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Original scientific paper

The Test Results of Microbiological and Chemical Quality of Water in Recreation Center "Fortuna" Banja Luka

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Abstract: It is recognized, that a man in wider and immediate community, especially by living in larger, urban areas is exposed to a variety *of factors that directly or indirectly affect his health, living conditions, and ability to work, as well as the life expectancy. Life in changed working and living surroundings, with decreased physical and neural condition , and inadequate active and passive relaxation results in increase of number of depression, trauma traffic, respiratory disease, deformity- especially in children, degenerative diseases, etc.*

To prevent thisone has to sit less and become more active, since physical activity in variety of forms, increases the functional capability of all organ systems, and is essential, as a mean of maintaining overall psychological and physical health as well as the ability to work. Swimming is a healthy physical activity that is valued for its benefits. It has a powerful effect on all body systems, and nowadays a significant number of people use swimming pools more or less frequently. However, recreational activities at the swimming pool can endanger health, so it is necessary to the properly manage the pools, as to reduce threats to the smallest possible measure.

The research confirmed the hypothesis that the water quality in swimming pools and recreation in many respects depends on the correct design and construction of swimming pools, rationally established hydraulics, acceptable water quality, capacity and efficiency of the water treatment, the workload of the pool, the implementation of appropriate sanitary and hygienic measures and control of the critical points in and around the pool, behavior of users as possible contributors to water pollution, provide a satisfactory quality of water, which endangers the safety of users.

Keywords: *quality, hazards, risks, microorganisms, chemicals, trihalomethanes*

Introduction

It is recognized, that a man in wider and immediate community, especially by living in larger, urban areas is exposed to a variety of factors that directly or indirectly affect his health, living conditions and the work ability.

Life in changed working and living surroundings, with decreased physical and neural condition , and inadequate active and passive relaxation, results in increase of number of depression, trauma traffic, respiratory disease, deformity- especially in children, degenerative diseases, etc..

Also, increase in mental work, division of labor, mechanization and automation of production, relieve human of physical labor, which in the historical development was the basis for his existence and biological survival. Less physical activity leads to degenerative changes in bone and joint and muscle system, the attenuation of the respiratory and cardiovascular system, arteriosclerosis due to the deposition of an excess fatty substances, metabolism disorders, reduction in the amount of protective immune substances against infectious diseases and cancer, increase in the amounts of free radicals, etc (Kurtovic, 2008; Biberović and Mačković, 2005). To prevent this, one has to sit less and be more active, since physical activity in variety of forms, increases the functional capability of all organ systems, and is essential, as a mean of maintaining overall psychological and physical health as well as the ability to work. Swimming is a physical activity renowned for its efficiency. It has all-round benefit for all body systems, and for that reason a significant number of people more or less frequently use swimming pools. However, recreational activities

at the pools could endanger health, so proper management of the pools is essential in reducing risks to the smallest possible measure (Biberović and Mačković, 2005). Management of pools is a relatively complex issue, but the focus of these considerations will be the most important part of the problem, risk management of physical and chemical and microbiological hazards, which is based largely on the recommendations of the World Health Organization (WHO, 2000). There are different classifications of pools: private (home), semi-public (in hotels, schools, various clubs, on cruise ships) and public. Pools can be placed in buildings (indoor), or in the open space (open), and there are the combination swimming pools that are roofed in cold season (Muškatirović, 2001) Each type has a different potential problems related to its operation and use, meaning that users may be exposed to different hazards or different degrees of the same hazard. They are used by people of all ages and different physical abilities (Antonić et al., 2016) Culture and self-discipline swimmers are contributory factors to their security.

