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Original Article

Municipality of Cluj-Napoca – The Quality of Wastewaters. Note 1. Monitoring Disolved Oxygen

ODAGIU Antonia*

University of Agricultural Sciences and Veterinary Medicine Cluj - Napoca,Mănăştur St., No. 3 - 5, 400372 Cluj-Napoca, Romania

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Abstract

The results of monitoring the disolved oxygen from municipal wastewater collected from the Cluj – Napoca channels network are presented in this paper. Monitoring was performed during one year and five months. The water samples were harvested from three distinct areas of the same municipal collection channel (Canalul Morii – Mărăşti quarter, Canalul Morii - Parcul Mare and Pârâul Popii – inside of the University of Agricultural Sciences and Veterinary Medicine Cluj – Napoca). The samples were instumentally analyzed (amperometry) and statistical processed with STATISTICA v. 7.0. During entire experimental time interval, values that did not exceed the established limits for disolved oxygen in water were recorded. An average of 4.50 mg/L was obtained by entire experimental time interval with a maxim of 4.92 mg/L and a minim of 4.23 mg/L.

Keywords: oxygen deficit, instrumental analyze, amperometry

1. Introduction

The municipal wastewaters are a mixture of domestic and industrial waters, resulted from domestic needs of populated centres, as well as of domestic, hygienic, sanitary, social and adminsitrative needs of the different samll industrial units [1, 2, 6, 7].

The disolved oxygen is one of the important indices of these wastewaters quality. It can be defined as the quantity of oxygen that remains disolved in water at certain temperature and pressure [2, 6]. The difference between the oxygen quantity that can be disolved by a water body, at certain temperature and pressure, and oxygen remained disolved is called ”the oxygen deficite”.

The identification of the oxygene deficit can give indications on water putity [8, 10]. The waters where reduction reactions occure will have big oxygen deficite [3]. The inverse proportionalyty between the quantity of water disolved oxygen and temperature is well known [12].

The water disolved oxygen usually records values between 0 and 14.6 mg/L. Bigger values are observed when (normal environmental temperatures) pollutants present in wastewaters (organic and/or inorganic) ireversible produce reactions simultaneously consuming high oxygen quantities (e.g. aerobic bacterial decompositions), which leads to decrease of its concentration [12].

The present study aims to identify the quality of municipal wastewaters, collected from the Cluj – Napoca municipality wastewater channel network, during one year and five months experimental time interval.

*Corresponding author.
Tel.: 0040 264 596384; Fax: 0040 264 593792
e-mail: aodagiu@gmail.com

2. Material and Method

The laboratory analyzes were conducted in the Laboratory of the Montoring of the Environmental Quality from the Faculty of Agriculture of the University of Agricultural Sciences and Veterinary Medicine Cluj – Napoca, during January 2009 – May 2010.

Determinarea conținutului în oxigen s-a realizat din probe prelevate din Canalul Morii din Mărăşti, Canalul Morii din Parcul Mare al municipiului Cluj – Napoca şi Pârâul Popii din incinta Universității de Ştiințe Agricole şi Medicină Veterinară Cluj – Napoca.

In analyzes performed in order to quantify the disolved oxygen content in wastewaters were used water samples harvested from: Canalul Morii in Mărăşti quarter, Canalul Morii in Parcul Mare of Cluj – Napoca and Pârâul Popii inside from the University of Agricultural Sciences and Veterinary Medicine Cluj – Napoca.

The sample were harvested from the same points nominated at the above mentioned locations according to present standards and norms. The preserved samples were placed in refrigerator at de 6° - 10°C until they were analyzed, at 12 hours from sample harvesting [9, 5].

The quantitative analyze of water disolved oxygen was instrumentaly performed in laboratory [9], by amperometry (with Oxi 315i SET equipment - fig. 2). After device calibration, the content of wastewater sample in disolved oxygen was measured by imersion of the CellOX 325 sensor (fig. 1). The STATISTICA v. 7.0 programme was used for statisrtical processing.

