ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

Evaluation of the Water Quality of the Ohrid Lake (Albanian Part) Compared to the International Standards

Sotir Mali.
University"Aleksander Xhuvani" Faculty of Natural Sciences, Elbasan, Albania.

Abstract: ***The big demographic changes that have happened these two last decades in the area around Ohrid Lake are followed by the increase of the inhabitant's number and the different kind of pollution levels particularly in the Albanian littoral. The discharge of the wastewater of Pogradec city into the lake without treatment was the main cause of the high coliform pollution level until 2009. The wastewater treatment plant of Pogradec city started to function partially four years ago 2009. It is situated around 5 km far from Pogradec City. The goal of this paper is to evaluate the quality of the water Ohrid Lake (Albanian part), after the wastewater treatment process. In order to achieve that, some physic-chemical and bacteriological analyses were carried out in 1998, 2011 and 2013. Some data about diluted oxygen, conductivity, temperature, pH and total coliforms are presented in this paper. The comparison of these data with international standards shows that some of them are comparable, but some others are higher.***

Key words: **Ohrid Lake, Albanian littoral, coliforms pollution, wastewater treatment plant, conductivity, wastewater quality.**

I. INTRODUCTION

Based on many scientific papers published by many authors the Ohrid Lake is very important from the tourist and ecological point of view. Ohrid Lake is tectonic lake and around two million years old [14]. Based on the throphic classification it is oligotrophic extreme lake [12]. This lake is called "Museum of the fossil alive" because of many endemic species [12]. Ohrid Lake is facing with some ecological problems these two last decades, especially in the Albanian part. Some big demographic changes have happen on all Albanian shore lake especially next to the Pogradec city. The discharge of wastewater into the lake has a negative impact on the water quality of this ecosystem [11]. The functioning with full capacity of the wastewater treatment plant in Albanian part will have the positive impact on water quality especially next to Pogradec city. The wastewater treatment plant started his functioning from the year 2009, but partially. The goal of this paper is to evaluate the quality of the water of Ohrid Lake (Albanian part) after the functioning of the wastewater treatment plant. In order to achieve that, we analyzed the water samples taken from the same sampling stations with those before functioning of wastewater treatment plant. Along the littoral between the Albanian-Macedonian border and Guri Kuq area discharge four streams that have their impact in the level of coliform pollution lake, but also some sewage collectors are closed. Analyzing the quality of wastewater before entering the lake and the change of the level pollution in the same sampling stations point out the positive impact of the of the functioning of the wastewater treatment plant on water quality.

II. MATERIALS AND METHODS

Sampling stations are determined with GPS ALAN MAP 500 device. The first station is next to the Albanian Macedonian border, around 100 m far from the Albanian custom of Tushemisht. The second one is exactly next to outflow of treated wastewater. The third station is beside of May Day restaurant. The fourth is next to main hotel of the city called Tourist Hotel and the last one is in the front of the residence of the Guri Kuq or Memelisht.

Coordinates of the sample stations	
1. Custom Tushemisht	N. 40 54 455 E.020 43 643
2. Drilon	N.40 54 135 E.020 42 616
3. Hotel May Day	N. 40 54 174 E.020 40 325

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

4. Hotel Tourist	N.4054223 E.02039521
5. Memëlisht	N.4055487 E.02038415

Table .1 coordinates of sample stations

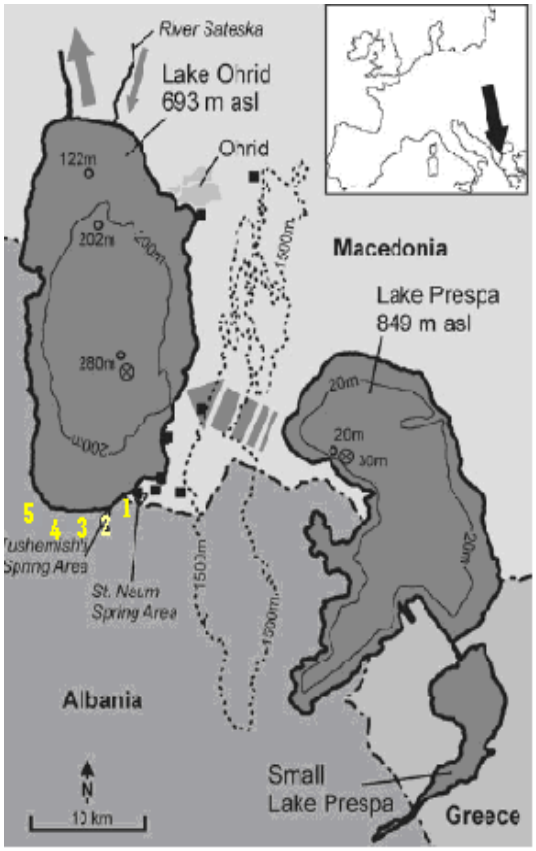

Fig: 1. Map of Ohrid Lake [12]