Risks from microbiological hazards

Users of pools are exposed to various risks, among which the risk of microbiological contamination by pool water is the greatest. Water treatment, when applied, reduces the extent of that risk, but the highest security is achieved only by disinfection of pool water (Antonic et al, 2014) Since water is a medium for transmission of various infectious agents, microbiological characteristics are an important quality parameter of water. In the broadest sense, the water is often starting point for variety of infections in men, either by digestive tract (fecal-oral transmission through ingestion of contaminated water) or via the transmission contact with the contaminated water. Pathogens are the most common and most widespread health risks associated with water, due to the occurrence of infectious diseases caused by bacteria, viruses and parasitic protozoa. Besides fecal pathogens, numerous other infectious microorganisms can be transmitted from diseased user pool to the other users. Also, the pool equipment and water in the pool, as well as the ventilation system or air conditioning system can be a habitat for some aquatic bacteria and amoeba that can cause various infections and diseases of the respiratory system, skin and even CNS. Especially suitable as a habitat are therapy pools that usually have hot water, often rich in salts and other nutrients (Antonić et al., 2016) The main risk reduction measure is avoiding conditions and situations that lead to increased occurrence of danger and one of the most important preventive measure is, of course, educating people with impaired immunity to avoid swimming pools because of the increased risk to their health. Many micro-organisms in the pool water originate from users themselves (skin, secretions from the nose or mouth). Infected users can directly contaminate pool water, as well as the surrounding surfaces that become a direct source of infection for other people who come into contact with contaminated environment (Antonic et al, 2014) The greatest danger to human health represents water contamination with human or animal excrement, or the direct or indirect fecal contamination. The risk of disease or infection from the pool water is essentially the most associated with: fecal pollution either from bathers or contained in the water source which feeds the pool. Many diseases resulting in a pool, a consequence of the poor performance of its disinfection or complete lack of it. The outburst of some epidemics have been connected with pool water, where the reason is the habit of people to use the pool even if they are ill, therefore causing often that these facilities for refreshment and recreation become a hotbed of various diseases and infections. Most often cited as a cause of epidemic are viruses, although recent incidents occur due to the presence of bacteria and protozoa. Certain species of fungi are also a very serious cause of many surface infections of skin and hair of bathers (Antonić et al., 2016).In summary, use of the pool (either opened or closed) carries with it a certain health risks associated with microbiological quality of the water (Antonic et al, 2014).

Risks from microbiological hazards

Users pools are exposed to various risks, of which the risk caused by microbiological contamination of the pool water is greatest. Water treatment, if any copies, reducing the extent of that risk, but that most of the security measures users can achieve only disinfection of water in the pool (Antonic et al, 2014). Since the water, often occurs as a means of transmission of various infectious agents, microbiological characteristics are an important quality parameter of each the water. In the broadest sense, the water is always essentially the appearance of a variety of infections in man, via either: the digestive tract (fecal-oral transmission through ingestion of contaminated water) or via a muco-cutaneous barrier (the transmission contact with the contaminated water).

Pathogens are the most common and most widespread health risks associated with water as the environment due to the occurrence of infectious diseases caused by bacteria, viruses and parasitic protozoa. I faecal pathogens, numerous other infectious microorganisms can be transmitted from diseased user pool to the other users. Also, the pool equipment and water alone in the pool, as well as the ventilation system or air conditioning system can be a habitat for some aquatic bacteria and amoeba that can cause various infections and diseases of the respiratory system, skin and even CNS. Especially as a habitat suitable for the therapy pool with her, as a rule, hot water, often rich in salts and other nutrients (Antonić et al., 2016).

The main risk reduction measures is to avoid conditions and situations that lead to increased occurrence of danger and one of the most important preventive measure is, of course, getting to know people with reduced immunity to avoid swimming pools because of the increased risk to their health. Many micro-organisms in the water basin originate from customers or users (with skin secretions from the nose or throat). Infected users of the pool can directly contaminate water around the pool, as well as the surface of the object and the material in time become a direct source of infection for other people who come into contact with contaminated environment (Antonic et al, 2014). The greatest danger to human health represents water contamination with human or animal excrement, or the direct or indirect fecal contamination$_5$. The risk of disease or infection from the pool water is essentially the most associated with: fecal pollution from bathers themselves or contained in the water source which feeds the pool. Many diseases resulting in a pool, a consequence of the poor performance of its disinfection or complete izostanka$_1$.For the appearance of some epidemic with certainty was found to originate from the pool, where the biggest culprits are considered habit of people to use the pool even if they are ill, but often these facilities for refreshment and recreation have become a hotbed of various diseases and infections. Most often cited as a cause of epidemic viruses, although recent incidents occur due to the presence of bacteria and protozoa. Certain species of fungi are also a very serious cause of many agents and surface infections of skin, hair, fingers bathers (Antonić et al., 2016).In summary use of the pool (either open or closed) carries with it a certain health risks associated with microbiological quality of the water (Antonic et al, 2014).

Risks from chemical hazards

Chemical in water of the pool derived from a number of sources, the most notable being: remnants of disinfectants and products of chemical reactions between them and the organic and inorganic materials from water which are toxic (trihalomethanes chloroform and bromoform most common), as well as those substances imported strawberries from customers themselves (remnants of soap, cosmetics, oils for sunbathing, etc.). These are mainly dermal contact, direct contact or ingestion of aerosol inhalation or of volatile chemical substances (Antonic et al, 2014a).