Figure 1. The CellOX 325 oxygen sensor

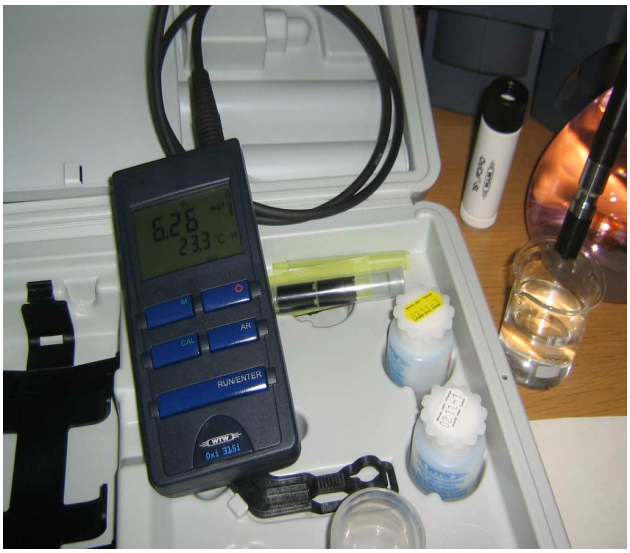


Figure 2. Determination of the oxygen content using the Oxi 315i equipment

3. Results and Discussions

The values of the indices of disolved oxygen in the municipal wastewaters samples analyzed during the entire experimental time interval, January 2009 – May 2010, respectively, are included within the interval:

- 4.60 – 4.62 mg/L in the samples harvested from Canalul Morii – Mărăşti quarter
- 4.41 – 4.45 mg/L in samples harvested from Canalul Morii - Parcul Mare

and

- 4.46 – 4.57 mg/L in samples harvested from Pârâul Popii located within USAMV Cluj - Napoca (table 1).

The biggest content of dissolved oxygen was recorded in wastewater samples harvested from Canalul Morii – Mărăşti quarter, 4.61 mg/L, repectively, and the smallest in the wastewater samples harvested from Canalul Morii - Parcul Mare, 4.43 mg/L, respectively (table 1).

By entire analyzed experimental time interval an index of the disolved oxygen of 4.50 mg/L was recorded, with a minim of 4.23 mg/L in 2010 in water harvested from Canalul Morii - Mărăşti quarter and a maxim of 4.92 mg/L in the same year - 2010, but in water samples harvested from Pârâul Popii (table 1).

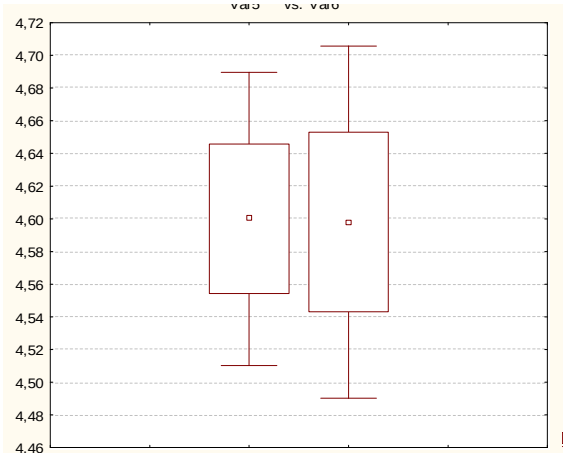
All these values were smaller compared to the maxim admitted level for the oxygen content of the wastewaters according to national present regulations [9].

Table 1. Average and dispersion parameters of the disolved oxygen from wastewater samples, harvested from three different areas located in Cluj – Napoca, quantified during three experimental time intervals (mg/L)

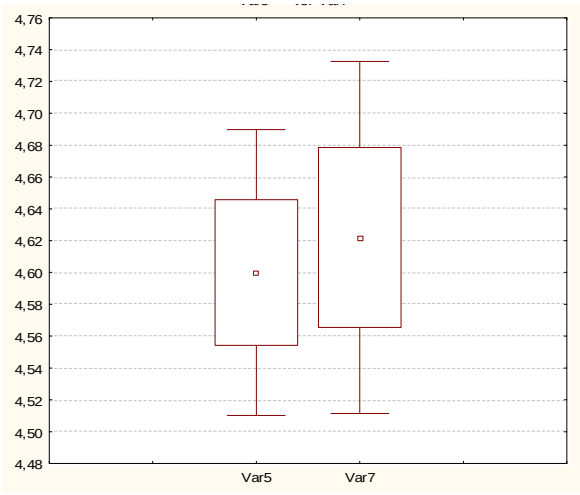
Location of sample harvesting	Date	n	$\overline{X}$	±	$s_{\overline{X}}$	Minim	Maxim
Canalul Morii – Mărăşti quarter	01- 06.2009	5	4,60	±	0,05	4,31	4,86
	07 - 12.2009	5	4,60	±	0,05	4,36	4,90
	01 - 05.2010	5	4,62	±	0,06	4,23	4,92
Canaul Morii – Parcul Mare	01- 06.2009	5	4,42	±	0,03	4,31	4,52
	07 - 12.2009	5	4,45	±	0,03	4,36	4,51
	01 - 05.2010	5	4,41	±	0,06	4,23	4,55
Pârâul Popii – USAMV	01- 06.2009	5	4,56	±	0,01	4,52	4,60
	07 - 12.2009	5	4,46	±	0,02	4,41	4,49
	01 - 05.2010	5	4,57	±	0,01	4,55	4,59
Canalul Morii – Mărăşti quarter	January 2009 – May 2010	15	4,61	±	0,02	4,78	4,86
Canalul Morii – Parcul Mare	January 2009 – May 2010	15	4,43	±	0,01	4,86	4,90
Pârâul Popii - USAMV	January 2009 – May 2010	15	4,51	±	0,01	4,85	4,92
Total	January 2009 – May 2010	45	4,50	±	0,03	4,78	4,92

