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Applied Technology and the Quality of Drinking Water

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Abstract: Water is the basic ingredient necessary for the maintenance of life of people and makes 60 - 70% of body weight. It is the most important ingredient in the tissue of plants and animals. In addition, water is one of the most important raw materials in industry. Due to irresponsible use of water in the past, there is great danger that humanity will have serious problems in the future, both in terms of water quantity and in terms of water quality. It is still not too late that from this point forward, all of humanity take austerity measures and water conservation as a strategic raw material in the future. Every individual and every community, both individual and joint efforts can at least mitigate this problem.

Quality and hygiene of drinking water and water as raw materials in the food industry today are the parameters of quality of life, of which each local community must take more into account. The paper analyzes the situation in water abstraction from the wells that supplied Srbac drinking water, and chemical and microbiological quality of water in the aquifer, the water supply network and the reach of water consumption in the period from 2005-2009. The results obtained in this paper suggest that the appreciation of the applicable regulations in this area and conscientious work of all participants in the supply chain can affect the water today for the needs of the population can provide a satisfactory water quality, and at the same time can preserve water reserves for future generations.

Keywords: Drinking water, Quality, Sanitary-Technical Conditions

Introduction

Water is the source of life in the country. Water in nature is the most common material and covers 71% of the Earth's surface. It is present in the atmosphere, hydrosphere, biosphere and lithosphere. Water in the biosphere is most commonly found in liquid form, which appears in the form of vapor and solid state. Of the total amount of water, only 2.4% of the water is fresh water and can be used to meet most human needs. The largest part of the fresh water is trapped in the ice at the North and South Pole. The second major part is located in the groundwater, and a river is the smallest part of freshwaters. There is a significant portion of fresh water in the atmosphere, but because of the increasing pollution of the water its quality is questionable (Dalmacija, 1999).

Water, as indispensable ingredient of life, holds a special place among environmental factors, and influences the lives and health as well as economic and cultural development of society. Water is a property of general interest, is the wealth of each country, it is socially-owned, and used to meet general and individual needs. Water has been and always will remain indispensable for the maintenance of human life, health and material wealth. Since the primary use of water for drinking, food preparation and personal hygiene, the development of modern society has led to the use of large amounts of water for various human activities and production processes in industry, agriculture and other industries (Manojlović et al., 1978).

Disturbances in the water supply can occur due to natural disasters such as floods, droughts, earthquakes, war and pollution of water supply facilities and water and chemical, biological and radioactive substances, which can cause far-reaching consequences.

Of great importance for the quality of water are: the origin of water, the method of abstraction, safety equipment, the choice of plumbing material, procedures and methods of purification, disinfection, control of safety in accordance with applicable legislation (Antonić et al., 2010 b).

Taking into account the importance of water for human life and health, the aim of this paper is to examine the current situation of water supply from wells in Srbac, and to conduct monitoring of water quality and safety, and on the basis that it points to certain shortcomings in the existing system of water supply and propose measures to be taken to ensure the hygienic drinking water.

The need and importance of using groundwater

In their composition and hygienic quality, if abstracted according to the technical and sanitary-hygienic principles, groundwaters are the most suitable for supplying the population with drinking water. Basal temperature of the water is relatively constant and depends on climatic conditions, field and air temperature, precipitation and groundwater environment. The taste of water depends on the dissolved minerals. Natural water composition can change significantly due to the pollution of air and land with which it comes into contact in the hydrological cycle. Methods of conditioning underground water are most suitable for the preparation and treatment for drinking (Kristoforović, 2003).

Groundwater is generated as a result of precipitation plunging from the ground surface. Speed of descent depends on the geological structure of the terrain. The Earth's crust contains waterproof and permeable layers. The impermeable layers consist of clay, marl or uncracked rocks. Above these layers are water-bearing strata which are the composition of sand and gravel and can be found at various depths. Waterproof layers are important because they protect the groundwater from pollution coming from the soil surface (Antonić et al., 2010 a).

The quality of groundwater as a resource for supplying drinking water must be in accordance with the Regulations on the hygiene of drinking water (Anon, 2003b). This Ordinance prescribes the hygienic quality of drinking water used for public supply population or for the preparation and production of food.

