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INFORMATIONAL CHARACTERISTICS OF WATER CONSUMPTION IN HOTELS IN AREA OF RIJEKA

INFORMATIVNE KARAKTERISTIKE POTROŠNJE VODE U HOTELIMA NA PODRUČJU RIJEKE

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Abstract

This paper analyses the quality of municipal water in the hotels in the area of Rijeka as well as the amount of its consumption. This paper also discusses the probability of contamination and consequences that tourists and citizens who use such water could suffer. The area of this water system belongs to the karst relief marked by a significant underground circulation and high sensitivity to external influences which leads to contamination. Considering the peculiarity of karst aquifers, during heavy rainfalls after long dry periods there is a possibility of turbidity and microbiological water contamination which usually are not long lasting. Despite occasional hydro geological problems, the public utility company has organised a system for monitoring water quality in water supply system and sanitary correct drinking water is discharged into the system. Besides being drinking water, that water is clean and has good quality of mineral composition. Although Rijeka's water supply system is leading in Croatia according to security of water supply and drinking water, consumption in hotels is mainly related to sanitary water, because tourists do not have the habit of drinking tap water or they are not enough informed about such possibilities.

Sažetak

U radu su analizirani kvaliteta komunalne vode u hotelskim objektima na prostoru Rijeke kao i količina potrošene vode. Razmatrane su i vjerojatnosti onečišćenja te posljedice koje onečišćenje može stvoriti turistima i stanovništvu koje bi koristilo takvu vodu. Područje ovog vodoopskrbnog sustava pripada kršu za koji je značajna podzemna cirkulacija vode, te velika osjetljivost na vanjske utjecaje, odnosno na moguća onečišćenja. Obzirom na specifičnost krških vodonosnika, za vrijeme jakih kiša, nakon dužih sušnih perioda, moguća su zamućenja i mikrobiološka onečišćenja vode koja obično nisu dugotrajna. Unatoč povremenim hidrogeološkim poteškoćama, Komunalno društvo ima organiziran sustav praćenja kvalitete vode u vodovodu te se u sustav ispušta zdravstveno ispravna pitka voda. Osim što je pitka, ta je voda čista i kvalitetnog je mineralnog sastava. Unatoč činjenici da je riječki vodovod vodeći u Hrvatskoj, po sigurnosti vodoopskrbe i kvaliteti pitke vode, potrošnja u hotelima uglavnom se odnosi na sanitarnu vodu jer turisti nemaju naviku piti vodu iz vodovoda ili o takvoj mogućnosti nisu dovoljno informirani.

1. INTRODUCTION

Through the history the city of Rijeka was supplied with drinking water from numerous springs in the city (22 greater) and streams that are now mostly covered by buildings and roads. Their use was abandoned during the period of industrialization and urbanization of the city at the end of 19th century, due to numerous infections and epidemics which were frequent because of contaminated water. Nowadays the water of these springs, due to the direction of their flows beneath the urban

tissue of Rijeka, is not used for drinking but for technological purposes and irrigation of green areas.

In the period that preceded the commissioning of the first Rijeka's water supply system recommendations of the city authorities of that time to caterers were to use water from public wells in which were placed large quantities of quicklime/**1**/. It was a bit different with the hotel facilities that needed more water for working so they were built near water flows. An example of such a water supply became the Hotel Continental, which was built along the riverbed of Rječina /**2**/.

At the beginning of 20th century in Rijeka's tourism special attention was given to the so-called hygienic residence and therefore hotels Bonavia, Europe, Lloyd, Bristol, Royal, Hungaria, Imperial and Deak, and even some smaller hotels, became the first buildings in which the pipe plumbing was introduced and sewage system was built inside. Other buildings gained with water from the public outflow.

Although together with the construction of Rijeka's water supply system started implementation of chemical and bacteriological analysis of water and its sanitary protection, in the period between the world's wars, in hotels were evident more sanitary problems and guests complained about an excessive amount of chloride in the water /**3**/.

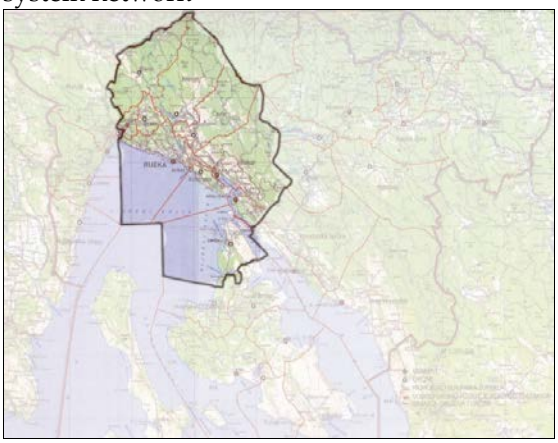
After the Second World War business technology in the hotels began to use more water and other unavoidable hotel installations (heating, ventilation, air conditioning, fire protection installations) that previously did not exist.

From the new data concerning the water consumption at municipal level of Rijeka, one can see that tourism is becoming, among economic subjects, an increasingly important consumer of the water fund, and therefore contributes to restrictive measures during the summer heats.

2. METHODOLOGY

The terrain covered by this paper is widespread in the area of Rijeka and in the area of municipalities Kostrena, Jelenje, Viškovo and Čavle as well as the cities of Rijeka, Bakar, Kraljevica and Kastav (Fig. 1). The municipality of Klana belongs to the organizational municipal system of Rijeka, but water supplies come from the water supply system of Ilirska Bistrica in the neighbouring Republic of Slovenia.