The degree of dispersion of the average values is illustrated using "Boxplot" diagrams (fig. 3) that provide an appropriate statistical and graphical support for rapid comparison of the studied groups [4]. Positive differences, distinct significant, were recorded during the entire studied time interval, January 2009 – May 2010, between the oxygen content of the wastewater samples harvested from Canalul Morii Mărăşti and Parcul Mare 0,18 mg/L ($p < 0,01$) respectively (fig. 3.j), and those harvested from Canalul Morii - Mărăşti and Pârâul Popii, 0.10 mg/L (fig. 3.k).

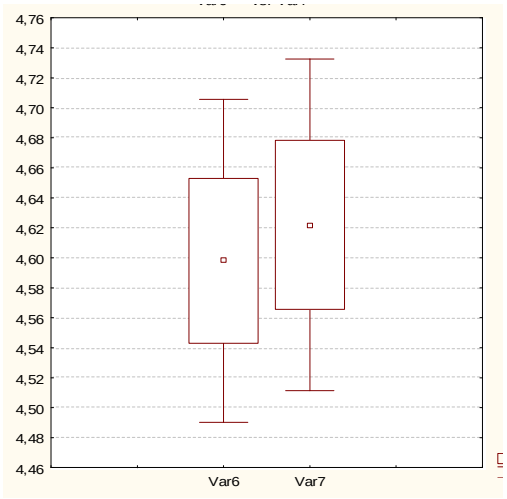
This demonstrates a higher oxygen content of municipal wastewaters from the Mărăşti quarter. Negative, staitistically very significant differences were recorded recorded, during the time interval prom the wastewaters samples harvested from January – May 2010, between the oxygen content Canalul Morii - Parcul Mare and those from Pârâul Popii (fig. 3.i), – 0.10 mg/L, respectively ($p < 0.001$).



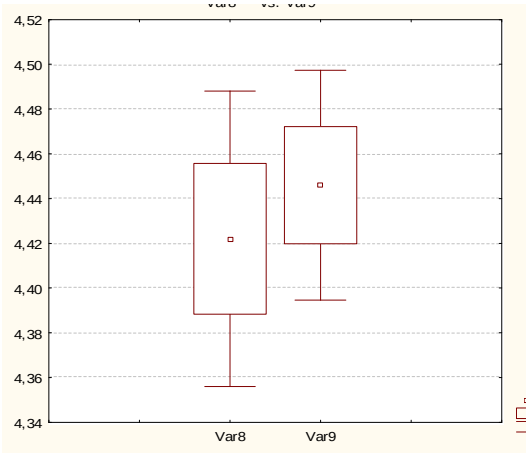
a. $X_{CMM\ 01-\ 06.2009} - X_{CMPM\ 01-\ 06.2009}$ ($p = 0.9779^{ns}$)



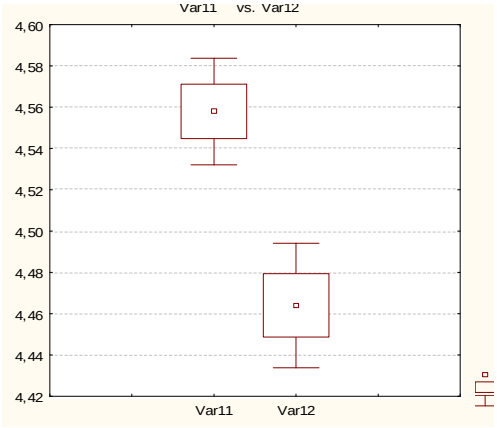
b. $X_{CMM\ 01-\ 06.2009} - X_{PP\ 01-\ 06.2009}$ ($p = 0.7643^{ns}$)