Catchment water wells

The choice of location for the well is chosen so as to prevent any pollution to surface and groundwater. To this end, the well should not be placed in a depression on the floodplain site, should not be near sources of pollution such as septic tank, dump, cemeteries, etc. Care should be taken into account that the well has a good approach, sufficient capacity, not be located next to the slopes, inlets and drainage ditches due to whose action, in dry years, can stay without water. Particular attention should be paid to the direction of movement of groundwater, of which will ultimately depend the location of wells (Antonić et al., 2010 a).

Wherever possible, primarily use deep drilled wells as hygienic water supply safest way. They are impermeable to surface water and water from the upper layers of soil. Their capacity, if the water is taken to greater depths, almost does not depend on fluctuations in rainfall, which causes a more constant temperature and constant chemical composition of water. Drilled wells in terms of hygiene are much more acceptable than dug and killed because the water from them in terms of species is much better with the assumption that they are built to the technical and sanitary-hygienic principles, i.e. to prevent mixing of water from shallow layers with hygienically safe water from the aquifer (deep layers) (Antonić et al., 2010 a).

Regulations on safety measures, the manner of determining and maintaining zones of sanitary protection zones, areas of water sources, water supply facilities and water intended for human use (Anon, 2003b) recommended the establishment of sanitary protection zones and belts of sanitary protection.

Under the water, disinfection process involves the destruction of pathogenic and saprophytic microorganisms to train as potable water, or to reduce the bacterial flora in concentrations below the permissible maximum. It should be borne in mind that successful water disinfection can be carried out only in clear water. Slightly turbid water interferes with the disinfection process and does not guarantee obtaining microbiologically safe water (Rasić, 1985).

In the field of supplying the population with hygienically safe water for drinking, exercise, such as regular checkups and hygiene of drinking water and control of the state of water resources, distribution system and sanitary protection zones are conducted (Dalmacija et el., 2004). Hygienic quality of drinking water is regulated by Rulebook governing the hygienic quality of drinking water (Anon., 2003b) and Rulebook on protection measures, the manner of determining and maintaining zones of sanitary protection zones, areas where there are sources, as well as water supply facilities and water intended for human use (Anon., 2003a).

General information about the location of water in Srbac

Srbac is located in the western part of the Republic of Srpska and the north of Bosnia and Herzegovina's territory and the procedures around the lower river Vrbas to the eastern slopes of Motajica, and the Sava River in the north to the Careva Gora and Lipica in the south.

Organized supply of drinking water through the municipal water supply system in Srbac began in 1966. Hydrological research in this field has been carried out in the village of Mali Sitneši approximately 1.5 km southeast of the urban part of Srbac in 1965. The realization of research work, water supply solutions to urban areas drilled two wells in the zone of sand-gravel sediments of Quaternary and Pliocene depth of 16 m and 17 m, with the distance between them being 105 m. In the exploitation, the wells were supposed to provide Q = 30 l / sec quality groundwater water with a decrease of S = 5.6 m. In the process of pumping pretests the quality of groundwater was not tested. Then they built a reservoir of volume V = 400 m3 of water.

Richness over time showed a tendency of constant reduction of the capacity (Q = 18 l / sec, S = 9.6 m). The conclusion is extremely high content of Fe-ions up to 42 times higher than what is allowed according to Ordinance on hygienic quality of drinking water (0.3 mg/l), which caused the installation of devices for aeration, rapid filters with silicium sand and devices with deferization with coke batteries, which did not resolve the problem of water quality. As a source of exploitation was not satisfied regarding the quality and quantity of groundwater, then current, and analogy and perspective of Srbac development and its economic development, came to define a new source of underground water of better quality and greater capacity.

It was then determined that the investigative work must be performed in the hydrogeological alluvion right bank of the river Vrbas in Oriolik - Prijebljezi - Srbac. Frontier areas of research were done on the north side of the field, south of the Sava River, in the east of the field in the move too - Ina river, the terrain in the south of the river Vrbas - Sređani Village - Village Brezovljani - Povelic River, and west of surface flow of the river Vrbas. Research area consisted of approximately 40 km2. The purpose of the hydrogeological study was to collect data for exploring the aquifer properties of alluvial collectors in this part of the terrain and determine the conditions and possibilities of groundwater's exploitation for Srbac water supply. Studies with data processing were performed in the period from December 1978 - January 1980 (Investprojekt, 1981).