Table: 2. Suggested Sample Volumes for MF Total Coliform Test (mL) [1]

Water Source	100	50	10	1	0.1	0.01	0.001	0.0001
Drinking water	X							
Swimming pools	X							
Wells, springs	X	X	X					
Lakes, reservoirs	X	X	X					
Water supply intake			X	X	X			
Bathing beaches			X	X	X			
River water				X	X	X	X	
Chlorinated sewage				X	X	X		
Raw sewage					X	X	X	X

The collecting of the samples was carried out with the sterile bottles with a volume of 300 ml; meanwhile their transportation was realized on portable fridge which provided temperatures lower than 5^{o} C. The analyses are carried out in the Elbasan University according to MP technique based on the Standard Methods for the Examination of Water and Wastewater [1]. The determining of the total coliforms was carried out with the filter membrane technique respectively in the EndoNutriDisk (10434162) [1]. The study was carried out in three

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

periods of time. The first period is February 1998, the second one is February 2011 and the last one is February 2013.

III. RESULTS AND DISCUSSIONS

Table: 3. Physic - chemical and bacteriological data, February 2013

Sample stations	Coordinates	t	pH	O_2 mg/L	Conductivity µ S /cm	Volume sampling water (m L)	Coliform total/100 mL water
1. Custom Tushemisht	N. 40 54 455 E.020 43 643	9.3	8.32	8.74	340	10	600
2. Drilon	N.40 54 135 E.020 42 616	8.5	7.95	6.0	917	0.1	7000
3. Hotel May Day	N. 40 54 174 E.020 40 325	7.6	8.20	8.86	592	0.1	17000
4. Hotel Tourist	N.4054223 E.02039521	7.4	8.42	9.73	264	10	420
5. Memëlisht	N.4055487 E.02038415	8.3	8.62	8.62	312	1	4000

Table: 4. Coliforms total according to the sample stations during 1998, 2011 and 2013

Sample stations	1	2	3	4	5
Coliforms total / 100 ml. February 1998	0	200	5000	12000	1500
Coliforms total / 100 ml. February 2011	20	6000	16000	260	2600
Coliforms total / 100 ml. February 2013	600	7000	17000	420	4000

The table 4 and figure 2 display the data of the total coliforms bacteria of the five sample stations. The comparison of the values registered during the February of 1998 with those registered on the February of 2011 and February of 2013 shows the fact that the level of the coliform pollution is increased some times more, except the station number one. The main source of the coliform pollution in the station one has not been and still is not the discharge of the wastewater into the lake, but different kind of organic remains discharged next to this station during the winter of the year 2011 and 2013. According to some authors some fish, snakes, insects, and vegetation harbor fecal coliforms in low numbers [8], [6].

Regarding the station three, the results registered in the February of 1998 compared with those taken in the February 2011 and February 2013 can point out the fact that the coliform pollution level is some times higher than standards [11]. High temperature is a factor which makes possible to coliforms bacteria to live from some weeks to some months in the water and they can also proliferate in the presence of organic remains, [10], [5], and [4]. The main cause of this pollution in station 3 is a continuous discharge of the polluted water of the stream beside the May Day restaurant without a preliminary treatment. The data of the coliform total of the station 4 show clearly a decrease of the coliform pollution level during the February 2011. The registered values are lower than the European Community standards, 500 coliforms / 100 mL water, Ontario Standards, Canada, 1000 coliforms / 100 ml water [3]. The values registered in the all five sample stations of the littoral during February 2011 and February 2013 are lower than those taken in Kariba Lake in Zimbabwe, 40400 coliforms bacteria / 100 ml water, and those registered in the Albanian littoral of Belshi Lake during June-July 2005, 46000/ coliforms bacteria / 100 ml water [9]. Comparing these results with those registered in summer 1997 in the Macedonian littoral of Ohrid Lake 2400/100 mL they are a several times lower [13].