High dilution of pollutants, hygiene swimmers before entering the pool, good ventilisanost and use of alternative disinfectants are contributory procedures to minimize the risk exposure of the organism trihalomethanes. When it is in the application of ozone, the risks of disinfection by-products created are minimal (Kovačević, 2000). Reduction of chemical hazard will significantly contribute to the application

of the combination of slow coagulation with a filter. Dilution water and enrichment of new water, as well as the exchange of water is imperative for eliminating chemical hazards.

Input in the reaction of precursors and chemical constituents are dependent on the number of customers, urine, oil residues, applied cosmetics, soap and so on. Possible occurrence of trihalomethanes in the air above the surface of the pool water, thanks to its light volatility, usually elevated water temperature and water turbulence caused by movement of the user. Air contamination is higher in indoor pools and vulnerable persons who are long staying in and around water (children, swimmers, water polo players, workers at the pool, lifeguards) (Antonić et al., 2016).Contributory factors of the origination of trihalomethanes in the water as nitrogen ingredients in the sweat and urine, which can be found in the pool water (urea, ammonia, amino acids, creatinine, and other ingredients in the sweat and urine), as a possible precursor of the chlorinated by-product (Ivančev-Tumbas, 1998). The reaction between the precursors of trihalomethanes and chlorine during the chlorination of water is not immediate, it may take several days (Ivančev-Tumbas, 1998).The formation of disinfection by-products, one can substantially reduce the different measures: reduction in the intake of precursors derived from the user via the body hygiene, removing precursor from its water treatment or by dilution with fresh water and accurate disinfection process. Concentrations of disinfection by-products which are moved in the air, held well ventilated area (Antonic et al, 2014a).Bearing in mind the remarks made, originated the aim of this paper is to examine the physical-chemical and microbiological water indoor swimming pool SRC "count" as an indicator of pollution, and on this basis assess the safety profile of the pool.

Methodology

Water sampling swimming pool at RC "Fortuna" Banja Luka, in 2015 and 2016year, was carried out by representatives of the Institute for Public Health RS Banja Luka in the presence of the person responsible for the operation of the pool, and included:

- the water filling the pool - entry,
- preparation of water - clean, treated water and
- the water in the pool (closed type)

The test was performed in an accredited (EN ISO / IEC 17025) laboratory the Institute for Public Health RS, and methods for monitoring of the pool water (Official Gazette of the RS no. 68/14, Appendix IV).

Trials parameters of physical-chemical and microbiological parameters were performed according to Appendix 3, and the frame of the study are listed in Appendix 5 of the technical and sanitary-hygienic conditions (Official Gazette of the RS no. 68/14).

RC "Fortuna"

Fortuna SRC consists of the outdoor swimming pool for non-swimmers, swimming pools for swimmers, children's pool and the pool closed, including the restaurant and all ancillary facilities.

Indoor swimming pool with a depth of 1.5 m, the surface of the aqueous looked of 100.0 m^2 and a volume of 150.0 m^3. The pool can maintain a constant temperature of 25 ° C. Pool over four skimmers connected directly with a filter for water purification.

The pool is filled with water through city water hydrants from Banja Luka. Filling the pool can be performed manually or automatically via the electronic controller of the water level. When the pool is full automatic, water comes through the filter and heat exchanger and through the plant for disinfection, which means that only the prepared water reaches the pool. Because when you use the pool there is a loss of water by evaporation in part, a partial bodies of bathers, it is necessary to continually leads and poured fresh water. This allows devices such as electronic level controller, probe and solenoid valve.

Hydraulics pools establishing filtered water inflow into the pool through a one-way system floor and wall jets. Dirty water from the pool, and flows through the skimmer via the coarse filter, is sucked through the sand filters, with automatically necessary dosage of chemical and purified as purified and disinfected back to the pool. Dosing chemicals running through BAJROMAT-ANALIT-3U, measuring, regulating and dosing plant for the public sector. ANALIT-3U has set the alarm to the user to indicate specific conditions of work and possible problems. When a warning alarm dispensing temporarily blocked.

Heating swimming-pool water is carried out using two heat exchangers, which are installed in a supply of floor nozzle. The control is fully automatic control over the filter.

Test Results and Discussion of Results

In studies used retrospective results of the physico-chemical and microbiological tests of samples of pool water from a closed basins RC "Fortuna" Banja Luka between 2015 and 2016. In that period were tested 48 samples of water from swimming pools, and which is always preceded by examinations of clean treated water and water for filling swimming pools with defined parameters of the test, according to Annex 5 of the Ordinance.