Hydro-chemical research, the determination of qualitative properties of the accumulation of free groundwater in the alluvial sediments of the river Vrbas had a crucial importance in making decisions about building test-exploitation wells EB-1 and EB-2.

On the basis of the report on the quality of the groundwater, samples were analyzed from the standpoint of physical and chemical composition of good and uniform quality. The concentrations of all components that have been determined, with the exception of ammonia and nitrite, were below the maximum allowable concentration. The concentration of ammonia and nitrite is quite high and does not satisfy the above Ordinance.

The origin of these components is partly due to the degradation of organic material in surface sediments. Organic matter originating from the meander and the elderly that existed before the reclamation performed in this field, as well as their deposit "in city", which can be explained by reduction of the "evaporating residue" in water samples, were tested during the time of drawing. These are partly of the artificial origin, since the terrain in which ground water supply is abstracted is processed and the soil enriched with fertilizers for about 15 years, containing ammonia and nitrite.

Based on the reports of microbiological testing of all three samples, tested groundwater wells with EB-1 contain a certain percentage of "coliform" bacteria that by technological processing the underground water chlorination was eliminated so that the water fully meets the requirements of the Ordinance on the hygienic quality of drinking water. Origin of pollution comes partly from the water supply construction period, a part of the local character, which will eliminate the organization of sanitary protection zones.

Analysis of the research results demonstrated hydrogeological and terrain data evaluation and exploitation of alluvial sediments and the possibility of qualitative properties of the groundwater of the wider area of research. Conducted research showed that in the zone of alluvial sediments, the right bank of the river Vrbas, in the Prijebljezi area, contains rich natural reservoirs of free ground water, which can provide the abstraction and exploitation of Q = 200 l / sec groundwater for water supply. The relatively large spatial distribution of gravel complex sediments with the prevailing hydrogeological properties of the collector, enabled in this part of the terrain formation of large aquifer in rocks of considerable thickness ranging from intergranular porosity structure. A free level has been released, and at higher water levels the river Vrbas character gets released under pressure, subarterial character (Investprojekt, 1981).

Crucial to the creation of natural reserves of this accumulation of free groundwater are the surface waters of the river Vrbas. Underworld contacts in other parts of the alluvial aquifer and the infiltration of precipitation "in city" is much smaller. General direction of groundwater is a southwest-northeast, with small gradients falling groundwater flow (i = 0.001 to 0.002) in natural conditions (Investprojek, 1981).

Complex alluvial gravel aquifer is characterized by good filtration and reservoir properties. Spatial heterogeneity of size distribution, i.e. the difference of natural relations of lithologic composition caused a certain local differences in gravel filtration properties of the complex. Existing hydrodynamic characteristics and spatial distribution of a large complex of alluvial gravel aquifers have enabled the movement of test-exploitation wells, compared to the river bed of Vrbas to the boundary where the infiltration of the river Vrbas natural cleaners are supposed to obtain properties of groundwater water-quality (Investprojekt, 1981).

Based on the results of the research and development and exploitation well test-EB-1 and EB-2, water abstraction facilities present good technical characteristics of the event without excessive loss of pressure in the well or nearby wells. Inlet velocity affluence of underground water in the wells of the realized and projected yields is in the area of allowable speed affluence.

Comprehensive analysis of the results of hydrogeological studies may be taken the view that a well developed system can provide the amount of groundwater from Q = 160-200 l/sec water catchments without building new facilities in the area of Prijebljezi water supply. Such a system of 2 wells has resulted in more pronounced reductions in water abstraction facilities, but also the possibility of organizing sanitary protection

zones on the lower surface of the water resources and abstraction of groundwater from deeper water-bearing gravel complex, better physical-chemical and microbiological properties.

In this sense, as in order to provide sanitary protection, it was decided that the definition of protection zones and the separation of this part of the field for the source must be done in accordance with the agreed plan of urban development and agricultural crops in the immediate and wider environment.

