Adjusting Water Processing Technology in the Function Water Quality of Lake Radoniqi

Environment and Ecology

Keywords: water, parameters, lake, methods, results.

Luan Daija	**Regional Water Company "Radoniqi" in Gjakova, Kosovë.**
Xhelal Këpuska	**Regional Water Company "Radoniqi" in Gjakova, Kosovë.**
Seit Shallari	**Department of Agrienvironment and Ecology, Tiranë, Albania.**
Leonard Shehu	**Regional Water Company "Radoniqi" in Gjakova, Kosovë.**

Abstract

In different seasons the water of the lake "Radoniqi" showed changes in the water quality, such as increased turbidity, presenting an unpleasant odor or flavor. Aeration, flocculation, filtration and disinfection with chlorine failed to completely eliminate undesirable odor or flavor. The purpose of this paper is the adjustment of water treatment technologies based on physical-chemical and bacteriological characteristics of Lake Radoniqi water. The objectives of the study are to identify the physical-chemical and organoleptic parameters of water before and after treatment of water in the treatment plant, and adjustment of technologies in the function of unprocessed water quality. In this study were analyzed following water parameters, such as turbidity, smell, taste, pH value, potassium permanganate value, dissolved oxygen, iron, manganese, ammonia, nitrites, nitrates, phosphates, aluminum, etc. Water samples are tested in the physical-chemical laboratory with methods, such as jar-test method, organoleptic test, pH meters, conductivity, turbidity, spectrophotometric methods and classical methods of chemical analysis (volumetric method). Results of physical-chemical and organoleptic analysis of lake water help us to determine the water intake level of the lake as well as make a decision for the most appropriate technology for water treatment.

Introduction

Radoniqi Basin, as a new ecosystem, has not yet reached a biological sustainability and fair relations between different species living in it. For this reason, for a period of several years was apparent the phenomenon of species dominance imbalances, until the establishment of the full balance between them, which would create consistency in the stabilizing this ecosystem.

Eutrophic phenomenon in Lake Radoniqi occurs with the increase of algae in the water, which is favored by enrichment of water with nutrients (such as nitrogen and phosphorus that are very important for the growth of aquatic plants), which leads to natural imbalances aquatic ecosystem. To this problem contributes uncontrolled spill of waste, garbage and wastewater in the river Lumëbardhi from derivation channel as well as soil erosion that increases the turbidity on one hand and on the other hand increases the amount of nutrients that contribute to appearance of eutrophication. Hence physical-chemical and bacteriological characteristics of the water are best determinants of water quality, which determine the treatment technology to meet the quality standards.

Material and methods

When water quality was changed such as, increased turbidity, appearance of unpleasant odor, water samples were taken at different levels of depth (5 levels). For sample were taken 1 liter of water. Measurements and the assessment were made of physical and chemical parameters, such as turbidity, odor, pH value, potassium permanganate value, dissolved oxygen, iron, manganese, ammonia, nitrites, nitrates, phosphates, etc.

During experimentation in the physical and chemical laboratory following methods were used like: jar-test method, organoleptic test, pH meters, conductivity, turbidity, spectrophotometric methods and classical methods of chemical analysis (volumetric method).

Organoleptic method for determining the odor in the water is carried out with the following procedure: - 100 ml of sample water is poured in *Erlenmeyer flask* with V = 300ml, covered with watch glass and placed in the tub with warm water. When temperature reaches 40 ° C, the flask is removed from the tub, the watch glass is removed and immediately smelled.

Table 1. Determination of odor sensitivity threshold expressed by the scoring system 0-5.

Number of points	Intensity	Descriptive definition
0	No odor (taste)	The smell (taste) not detected.
1	Very poor odor (taste)	Odor (taste) is detected only by persons who work on laboratory.
2	Poor odor (taste)	Consumers does not distinguish if they were not made aware
3	Odor (taste) detected	The odor and taste are detected and can be cause for complaint.
4	The odor (taste) clearly defined	The sense of odor (taste) is easy detectable and can cause nuisance to consumers (consumer do not use this water for drink).
5	Very strong odor (taste)	Odor (taste) is highly perceptive and the water is inadequate to drink.