Table 1. Results of physical-chemical analysis of water indoor swimming pool for the 2015/16 year

Date	2015						Date	2016					
	Cl	pH	color	NTU	OKS	THM		Cl	pH	color	NTU	OKS	THM
16.01.	0,50	7,35	< 5	0,14	3,40		13.01.	0,30	7,03	< 5	<0,02	<0,5	
29.01.	0,40	7,45	<5	0,09	2,70	52,10	28.01.	0,35	7,30	<5	<0,02	0,10	50,13
12.02.	0,50	6,65	< 5	0,04	0,00		08.02.	0,45	7,05	<5	0,08	1,40	
24.02.	0,30	6,74	< 5	0,02	0,00	46,99	24.02.	0,35	7,24	<2,5	0,12	0,00	57,50
13.03.	0,40	7,03	< 5	0,03	0,00		10.03.	0,40	7,03	<2,5	0,24	0,00	
25.03.	0,50	6,82	< 5	0,02	2,00	90,50	24.03.	0,40	7,01	<2,5	0,31	0,00	89,80
08.04.	0,35	6,84	< 5	0,04	0,50		12.04.	0,40	7,50	<2,5	0,21	0,20	
23.04.	0,30	7,79	< 5	0,02	0,00	77,00	25.04.	0,40	7,03	<2,5	0,29	0,00	49,90
30.04.	0,30	7,50	< 5	0,02	4,10		10.05.	0,45	7,04	<2,5	0,12	0,00	
12.05.	0,30	7,57	< 5	0,04	0,00	10,50	25.05.	0,45	7,04	<2,5	0,07	0,00	21,10
21.05.	0,35	7,50	< 5	0,04	0,00		08.06.	0,40	7,32	<2,5	0,04	0,65	
08.06.	0,40	7,32	< 5	0,04	0,00	54,80	27.06.	0,40	7,29	<2,5	0,28	0,00	67,80
25.06.	0,40	6,98	< 5	0,04	0,60		07.07.	0,40	7,30	<2,5	<0,02	0,07	
10.07.	0,50	6,92	< 5	0,04	0,00	47,30	20.07.	0,40	7,40	<2,5	<0,02	0,20	38,60
31.07.	0,40	7,21	< 5	0,02	0,00		03.08.	0,40	7,05	<2,5	<0,02	0,20	
11.08.	0,40	7,20	< 5	0,17	0,00	76,30	30.08.	0,50	6,98	<2,5	<0,02	<0,5	50,10
31.08.	0,45	7,01	< 5	0,18	0,44		05.09.	0,45	7,09	<2,5	0,24	<0,5	
10.09.	0,40	7,55	< 5	0,02	0,00	38,10	10.10.	0,40	7,02	<2,5	0,15	0,30	24,80
28.09.	0,50	7,01	< 5	0,02	0,00		26.10.	0,40	7,02	<2,5	0,27	<0,5	
20.10.	0,40	7,01	< 5	0,02	0,00	49,90	07.11.	0,45	7,08	<2,5	0,30	0,00	17,60
02.11.	0,45	7,03	< 5	0,02	0,00		28.11.	0,45	7,30	<2,5	0,40	<0,5	
11.11.	0,35	7,03	< 5	0,20	0,00	38,10	08.12.	0,45	7,50	<2,5	0,10	<0,5	38,10
19.11.	0,40	7,10	< 5	0,04	0,00		13.11.	0,30	7,03	< 5	<0,02	<0,5	
25.11.	0,35	7,01	< 5	0,02	0,40	46,20	28.11.	0,35	7,30	<5	<0,02	0,10	32,15
03.12.	0,40	7,03	< 5	0,12	0,30		5.12.	0,45	7,05	<5	0,08	1,40	
29.12.	0,40	7,19	< 5	0,02	0,00	84,40	27.02.	0,35	7,24	<2,5	0,12	0,00	57,50

Permanganate index as the concentration by weight is equivalent to the quantity of the permanganate ion is the usual method for the determination of pollution of water and an organic oxidisable inorganic substances, is used for the determination of the parameter **"oxidizability".** Water for filling tank (inlet water municipal water supply system), a pure water and the treated water of the closed bathing pools (Table 1, Figure 1), show a very low oxidizability, which is far below the allowable concentration (0.75% above the value of the filling of the pool). The high content of organic matter in the water that is chlorinated may represent precursors to the formation of toxic trihalomethanes.