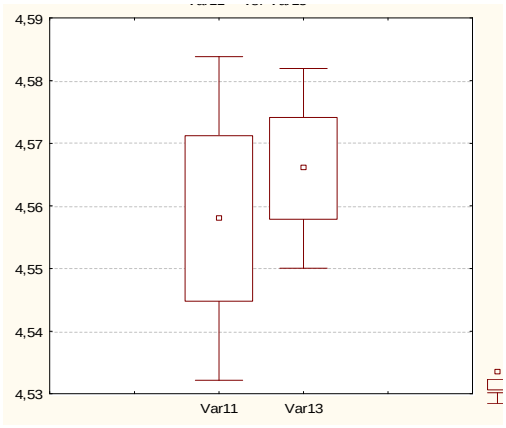
c. $X_{CMPM\ 01-\ 06.2009} - X_{PP\ 01-\ 06.2009}$ ($p = 0.7628^{ns}$)



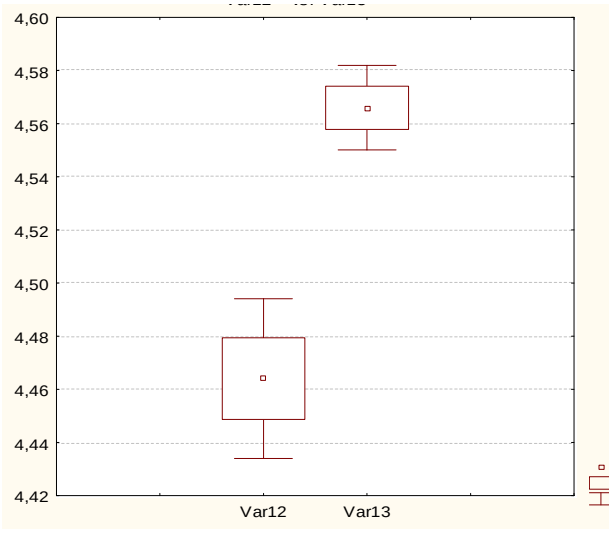
d. $X_{CMM\ 07\ -\ 12.2009} - X_{CMPM\ 07\ -\ 12.2009}$ ($p = 0.5891^{ns}$)



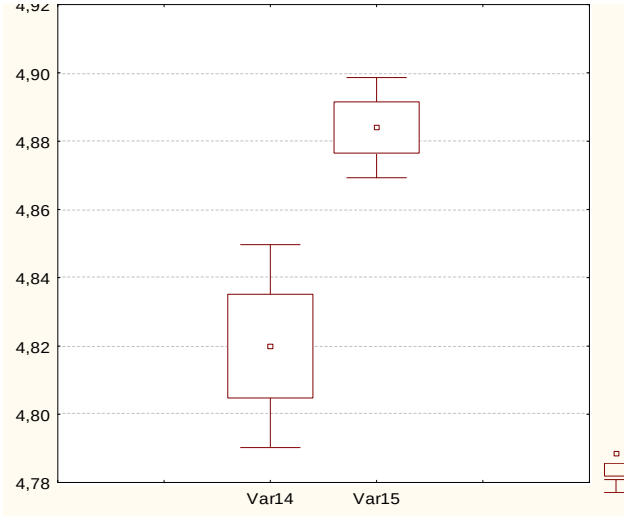
e. $X_{CMM\ 07\ -\ 12.2009} - X_{PP\ 07\ -\ 12.2009}$ ($p = 0.8895^{ns}$)



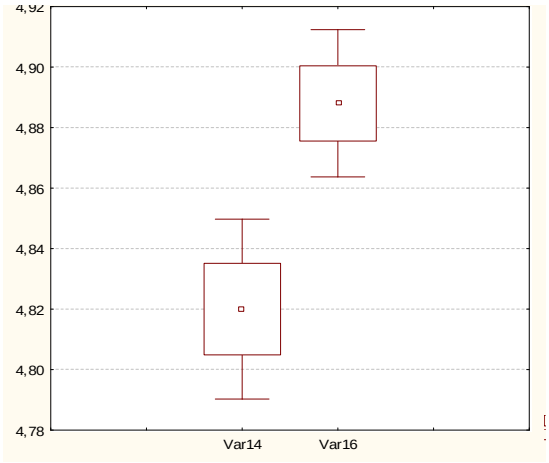
f. $X_{CMPM\ 07\ -\ 12.2009} - X_{PP\ 07\ -\ 12.2009}$ ($p = 0.6225^{ns}$)