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

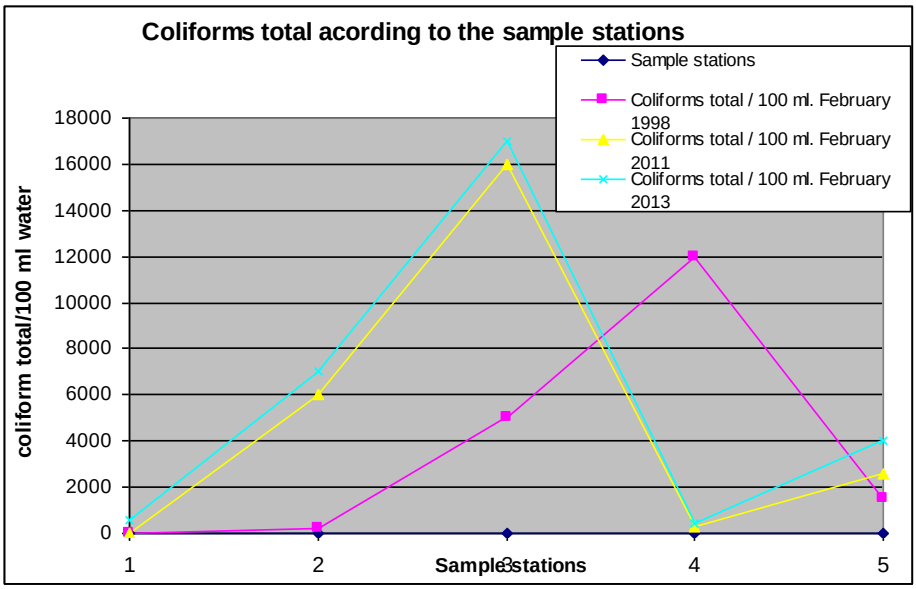

Fig. 2 Coli forms total according to the sample stations

The higher results of coliforms bacteria are registered in sewage and polluted surface water in U.S.A, respectively 10^9 and 10^5 coliforms / 100 mL water [15]. Also some other data are registered in the different sources of wastewater in U.S.A 150000 / 100 mL water [2]. The comparison of the coliform data in the station 2 during February 2011(6000 / 100 mL of water) and February 2013 (7000 / 100 mL of water) with those given by the U.S. EPA [16], clearly shows a high increase of water quality from coliform pollution point of view.

Table: 5. Conductivity according to the sample stations during 2011 and 2013

Sample station	1	2	3	4	5
Conductivity µ S /cm February 2011	300	754	584	253	223
Conductivity µ S /cm February 2013	340	917	592	264	312

The conductivity data presented in table 5 and figure 3 show that the higher results are in station 2 and station 3. According to many studies there is no exact relationship between conductivity as µS/cm and TDS as ppm, but it has been discovered experimentally that for particular types of water there is an approximate relationship [7].

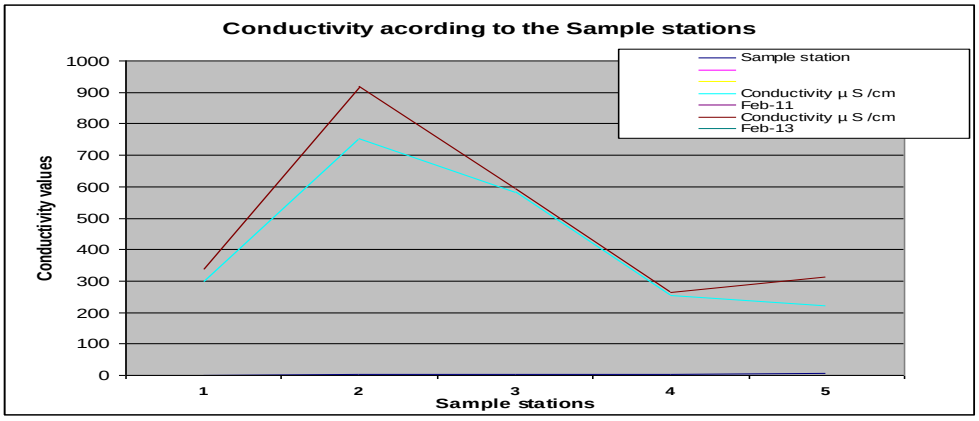

Fig: 3. Conductivity according to the sample stations

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

Even though the water temperatures affect the electric conductivity from 2 up to 3 % per 1 degree Celsius the values of EC of the station 2 and station 3 are higher than those of the other stations [7]. The main raison of these high values in the station 2 is the untreated discharge of the wastewater because of the absence of the tertiary treatment of the wastewater treatment plant, meanwhile for the station 3 is the discharge of the stream which enters the lake next to this station.