General information about water supply Srbac

Organized supply of drinking water of Municipality was conducted by the KP, "Water" AD Srbac water supply system. Water supply is gravity-displacement type. Municipal water supply system Srbac is 230 046 m long, capacity of pump station 120 l/sec, 1650 m^3 of reservoir space. It currently has 4530 connections and provides about 16,000 residents, and provides water for about 90% of industrial capacity and 60% of the population of the municipality.

Srbac water system is currently divided into two separate parts: water and plumbing Srbac Lijevče field. Plumbing Srbac comprises: source "Prijebljezi" with two punched wells, chlorine cells, displacement pipelines ø 400 mm diameter and 500 mm, length 7000 m, two tanks total capacity of 1650 m3 and distribution network totaling 183 625 m (primary secondary 124 702 58 923 I m). Within this water, works hydrostation 8, which increases the pressure for consumers in other highland areas. Piping material in water supply Srbac is mainly PVC (chloride) - 85%, while the presence of other materials is 15% of profiles of more than 50 mm in diameter. Profiles smaller than 50 mm in diameter (distribution network) are made of HDPE (High Density Polyethylene) pipe. The largest part of the water network (90%) was built in 80s.

Plumbing supplies Lijevče field from the source "Prijebljezi" from the same wells and water Srbac. Transport 300 mm diameter pipeline connects the source of the bridge over the river Vrbas to the settlements Lijevče fields. Total length of the main pipelines (sections ø 80 mm and larger) need to be 17 601 I distribution network (small sections of ø 80 mm) in length 28 820 m, a total of 46 421 m of water supply network. This water is currently connected to 298 households, and for another 113 access is allowed. Material for pipe Ø 300 mm iron Lebanon is insulated, the profile of ø 80 mm to 200 mm diameter PVC profile and less than 80 mm diameter HDPE pipe. Plumbing Lijevče Field was built in the period from 1999-2001. (Reuters Pack documents KP Plumbing)

The source of water Srbac

Location Lipovo source is a field in the village Prijebljezi, 8 km away from Srbac. Hydrogeological relations and status of this area in relation to the river Vrbas initiated the construction of water catchments as well as object vertically drilled wells of infiltration type, whose work demonstrates favorable conditions for the formation of additional reserves of groundwater on account of the Vrbas river water. There are two wells punched EB-1 depth of 18 m and EB-2 depth of 19 m. Well EB-1 is away from the bed of the river Vrbas 500 m, and the well EB-2, 743 m. The distance between the wells is 243 m. The wells are drilled by direct method; drilling diameter was 600 mm, with built-Well structures ø 500 mm from the filter (a combination of bridge-like and rectangular) "geomachine" type.

Conduit and boxes are constructed of reinforced concrete structures in combination with a facade brick measuring 3.0 x 3.0 m height of 5 m. The elevation of falling objects was 96.00 and was raised in relation to the field of 1.5 m because the wells are located in the water defense area. The peak elevation of field wells is 93.50 m above sea level. Estimated minimum water level in wells is 86.40 m above sea level. The total yield of Prijebljezi spring is 180-200 l / s. Gas plants now allow the procedure 120 l / s of both wells. Currently, the average extends over 60 l / s. Pipelines from the wells to the displacement of the joint

pipeline are made of cast iron Class "A" ø 500 mm with a working pressure of 12 bar. Wells are connected with chlorine metering station with crushed stone roads width of 3 m.

Program of sanitary protection of water at the source "Prijebljezi" Srbac was made on the basis of the Law on Waters, Regulations on protection measures, the manner of determining and maintaining zones of sanitary protection zones, areas where there are sources, as well as water supply facilities and water intended for human use (Anon., 2003a) and the Law on Physical Planning, pursuant to which the Ministry of Agriculture, Forestry and Water Management issued a water management agreement.

Precision surveying the boundaries of each buffer zone are descriptive and graphic Study provided in the "zone of sanitary protection of water resources Prijebljezi." The first zone area of 17.25 ha is defined by the coordinates of eleven points that are marked with the letters A to K. The second area of 55.25 ha zone is defined by boundaries of parcels and one p.m. coordinates of points marked with Arabic numerals from 1 to 13. The third zone, surface 195 ha, is defined by the existing boundaries and coordinates marked by Roman numerals from I to XXVII.