Jar-test method is carried out by this procedure: - In a bowl is poured 15 to 20 liters of untreated water, then filled 6 jars of 1000 ml, these jars are placed in flocculator and at the end of glasses mixers are activated by electrical currents to maximum speed and then we dose in the jar the given amount of solution prepared for coagulation, after 3 minutes, the speed is decreased and after 20 minutes the process of coagulation is interrupted and left resting for 10 minutes. Then it is observed in which jar are formed larger floccules, and are sedimented faster. In conclusion, half of the water is taken from each jar and turbidity is analyzed. Experimental dosage of activated carbon has been made in function of the intensity index of odor. Experimental dosage of iron chloride was made in function of water turbidity.

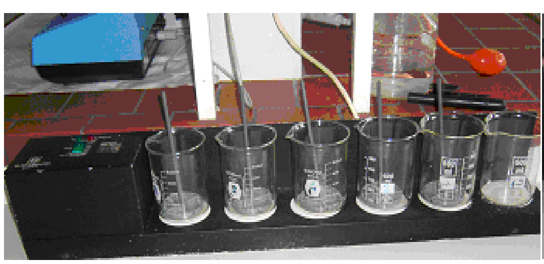

Fig. No.1- Jar – test equipment

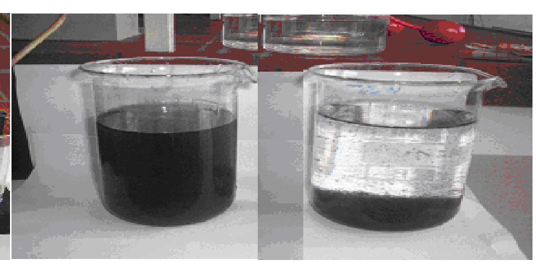

Fig. No.2- Untreated water with activated carbon before and after jar-test

Given the relationship between turbidity of raw water with activated carbon and quantity of coagulant -flocculant, amount of $FeCl_3$ dosage is calculated according to the following table:

Table 2. Calculation dose of $FeCl_3$

No.	Turb.NTU Of lake water	Dosing of C.A. mg/l	$\sum_{Tur.}=NTU_{U.L.}+D_{C.A.}$	Dosing in mg/l $FeCl_3$ $\sum_{Tur.}$ * f (0,2)
1.	1.0	10	11.0	2.2
2.	2.0	10	12.0	2.4
3.	3.0	10	13.0	2.6
4.	4.0	10	14.0	2.8
5.	5.0	10	15.0	3.0
6.	6.0	10	16.0	3.2
7.	7.0	10	17.0	3.4
8.	8.0	10	18.0	3.6
9.	9.0	10	19.0	3.8
10.	10.0	10	20.0	4.0
11.	11.0	10	21.0	4.2
12.	12.0	10	22.0	4.4
13.	13.0	10	23.0	4.6
14.	14.0	10	24.0	4.8
15.	16.0	10	26.0	5.2
16.	18.0	10	28.0	5.6
17.	20.0	10	30.0	6.0
18.	25.0	10	35.0	7.0

From the results of water analysis are defined the dosing of chemicals such as aluminum sulfate, iron chloride, polyelectrolyte, activated carbon, etc.

Results and Discussions

Table no.3, Physical-chemical analysis of water in five levels in Lake "Radoniq" and treated water