IV. CONCLUSION

- The quality of the wastewater discharge after the treatment and before entering the Ohrid Lake (Albanian part) is improved, but comparing with standards still needs some improvement.
- The functioning of the wastewater treatment plant has a positive impact on the water quality in the Albanian part of Ohrid Lake especially next to the center of Pogradec city, even though this functioning is not completed.
- The main cause of the high continuous coliform pollution level in station 3 is the discharge of the polluted water of the stream next to it.
- The guaranty of the permanent high water quality in the Albanian side of Ohrid Lake still needs the control of the wastewater quality before entering lake and the control of other pollution sources including stream waters, wastewater next to station 5 and different remains along the lakeshore.

REFERENCES

[1] APHA. "Standard Methods for the Examination of Water and Wastewater," 18th Edn. American Public Health Association, Washington, DC. pp. 9–56, 1999.

[2] R.G. Bound & C. P. Straub, (eds) Handbook for Environmental Control, III: Water Supply and Treatment. CRS Press, Florida, 1980.

[3] Directive2006/7E of the E.P.C. of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC. Official Journal of European Union, ANNEX L, PP. 46, ANNEX V, pp. 51.

[4] Feachem at al., "Sanitation and Disease Health Aspects of Excreta and Wastewater Management," World Bank, Washington, DC, 1983.

[5] T.C. Hazen and A. Toranzos, "Drinking Water Microbiology," Springer-Verlag, New York, pp. 32–53, 1990.

[6] V. J. Harwood, J Butler, D Parrish, and Wagner V, Appl. Environ. Microbial. 65, 865–867, 1999.

[7] "Handbook of Chemistry and physics" 76 th edition, S. 5-90, 1995

[8] E.E. Geldreich, "Sanitary Significance of Fecal Coliforms in the Environment," Pub. WP-20-3, U.S. Department of the Interior, Cincinnati, 1966.

[9] C. H. D. Magadza, E. J. Dhlomo, Lakes and reservoirs. Research and management; "Wet season incidence of coliform bacteria in Lake Kariba in shore waters in Kariba town area" University of Zimbabwe, Kariba Zimbabwe, 1996.

[10] J. H. McCoy, "Sewage pollution of natural waters," In :(Eds G. Sykes & F. A Skinner) Microbiological Aspects of pollution. Academic Press, London, 1971.

[11] S. Mali, "Studies On Bacteriological and Physics-Chemical Parameters of Albanian Part of Littoral of Ohrid Lake," UNIEL. Scientific Bulletin Elbasan Albania. P; 49-57, 2000.

[12] B. T Ocevski and H. Allen, "Phytoplankton production, physico-chemical conditions and nutrient relationships in Lake Ohrid," Ygoslavia. Verh.Internat.Limnol. 20:1078-1084. 1978.

[13] V. Novevska, and L. Lokoska, "Pelagial and littoral water quality of Lake Ohrid from microbiological point of view," 27-th Annual Conference of Yugoslav Water pollution Control Society "Water Pollution Control'98", Conference Proceedings, p;357-364, 1998.

[14] N. Pano, S. Selenica, V. Puka, and B. Hysi, Hidrologjia e Shqipërisë. Tiranë, 1984.

[15] U.S. Environmental Protection Agency. Washington, DC, 1986.

[16] [16] U.S. Environmental Protection Agency. Washington, DC, 1988.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 5, September 2013

AUTHOR BIOGRAPHY

Prof. Dr. Sotir Mali, Lecturer of microbiology in Bachelor level of biology-chemistry, Environmental microbiology in Master degree level at Elbasan University for more than 20 years. Bachelor in biology-chemistry in 1982 at Elbasan University, PhD in water microbiology since 1999 at Tirana University. Participations (with both oral and poster presentations) in more than 40 International Conferences on the environmental protection as the first author and coauthors. More than 20 publications as the first author in proceedings. Publications: more than 15 scientific papers in the International scientific journals on water microbiology and environmental protection. 3 university books and one monograph as the first publications. All these books are available in Albanian National Library. Since 1993 until now participation in 8 international and national projects on environmental protections. Specializations in Paris-Sud University during1995-96, in Germany during 2010, Kansas University, U.S.A (JFDP) 2012. Since July 2013, Professor Title. Also member of PPNEA, BENA both environmental organizations. Tutor for more than 30 Master degree diplomas on Environmental protection and health education at Elbasan and Tirana University, Albania.