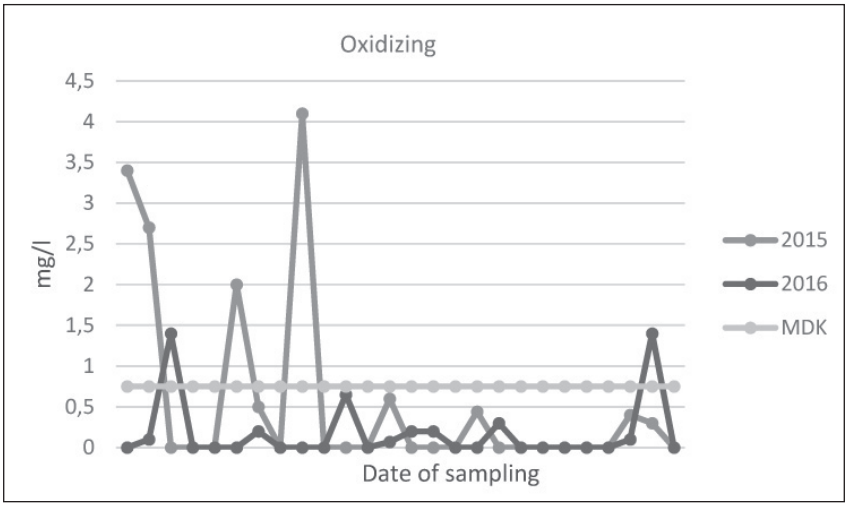

Figure 1. Oxidizing

Free chlorine (residual chlorine, excess chlorine) as parameter epidemiological safety regulations is at a certain level to be determined in pure water and processed water pools for swimming and recreation. Prescribed values of free chlorine in pure water in a concentration of at minimum 0.05 mg / l up to a maximum of 0.5 mg / l. Trials it was found that the concentration of free chlorine in the prescribed value and ranges from 0.2 to 0.5 mg / l. Prescribed values of free chlorine in the pool water of at least 0,12 mg / l up to a maximum of 1.02 mg / l, and the test results (Table no.1, Figure 2) showed that the determined values were within the prescribed limits and that the ranged from a minimum of 0.3 mg / l up to a maximum of 0.5 mg / l.

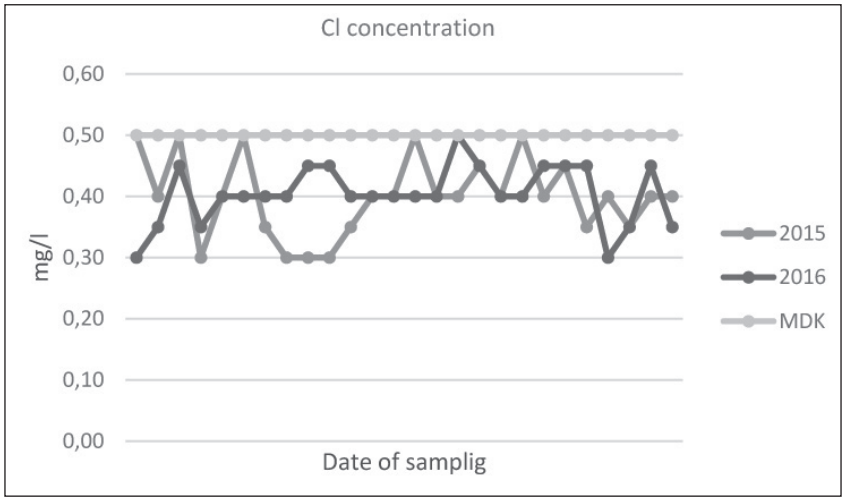

Figure 2. The concentration of Cl ions

The pH value is defined as the negative log of hydrogen ion of which depend on many chemistry in water, and thus the chemical composition of water, it is also important as a condition for successfully

implemented a method for purifying water in the application of means for coagulation and flocculation, as well as the conditions for successful and effective water disinfection. pH value under the provisions of the Ordinance moving, and for clean water and pool water, within the limits of a minimal 6.5 to a maximum of 7.6. Trials it was found that the pH values and the clean processed water and the water in the swimming pool is located within the prescribed limits (Table no.1, Figure 3).