Signs marking the zone of sanitary protection are placed on all main roads and highways that come to the zone, and on roads and highways that pass through the zone. Sign is placed at the entrance and exit from this zone on their borders. Sanitary protection zones are also marked in the area that is outside the corridor road or roads so as to provide proper access to information, namely, four characters for the zone of immediate protection, and eight characters for the immediate protection zone and the twelve signs of the wider protection zone.

Maximum "Prijebljezi" spring design capacity (from two wells) is 180-200 l/s, while the maximum designed capacity of the plant and facilities at the source is 160 l/s, with a current capacity of the pumping plant 130 l/s. The projected plant capacity is sufficient for the needs of the planning period, the reduction of losses in real boxes.

With "Prijebljezi" spring, 14,000 residents, or about 60% of the population of Srbac is supplied with water. Currently there are 4,000 connected households, and 300 other outlets (shops, businesses and institutions). All consumers annually deliver (invoice) 700 000 m^3, of which 600 000 m^3 of households, and 100,000 m^3 of other consumers.

Plan of conditioning and purification of water sources "Prijebljezi" shall be constant chlorination, by which regulations and quality standards in accordance with the applicable Rules of the hygienic quality of drinking water are met (Anon., 2003b).

Water distribution plan envisaged a 24-hour supply, and continuous supply of the population and other consumers of drinking water. In the event of interruptions in the supply of water longer than 24 hours, the company is obligated to provide water tankers for drinking and minimum hygiene needs for the population of Srbac.

Plan of quality monitoring and water quality control provided the following: the location of the source (after chlorine cells) measured concentrations of present residual chlorine, and the results are entered into the record book. In relation to the equivalent number of inhabitants, the basic analysis is carried out 3 times a month, and recurring on annual basis. Samples are taken from sources in Prijebljezi, reservoirs Srbac and 5 points on the water network (Sitneši, Srbac, Nozicko, Glamočani and Kladari). The number and types of inspection as well as the sampling sites, were in accordance with the Regulations on the hygiene of drinking water (Anon., 2003b). Analyses of water are conducted in the Institute for Public Health in Banja Luka. Program of sanitary protection of water at the source "Prijebljezi" is made for a period of 8 (eight) years. In the case of breakdowns and other dangerous pollution affecting the health of the residents, the source protection areas "Prijebljezi" has planned measures, procedures and accountability in the event of disasters and other hazardous kinds of pollution.

Methods of research

The research in this paper was conducted in AD Water and ZU "Health" Srbac in hygienic and epidemiological services on the basis of inspection of water facility and main water supply in Srbac.

The research was done on the basis of retrospective analysis of results of water samples conducted in the period from 01.01.2005 until 24.08.2009. Observed is related, as the microbiological quality of drinking water from the tap, and the physical-chemical validity of samples. The results are analyzed, and presented in tables by numerically absolute and relative numbers, and then graphically.

The total sample was divided according to the age and parameters monitored by microbiological and physical-chemical parameters for the assessment of water quality were demonstrated. In monofactorial analysis the absolute and percentage ratio of defective sample of the correct analysis of water samples by years of monitoring was considered. In multifactorial analysis the total number of faulty analysis in relation to the total number of correct analysis of water samples and the most common contaminant was considered.

Results and discussion

The work was done on the basis of retrospective analysis of data on microbiological and physical-chemical analysis of water samples for drinking water supply system Srbac for a five-year period (from 2005 to 2009), in order to realize the quality and hygienic safety of water from the mentioned water supply system. In the area of supply of the population, hygienically safe water for drinking is controlled in terms of regular checkups of the hygiene of drinking water, and control of the state of water resources, distribution system and sanitary protection zones.

Hygienic quality of drinking water is regulated by Regulations governing the hygienic quality of drinking water (Anon., 2003b). This Regulation prescribes the hygienic quality of drinking water used for public supply population or for the preparation and production of food. Drinking water is considered proper hygiene when it meets the requirements of the regulations in respect of: microbiological features, content of chemical substances, residues of coagulation and flocculation funds, disinfectants remains and incidental disinfection products, physical, physical-chemical properties and chemical and radiological properties. Types of drinking water include physical-chemical, chemical, physical, biological and microbiological parameters specified in this Regulation.

