conductivity is one of the most used indicators to determine the mineralization degree of the water.

In OM 161/2006 conductivity and turbidity aren't standardized.

Table 2. Physico-chemical parameters of water samples

Nr. crt.	Performed testing	M.U.	Sample name/ Determined values		M.O. 161/2006 Class of quality				
			Sample 1 (upstream)	Sample 2 (downstream)	I	II	III	IV	V
Lake GRIVITA									
1	pH	pH units	7.82	7.24	6.5 – 8.5				
2	Dissolved oxygen	mgO_2/l	4.23	4.59	9	7	5	4	<4
3	BOD	mgO_2/l	7.21	7.02	3	5	7	20	>20
4	Chlorine	mg/l	274.38	255.24	500	750	1000	1300	>1300
5	Ammonium	mg/l	0.47	0.35	0.4	0.8	1.2	3.2	>3.2
6	Nitrites	mg/l	0.019	0.032	0.01	0.03	0.06	0.3	>0.3
7	Turbidity	NTU	15.5	7.73	Are not standardized				
8	Conductivity	µS/cm	499	496	Are not standardized				
Lake BANEASA									
	pH	pH units	7.48	8.15	6.5 – 8.5				
	Dissolved oxygen	mgO_2/l	5.21	5.63	9	7	5	4	<4
	BOD	mgO_2/l	7.25	7.32	3	5	7	20	>20
	Chlorine	mg/l	273.67	770.87	500	750	1000	1300	>1300
	Ammonium	mg/l	0.26	0.82	0.4	0.8	1.2	3.2	>3.2
	Nitrites	mg/l	0.006	0.007	0.01	0.03	0.06	0.3	>0.3
	Turbidity	NTU	6.48	16.9	Are not standardized				
	Conductivity	µS/cm	512	587	Are not standardized				
Lake HERASTRAU									
	pH	pH units	7.33	7.68	6.5 – 8.5				
	Dissolved oxygen	mgO_2/l	5.71	5.83	9	7	5	4	<4
	BOD	mgO_2/l	7.23	7.78	3	5	7	20	>20
	Chlorine	mg/l	355.21	299.91	500	750	1000	1300	>1300
	Ammonium	mg/l	0.42	0.45	0.4	0.8	1.2	3.2	>3.2
	Nitrites	mg/l	0.009	0.021	0.01	0.03	0.06	0.3	>0.3
	Turbidity	NTU	6.99	3.86	Are not standardized				
	Conductivity	µS/cm	583	548	Are not standardized				
Lake FLOREASCA									
	pH	pH units	7.66	7.60	6.5 – 8.5				
	Dissolved oxygen	mgO_2/l	5.87	5.93	9	7	5	4	<4
	BOD	mgO_2/l	7.44	7.85	3	5	7	20	>20
	Chlorine	mg/l	265.87	443.12	500	750	1000	1300	>1300
	Ammonium	mg/l	0.33	0.29	0.4	0.8	1.2	3.2	>3.2
	Nitrites	mg/l	0.005	0.008	0.01	0.03	0.06	0.3	>0.3
	Turbidity	NTU	14.06	15	Are not standardized				
	Conductivity	µS/cm	500	503	Are not standardized				

Color legend		
(light blue)	Quality calss I	Ecological state "very good"
(green)	Quality calss II	Ecological state "good"
(yellow)	Quality calss III	Ecological state "moderate"
(orange)	Quality calss IV	Ecological state "weak"
(red)	Quality calss V	Ecological state "bad"

CONCLUSIONS

Following the determination of water quality, we can mention the following conclusions for the 28 analyzed parameters.

pH is within the limits for all the water samples;

The concentration of oxygen disolved is reduced in the 4 lakes. An important problem was identified for the samples that came from the Grivita lake where the quality degree was 4;

Based on the CBO5 indicator, the water of lake Colentina fits in the IIIrd category of quality;

Chlorine was registered with values under the allowed limit in all 4 lakes;

Nitrites are present within the allowed limits except for the sample collected from the Grivita lake where we can observe an unwanted evolution of this indicator so the quality fits in the second class;

Ammonia indicator was registered with values under the limit, with one exception from Baneasa Lake.

CBO values present an increase from upstream to downstream which means the existence organic pollution. This is confirmed by the OD concentrations which one decrease from upstream to downstream.

Further investigations have to be developed in order to ensure that there aren't illegal discharges along the lakes.

Lake's eutrophication can occur as a result of organic pollution so, obviously every measure of stopping the pollution is welcome. In this sense a program that tracks the quality of Colentina River is very much needed correlated with a strong monitoring of all discharges – both intentional and unintentional.

Based on the water analisys done by the Administratia Nationala Apele Romane and Administratia Lacuri, Parcuri si Agrement Bucuresti between 2007 and 2010 it has been observed that lake indicators on the course of Colentina river were within the normal limits except for the nitrites which in 2007 and today in Grivita lake had a spike of 0.42 mg/l. Today the tendency is towards lightly degradation of the indicators especially the OD and CBO which have a moderately ecological stat

REFERENCES

Caranfil N. G., 1963. Efectele asanarii Colentinei asupra Bucurestiului şi regiunilir invecinate. Buletinul Institutului Roman de Energie, 4(4), 5-42.

Giurescu C.C., 1979. Istoria Bucurestilor. Editura Sport-Turism, Bucureşti, 171.

Stanescu S.V., 2011. Aspecte ale calitatii apei Raului Colentina pe traseul din Municipiul Bucuresti (Romania), Ecoterra, no. 27.

*** Arhivele A.L.P.A.B

*** Ordinul 161/2006 pentru aprobarea Normativului privind clasificarea calitatii apelor de suprafata in vederea stabilirii starii ecologice a corpurilor de apa.

*** SRISO 3048-2:1996

*** SRISO 7150-1:2001