Parameters	Standards	Permissible limit		Level of water in the lake					Treated water
		Unit	Value	First	Second	Third	Fourth	Fifth	
Water temperature		° C	8-12	13.9	13.6	13.1	12.8	12.8	10.2
Odor	BSEN 1508:1999		Not present	Present	Present	Present	Present	Present	Very poor odor
Color	ISO 7887:1994	°Co-pt	Not present	Not present	Not present	Not present	Not present	Not present	Not present
Turbidity	ISO 7027:1999	NTU	1.2-2.4	6.12	7.8	8.4	8.8	8.9	0.34
pH value	ISO 10523:2008		6.8-8.5	7.77	7.9	7.74	7.81	7.78	7.59
Conductivity	ISO 27888:1985	µS/cm	1500	328	342	358	361	354	299
Dry residue	Gravimetric	mg/l	800-1000	196.8	205.2	214.8	216.6	212.4	179.4
Total hardness	ISO 6059:1984	d° H	30	6.88	7.12	7.0	7.12	7.12	7.0
Oxygen -0_2	SMWW 2710-B	mg/l	5	10.6	10.4	10.1	9.7	9.7	11.1
Chlorides	ISO 9297:1989	mg/l	200	6.38	7.09	6.73	7.09	6.73	7.09
KMnO4 value		mg/l	8-12	6.63	7.26	6.63	6.63	6.32	3.47
Ammonia N-NH_3	ISO 7150-5:1986	mg/l	0.1	0.12	0.11	0.12	0.11	0.1	0.016
Nitrites N-NO_2^-	ISO 6777;1984	mg/l	0.005	0.006	0.005	0.005	0.006	0.005	0.0035
Nitrates N-NO_3^-	ISO 7890-2:1988	mg/l	10	1.82	1.76	1.78	1.83	1.81	1.08
Sulfates	ISO 9280:2000	mg/l	200	21	24	26	25	25	21
Phosphates	ISO 6878:2004	mg/l	1.5	0.82	0.73	0.69	0.81	0.79	0.037
Iron (Fe)	ISO 6333:1986	mg/l	0.3	0.082	0.076	0.081	0.079	0.077	0.053
Manganese(Mn)	ISO 6333:1986	mg/l	0.05	0.06	0.068	0.071	0.069	0.068	0.038
Aluminum (Al)	SMWW3500-Al	mg/l	0.2	0.11	0.10	0.09	0.089	0.087	0.039

Table No. 3 shows the results of physical - chemical analysis of the water, indicating that odor is present in unprocessed and processed water which impairs its quality.

Table 4. Number of odor sensitivity threshold depending on the volume of water.

Sample - Water with odor	Sample - Odorless water	The volume of water in cm3 sample diluted to 200 cm3	Number of odor sensitivity threshold	The strength index of odor
12,5	187,5	200	1	0
12,5	87,5	100	2	1
12,5	37,5	50	4	2
12,5	12,5	25	8	3
12,5	0,0	12,5	16	4

In Table 4, in the laboratory we analyzed the sensitivity threshold number of odor and the strength index of odor. Dilution is made with odorless water. The strength index of odor is number which shows how many times the concentration of the sample should be reduced to half by adding odorless water, to produce the dilution with odor. From the results of the analysis we got the ratio 1:3, the number of odor sensitivity threshold 4 and the strength index of odor 2.

Table no.5, Physical-chemical analysis of water in five levels in Lake "Radoniqi" and treated water