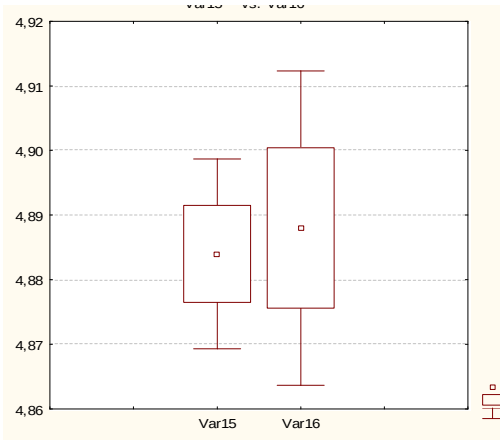
g. $X_{CMM\ 01\ -\ 05.2010} - X_{CMPM\ 01\ -\ 05.2010}$ ($p = 0.0017^{**}$)



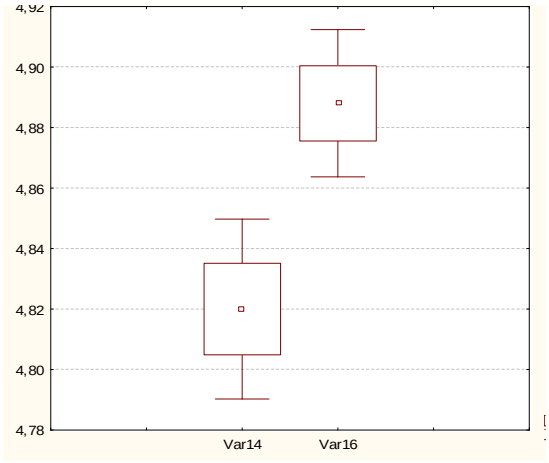
h. $X_{CMM\ 01\ -\ 05.2010} - X_{PP\ 01\ -\ 05.2010}$ ($p = 0.6195^{ns}$)



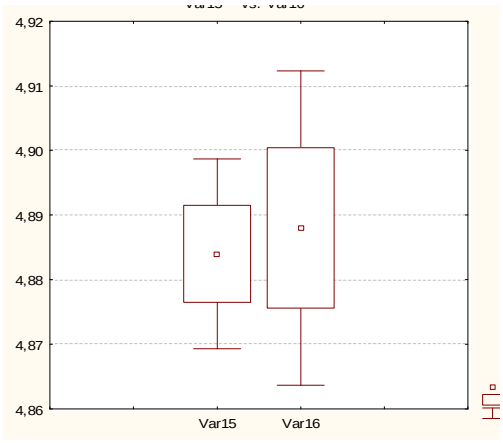
i. $X_{CMPM\ 01 - 05.2010} - X_{PP\ 01 - 05.2010}$ (p = 0.0004***)



j. $X_{CMM\ 01.2009-05.2010} - X_{CMPM\ 01.2009-05.2010}$ (p = 0.0054**)



k. $X_{CMM\ 01.2009-05.2010} - X_{PP\ 01.2009-05.2010}$ (p = 0.0084**)



l. $X_{CMPM\ 01.2009-05.2010} - X_{PP\ 01.2009-05.2010}$ (p = 0.7895 ^{ns})

CMM - Canalul Morii, cartierul Mărăşti, CMPM - Canalul Morii, Parcul Mare, PP - Pârâul Popii, USAMV
ns - p > 0.05; ** - p < 0.01; *** - p < 0.001

Figure 3. Graphic illustration of the significance of differences between the average values obtained for oxygen content of the analyzed wastewater samples

The data study emphasizes that, by entire analyzed time interval, the oxygen content from wastewaters collected from different areas of the entire collector channel of the Cluj – Napoca municipality framee within normatives [9, 12].

4. Conclusions

The oxzgen content of the analyzed wastewater content framdd within limits admitted by normatives, but the biggest values were obrtained in wastewater samples from Canalul Morii, Mărăşti quarter, with statistical distinct significative differences (p < 0.01) compared to other analyzed areas. It indicates a satisfactory quality of the monitored wastewaters, with oxygen content superior even to the minimum admitted for drinking water (2 mg/L).

By entire studied time interval and all samples, critical values of the dissolved oxygen were not recorded. The average had value of 4.50 mg/L with maximum of 4.92 mg/L and minimum de 4.23 mg/L.

From „Boxplot" diagram, where the five values of distribution are emphasized (minimal value, first quartile, median, third quartile and maximal value) results that by the entire analyzed time interval, the dissolved oxygen had values within appropriate limits for classical statistical processing.

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