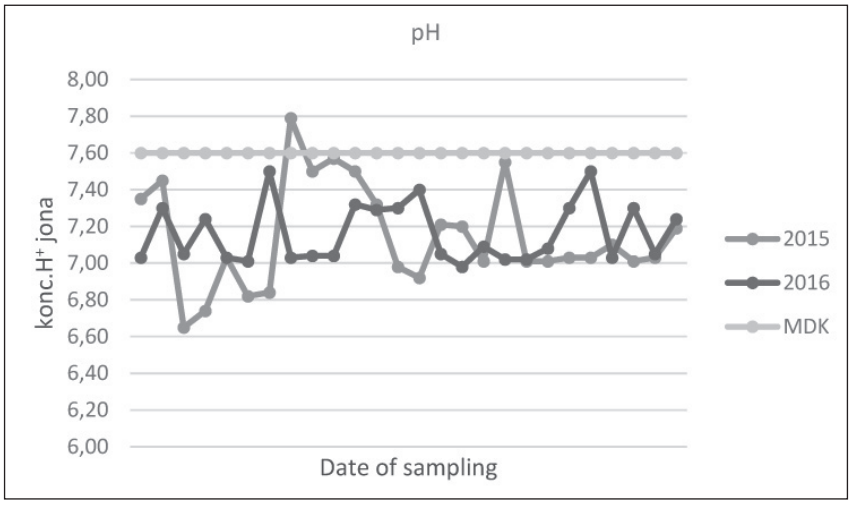

Figure 3. Concentration pH

The color of water, is determined by determining the spectral absorption coefficient at 436 nm = & regulations is set as a maximum value for the pure water of 0.4, and the pool water of 0.5. Testing of the color of water was carried out only in the water basin (table 1), and in all samples found to be located below the maximum permissible value. **Turbidity (turbidity)** is defined by regulations to be monitored only in the water basin for bathing and as determined by a maximum value of 0.4 NTU. Trials it was established (Table 1) that the present value of Cretaceous least 0.02 to a maximum of 0.35 NTU.

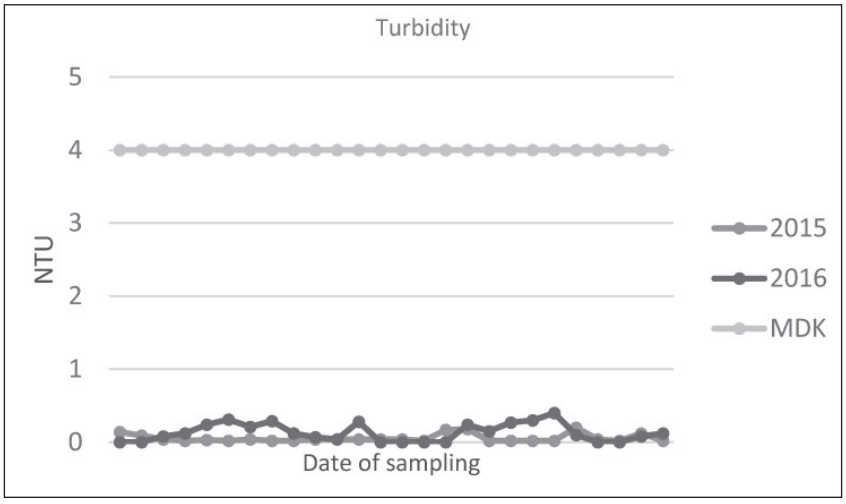

Figure 4. Turbidity

In the process for water disinfection with chlorine as a disinfectant, is formed about 200 different organochlorine compounds, of which four trihalomethanes: chloroform, bromdihlormetan, bromoform and dibromhlormetan. **Trihalomethanes**, as disinfection by-products formed by the reaction of chlorine as a disinfectant with organic impurities from the water, and are rarely present in the crude, nehlorisanoj water,

and their quantity depends on the temperature, the concentration of halogen-free, organic substances, and pH. The reaction between the precursor of trihalomethanes and chlorine during the chlorination of water is not present and can last for several days. Legislation is intended to be determined only by trihalomethanes in the water of swimming pools and that as total trihalomethanes whose maximum value is 100 mg / liter. Testing was done once a month over the two year follow-up period showed (Table 1, Figure 5) that the amount of trihalomethanes ranged from 10.5 to 90.5 g / l. Although the amount of trihalomethanes created is not current, the determined content may be associated with increased oxidising in this test period.