Sanitary Protection Zone Regulations governs the protection measures, the manner of determining and maintaining zones of sanitary protection zones, areas where there are water sources and water supply facilities and water intended for human use (Anon., 2003a). As described above, the zones of sanitary protection of watercourses in the spring Prijebljezi are clearly defined; measures for the way of monitoring are established. In this regard it is necessary to prescribe the use of space and construction of buildings on the same and comply with the provisions of the Regulations and guidance on protective measures, the manner of determining and maintaining zones of sanitary protection zones, areas where there are water sources and water supply facilities and water intended for human use (Anon., 2003a), and successfully solve the disposition of waste, rainwater and sewage and surface water from the main road Poplar-Srbac, limit the excessive use of fertilizers and pesticides, and educate the population about the proper use of these funds and disposal of used packaging.

It is necessary to regularly maintain the defense embankments in the immediate area of protection (Zone II) in order to prevent spring flooding because they are located in the same area and water defense inspection and maintenance of bank revetment of the river Vrbas in the wider protection zone (Zone III) in order to prevent movement of the river Vrbas Prijebljezi source. It is also necessary to prohibit the extraction of gravel and sand in the wider protection zone on the river Vrbas. In the immediate protection zone (Zone I) keep a register of labor records, records of work stations and the amount of water produced, as well as the book of check-ups.

In the period from 01.01.2005 to 24.08.2009 the laboratory has tested 393 samples of water from the water supply system in Srbac (Table 2). Water samples were analyzed at the microbiological and physical-chemical parameters (Table 3). Assessment of hygienic drinking water was made in relation to the existing regulations for hygienic drinking water Official Gazette of RS (Anon., 2003a). The results of analysis concern the scope of the initial survey analysis. In all the samples the basic overview of water was carried out, and it can be seen from these five-year period that the number of analyzed samples is of a growing trend (33 in 2005 and 119 in 2009 - until 24.08.2009.). Samples were taken at the source (raw and disinfected water), reservoir and distribution network.

Table 1. Number of water samples taken for analysis at different sources, 2005-2009

Sampling location	Year				
	2005.	2006.	2007.	2008.	2009*
Water well I	-	-	-	20	4
Water well II	-	-	-	26	23
Source Prijebljezi	11	12	12	28	23
Reservoir Srbac	11	12	12	28	23
Perutnina Povelič	-	-	11	28	23
Other points	11	12	12	28	23
Total	33	36	47	158	119

*ending with the samples taken on 24.08.2009

Table 2. Number of water samples taken from fixed and variable points

Year	The number of samples for fixed points**	The number of samples at varying points	The total number of samples taken from water supply system Srbac
2005.	22	11	33
2006.	24	12	36
2007.	35	12	47
2008.	130	28	158
2009.*	96	23	119

*ending with the samples taken on 24.08.2009
**further analysis is presented relating to the control of fixed points

Until the year 2008, the sampling for microbiological and physical-chemical analysis was performed once a month on a small number of places and that was certainly not enough according to the amount of water distributed to consumers. Changes in the way of water sampling took place in 2008, after the Republic of sanitary inspectors requested the control of water and insight into current state, after which they issued a decision and request that sampling for microbiological, physical, physical-chemical and chemical properties required for a basic overview (list of 9:11 a.m. Ordinance on hygienic quality of drinking water Official Gazette. RS (Anon., 2003a) must be carried out three times a month from the following locations:

- Source (raw water samples) - Prijebljezi - 2 samples
- Source Prijebljezi (disinfected water) - 1 sample
- Tank – 1 sample
- Distribution network - 3 samples

The inspector's decision was also the request for the water to be sampled annually for the periodic review of water as follows: 2 samples of raw water from wells and 1 sample from the distribution system and to complete an investigation related to the physical, physical-chemical, chemical, microbiological and biological parameters laid down in the list 9, 10 and 11 for the periodic review of the Regulations on the hygiene of drinking water Official Gazette of RS (Anon., 2003b).

From this period (24.04.2008), K.P. "Water" A.D. Srbac properly plans the extraction of water samples for analysis on an annual basis and performs it fully.