Parameters	Standards	Permissible limit		Level of water in the lake					Treated water
		Unit	Value	First	Second	Third	Fourth	Fifth	
Water temperature		° C	8-12	13.5	13.2	12.8	11.9	11.6	10.1
Odor	BSEN 1508:1999		Not present	Present	Present	Present	Present	Present	Not present
Color	ISO 7887:1994	°Co-pt	Not present	Not present	Not present	Not present	Not present	Not present	Not present
Turbidity	ISO 7027:1999	NTU	1.2-2.4	6.3	7.9	8.5	8.7	8.9	0.31
pH value	ISO 10523:2008		6.8-8.5	7.77	7.9	7.74	7.81	7.78	7.61
Conductivity	ISO 27888:1985	µS/cm	1500	331	344	359	363	357	307
Dry residue	Gravimetric	mg/l	800-1000	198.4	206.4	215.4	217.8	214.2	184.2
Total hardness	ISO 6059:1984	d° H	30	7.0	7.12	7.12	7.28	7.42	7.0
Oxygen -0_2	SMWW 2710-B	mg/l	5	10.7	10.5	10	9.5	9.4	11.2
Chlorides	ISO 9297:1989	mg/l	200	6.02	6.73	6.73	7.09	7.09	7.79
KMnO4 value		mg/l	8-12	7.26	6.63	6.63	7.26	7.42	3.63
Ammonia $N\text{-}NH_3$	ISO 7150-5:1986	mg/l	0.1	0.12	0.12	0.11	0.11	0.11	0.015
Nitrites $N\text{-}NO_2^-$	ISO 6777;1984	mg/l	0.005	0.006	0.006	0.005	0.006	0.005	0.003
Nitrates $N\text{-}NO_3^-$	ISO 7890-2:1988	mg/l	10	1.83	1.77	1.78	1.84	1.81	1.06
Sulfates	ISO 9280:2000	mg/l	200	21	23	25	24	24	21
Phosphates	ISO 6878:2004	mg/l	1.5	0.82	0.75	0.71	0.80	0.79	0.036
Iron (Fe)	ISO 6333:1986	mg/l	0.3	0.083	0.077	0.082	0.079	0.078	0.051
Manganese(Mn)	ISO 6333:1986	mg/l	0.05	0.063	0.069	0.070	0.068	0.069	0.037
Aluminum (Al)	SMWW3500-Al	mg/l	0.2	0.12	0.10	0.092	0.088	0.086	0.034

Table No. 5, presents the results of physical and chemical analysis of unprocessed water where odor is present in the water, as well as processed water where odor and taste is not present. Problems with odor in water can also be avoided by changing the depth of intake of unprocessed water, where this is technically possible, but since the odor in the water has been present in all 5 levels, in the process of treatment of water has been necessary dosage of activated carbon.

Conclusions

The ratio between the number of odor strength index and the necessary dose of activated carbon, is determined by adding the activated carbon mg/dm3 in the untreated water until it removed the odor, which produced the ratio: 1 : 5 i.e. 1(odor strength index) : 5 (activated carbon mg/ dm^3)

Given the relationship between the number of odor strength index and dose of activated carbon, we calculate the amount of active carbon dosage depending on the production capacity. Analysis of coagulation - flocculation of unprocessed water with aluminum sulfate solution, iron chloride and polyelectrolyte as additional flocculants produce ratio between the unprocessed water turbidity and amount of coagulant - flocculant, as:

1NTU = 2 mg/dm^3 $Al_2(SO_4)_3x18H_2O$ + 0,01 mg/dm^3 polyelectrolyte

1NTU = 0,2 mg/dm^3 $FeCl_3$ + 0,01 mg/dm^3 polyelectrolyte

We assume that the basic hypothesis is physical-chemical indicator and microbiological parameters of water taken from the lake, which affect and determine processing technologies.

Recommendation

Problems with odor can be avoided by changing the depth of water intake, if it is technically possible. Removal of odor and taste is carried out by adding powdered activated carbon, as well as the most efficient method that is sand filters with low flow. During the processing with powdered activated carbon, it is preferred the use of iron chloride -FeCl3 as coagulant which is more suitable.

References

1. D.T.E. Hunt.,A.L.Wilson., The chemical Analysis of water 1995.
2. Korça B., Analiza kimike e ujit, Prishtinë 2001.
3. Dalmacija B., Kontrolla kvaliteta voda,Novi Sad, 2000.
4. Đukić D.,Ristanović V., Hemija i mokrobiologija voda, Beograd, 2005.
5. Haxhimihajli Dh., Teknoligjia kimike inorganike,Tiranë 1980.
6. Hoxha B., Kimia analitike- pjesa praktike, Prishtinë, 1999.
7.Degremond, Tehnika preciscavanja voda, Beograd, 1976.
8.Hoxha B., Trajtimi i ujërave të ndotur, 1996.
9.Rakelić V., Analiza zagađivaća vazduha i vode,Beograd, 1989.
10. Rugova M.,Gjeçbetriçi T., Kimia inorganike, Prishtinë, 1998.
11. Agolli F., Teknologjia kimike inorganike, Prishtinë,1983.
12. Çullaj A.,Kimia e mjedisit,Tiranë, 2005.