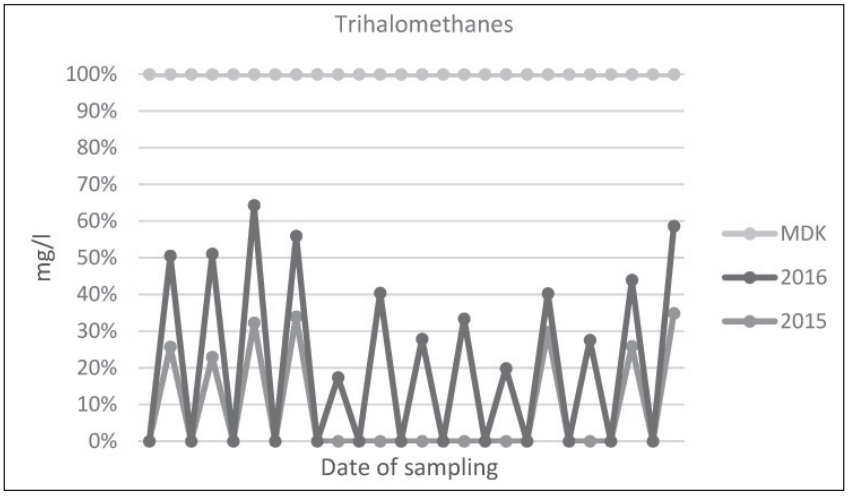

Figure 5. The content of trihalomethanes

Microbiological tests were carried out in pure water and processed water from the pool. Examining all the samples included the following parameters: Pseudomonas aeruginisa, Escherichia coli and total number of aerobic bacteria at 37^0C / 48 h. Trials it was found that none of the samples of clean treated water, in two-year study period, Figure 6 and Figure 7, are not detected Pseudomonas and Escherichia coli aeruginisa above permitted level (<cfu / 100 ml). Showed the presence of total aerobic bacteria at $37\,^0$C / 48 h, as well as indicators of water contamination, above the allowed value (20) into the water samples. All parameters of microbiological tests that exceed the exposure limits are corrective measures rehabilitated extraordinary trials. The test results of the pool water, in the same period of follow-up, we can see that only one sample is established from Pseudomonas aeruginisa, while the presence of Escherichia coli has not been proved in any of the sample test over the allowable value (cfu / 100 ml) Table 2.grafikon 7. It has been found, also, that the water in the pool has an increased total number of aerobic bacteria at 37^0C / 48 h, as well as indicators of water contamination, in case five, which is successful rehabilitation of emergency such as analysis and confirmed by.

Table 2 . The results of microbiological tests of pure processed water 2015/2016

	Pseudomonas aeruginosa	Escherichia coli	Total aerobic bacteria at 37	Date	Pseudomonas aeruginosa	Escherichia coli	Total aerobic bacteria at 37 °C
16.01.	0,00	0,00	20,00	13.01.	1,00	1,00	0,00
29.01.	0,00	0,00	3,00	28.01.	0,00	0,00	0,00
12.02.	0,00	0,00	0,00	08.02.	0,00	0,00	0,00
24.02.	0,00	0,00	10,00	24.02.	0,00	0,00	0,00
13.03.	0,00	0,00	5,00	10.03.	0,00	0,00	0,00
25.03.	0,00	0,00	0,00	24.03.	0,00	0,00	0,00
08.04.	0,00	0,00	<300	12.04.	0,00	0,00	0,00
23.04.	0,00	0,00	16,00	25.04.	0,00	0,00	0,00
30.04.	0,00	0,00	15,00	10.05.	0,00	0,00	0,00
12.05.	0,00	0,00	<200	25.05.	0,00	0,00	0,00
21.05.	0,00	0,00	<300	08.06.	0,00	0,00	0,00
08.06.	0,00	0,00	55,00	27.06.	0,00	0,00	0,00
25.06.	0,00	0,00	35,00	07.07.	0,00	0,00	0,00
10.07.	0,00	0,00	68,00	20.07.	0,00	0,00	0,00
31.07.	0,00	0,00	<300	03.08.	0,00	0,00	0,00
11.08.	0,00	0,00	15,00	30.08.	0,00	0,00	300,00
31.08.	0,00	0,00	3,00	05.09.	0,00	0,00	0,00
10.09.	0,00	0,00	8,00	10.10.	0,00	0,00	0,00
28.09.	0,00	0,00	2,00	26.10.	0,00	0,00	10,00
20.10.	1,00	1,00	10,00	07.11.	0,00	0,00	3,00
02.11.	1,00	1,00	0,00	28.11.	0,00	0,00	0,00
11.11.	16,00	1,00	15,00	08.12.	0,00	0,00	200,00