When you consider the overall five-year period, it shows that the quality of the analyzed samples of drinking water plumbing systems Srbac from the standpoint of physical-chemical composition and microbiological characteristics is of good and uniform quality, because the percentage of contaminated samples on the total level is 4%, while the percentage of correct sample is 96 %. Proportionally small degree of irregularity, in terms of microbiological and physical-chemical parameters are indirect indicators of water quality at the source and quality of the technological process of the pipework Srbac. Reasons for failure in terms of physical-chemical parameters is of the turbidity (3 samples), and increased consumption of KMnO4 (1 sample), while in terms of microbiological parameters, the reason is the total number of aerobic bacteria (2 samples) and coliform bacteria of fecal origin (5 samples).

The highest number of contaminated water samples, both in physical and chemical (Table 3), and microbiological terms, refers to the water taken for analysis of the exploitation wells (raw water) which, after disinfection processes in reservoirs and distribution network, in terms of hygiene accuracy was within the parameters of reference which demonstrates that the disinfection process performs well and that the consumer gets hygienic water.

In terms of monitoring of drinking water it is necessary to make and comply with the annual plan on taking water samples for analysis in accordance with the provisions of the Ordinance on hygienic quality of drinking water (Anon., 2003b) regarding the number of samples, the place for taking patterns and frequency of taking water samples for analysis in relation to the conduct of basic and periodic reviews depending on the number of equivalent inhabitants.

Table 3 Number of correct and incorrect water samples taken for the analysis in the period 2005-2009*

Year	The number of taken samples	The number of defective samples				The number of valid samples	
		microbiological	chemical	Total		Total	
	piece	piece	piece	piece	%	piece	%
2005.	22	0	0	0	0	22	100
2006.	24	1	1	2	8	22	92
2007.	35	0	0	0	0	35	100
2008.	130	6	3	9	7	121	93
2009.*	96	1	0	1	1	95	99
Total	307	8	4	11	4	295	96

Water quality control plan in water supply system should be achieved in a way to allow the insight into the status of water quality at the source, after disinfection, water storage tanks in some parts of the distribution network and provide data for the assessment of certain parts of the distribution system in terms of preserving water quality and sanitation in pipeline. Obtained are systematically processed to get the right balance of water quality in water supply systems and we have to know what kind of the water comes to the user. Sampling plan is to determine the fixed and variable sampling points on the network that could monitor the actual status of water quality in distribution networks and to accordingly undertake appropriate measures.

Table 4. The average values of physical-chemical parameters of water quality, 2005 - 2009*

Year	pH	Consumption $KMnO_4$	Nitrate NO_3	Iron Fe	Manganese Mn
	pH jed.	mg/L	mg/L	mg/L	mg/L
2005.	7.54	2.7	10.1	0.032	0.012
2006.	7.47	2.9	9	0.033	0.02
2007.	7.23	2.5	6.7	0.03	0.01
2008.	7.35	2.6	10.9	0.035	0.01
2009.*	7.11	2.4	9.5	0.032	0.01

In order to improve the existing water supply system, it should be on schedule to make the planning criteria and technical documentation, construction of new pipelines and push to change the worn out, old street in the city Srbac pipeline, with the aim of quality of supply consumers with water and reduce water losses in the network that are currently high, amounting to about 42%.

Supplying consumers in other altitude zones is not satisfactory, but can be successfully solved by building facilities and installations in other high altitude zones. Due to network expansion and lack of reserve capacity, it is necessary to plan the construction of additional reservoir capacity and the reconstruction of the old reservoir V = 400 m3 of water.

Plumbing Srbac should make a plan of control and monitoring and maintenance of all buildings, plant, equipment and installation of water supply system that would include a plan boiler blow-down and flushing mains and reservoirs. They should also make the water cadastre, organize and maintain neatness and cleanliness in and around water supply facilities.

Conclusion

All the above shows that the quality of drinking water depends on the proper selection of sources based on comprehensive studies and their protection, the quality of raw water, the process of conditioning-disinfection and sanitary-technical conditions of the distribution system and measures to preserve water quality in the distribution system to consumers consisting of a consistent implementation, monitoring, controlling and maintaining of hygienic conditions at all points of the water supply system.

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