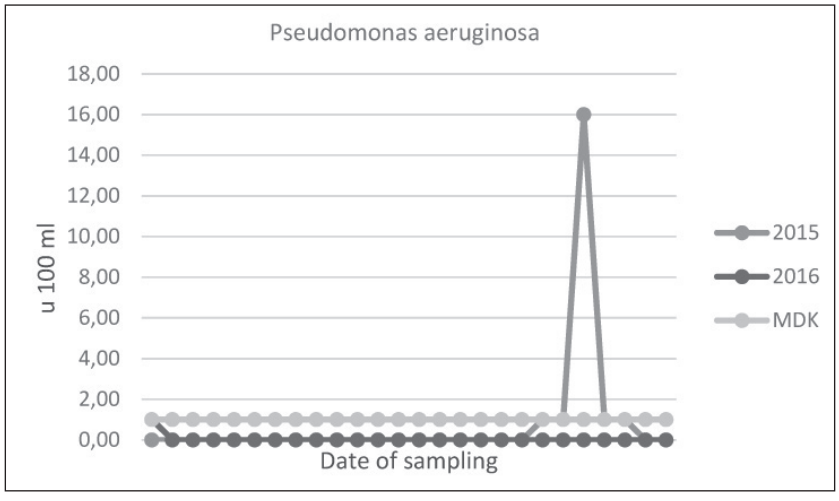

Figure 6. Pseudomonas aeruginosa

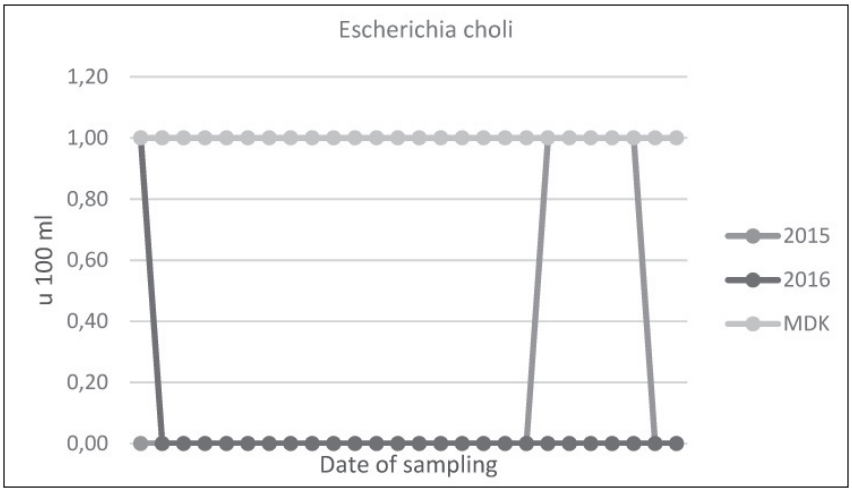

Figure 7. Escherichia coli

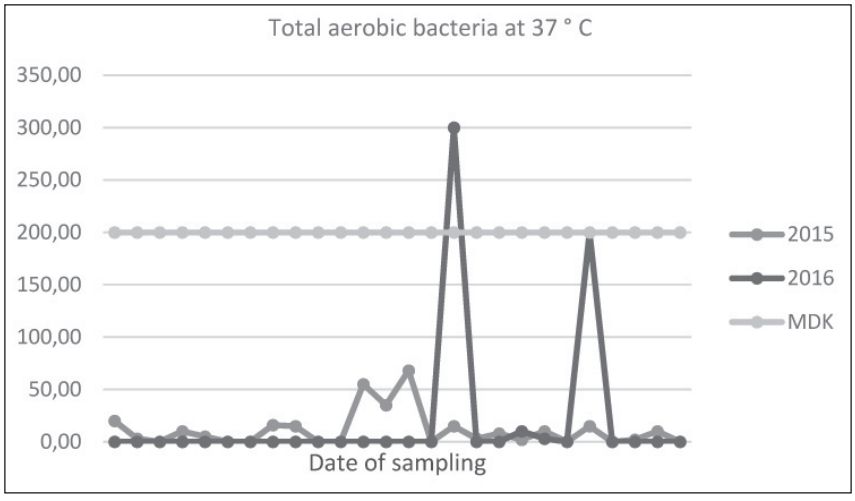

Figure 8. Total number of aerobic bacteria at 37 ° C

CONCLUSIONS

Based on the test results of water indoor pool for swimming and recreation in the two-year study period, we can conclude the following:

- The results of all physical and chemical parameters are within the permissible values and their maintenance as these do not threaten the health of users of the pool.

- By-products of water disinfection is also located within the allowable values for groups of users with increased exposure (children, athletes, water polo or in people who work at the pool) may constitute presently in danger to human health, is also located within the allowable value, but they can still significantly reduce the variety of measures: reducing the intake of precursors originating from users through body hygiene, by removing precursor from its water treatment or by dilution with fresh water and accurate disinfection process.

- Concentrations of disinfection byproducts that are crossed in the air, held up well ventilated.

- Results of microbiological parameters are within prescribed values, with sporadic exceedances, mostly aerobic mesophilic bacteria, that upon finding corrective measures have been rehabilitated and confirmed by re-analysis.

- Use of the pool, open or closed, carries with it certain health risks associated with microbiological quality of water. Water Treatment reduces the extent of that risk, but that most of the security measures users can achieve only disinfection of water in the pool and the constant maintenance of residual concentration disinfectant assets.

- Culture and self-discipline bathers are productive factors of its security.

- Authors extend the title of this work and feel that hygienic water pools for swimming and recreation, which was the subject of observation, not the result of random events, but deliberately designed preventive actions, proceedings and actions in securing a healthy safe water for bathing in accordance with legal regulations and as a measure to prevent and control of infectious diseases.

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