Figure 1: The area of the Rijeka's water supply system network



Writing the paper was preceded by thoroughly field test and exploration of the whole catchment and its hydrological mapping. Data about the inflow of water were taken from the database of the State Hydrological Institute.

In this research one part of the data was collected by the research interview (interview). Research interviews were conducted from February to November 2010. and include respondents who are indirectly involved in monitoring problems in companies, KD Water and canalization, Hotel Continental, Hotel Bonavia, lodging Lucia Kostrena, Hotel Neboder and Tourist Resort Scott Bay.

The aim of this paper is to examine the reliability of supply of hotel capacity with sufficient amount of water that has drinking quality and can be used without any health consequences. A hypothesis is will the environmental changes, in the near future, threaten the uniformity of water supply and method of water management.

3. THEORETICAL FRAMEWORK

In the case of other catchment areas as well as Rijeka's catchment area the amount of water depends on the hydrogeological and climatic conditions. Most of the catchment area of Rijeka and its hinterland built of limestone and

dolomite are the main aquifers. On such terrain underground runoff is greater than surface runoff. From the ecological point of view it is not so bad because the underground waters are more protected from contamination than surface water, and they also have better auto purification process. As springs these waters appear at the contact of carbonate and clastic rocks and at these places are the main sources from which Rijeka's water supply system takes water. The only problem is that part of the runoff is lost in the submarine springs or some of the sources become brackish and therefore are not drinking.

Finding adequate groundwater considering adequate quantity and quality of the environment and its engageing, is a complex geophysical work that is connected with tracing runoff and drilling in hard rock reaching great depths. Therefore, the research of the water fund in the whole catchment area is still not finished though it has been systematically monitored since 1994.

Surface runoff, which takes place along the Zala, Sušica and Rječina, is characterized by extreme values of flow and they make the development of water management more difficoult. But hydro accumulation Valići, built in the middle bed of Rječina, can have importance as a reserve in the case of larger water requirements.

To Rijeka's catchment area gravitate large amounts of precipitation. These are the orographic precipitations and their quantity is proportional to the altitude. Average amount of precipitation, which can be expected at sea level is 1362 mm and at height of 1500 m 3492 mm/**4**/.

Precipitation regime is characterized by strong short-term rainfall and big amount of rain, which makes this area one of the most extreme in Croatia. There are frequent daily rainfall in the amount of one hundred, or more millimeters, registered in a very short period. Because of that the surface streams have torrent character and great erosive power.

For a more balanced regime of runoff, and less amplitude between winter and summer, snowfall is very important. The share of snow in total precipitation at the peak of Risnjak in the previous climatological period (1961 - 1990) was about 32% and in the current climatological period (1991-2010) is about 25%.

Precipitation regime is in quite opposition with the water consumption. Precipitation has maximum in November (at higher altitudes from 600m in December) and minimum in July (at higher altitudes from 600m in August).

In accordance with the trends associated with global climate change, rainfall amounts will not remain so high and falling regime will become even more variable, which will create additional difficulties in water supply of Rijeka.

4. EMPIRICAL RESEARCH

One of the aims of tourism is health care of tourists that include preventing the appearance and spreading of hydro diseases.

Healthy proper drinking and sanitary water is considered that water which doesn't contain microorganisms, parasites and their developmental forms in the amount that is dangerous for human health, which doesn't contain substances in concentrations which alone or together with other substances are dangerous to human health (www . kdvik-rijeka.hr). In the Republic of Croatia the quality of drinking water is determined in accordance with the Rules on health suitability of drinking water (Official Gazette - official journal of the Republic of Croatia 46/o7). For prevention of diseases related to water, Croatia has signed the Protocol on Water and Health/**5**/ in 1999.

It is known that microbiological parameters are the most important indicator of the hygienic quality of drinking water. Although the bacteria are in natural waters mostly harmless, there are also pathogenic bacteria that can cause infectious diseases. For this reason, the Republic of Croatia reports World Health Organization on the state of health of the population, which includes information on hydro diseases in which transfer directly or indirectly participates water. According to the list of the Ministry of Health and Welfare hydro diseases whose prevention and suppression is in the interest to the state are: dysentery (Dysenteria), enterocolitis (Enterocolitis), enterovirosis (En-

terovirosses), cholera (Cholera), Legionnaires' disease (Legionellosis), leptospirosis (Leptospiroses) , malaria (malaria), typhus (Typhus exanthematicus), typhoid fever (typhus abdominalis), viral hepatitis (Hepatitis virosa)/**6**/. Of all hydro diseases caused by water in the broader tourist area of Rijeka, in the recent period, was recorded only Legionnaires' disease, however, not in any year the number of patients was greater than five /**7**/.

In earlier periods poor water supply solutions would frequently cause diseases, and most importantly, you never knew when the bad influences could repeat. Because of that usually the purity of water along with it's quantity was considered a main factor of water supply. The analysis includes the parameters that in the greatest measure affect the quality of drinking water in the hotels and other outbursts such as microbiological contamination, turbidity, and water hardness observed through the presence of calcium and magnesium in its composition, and gives a review of their impact on human health (Table 1).

Tab.1: The basic physical, chemical and bacteriological water quality indicators, which is delivered after disinfection to tourism industry (2011)

parameter	Measure unit	number of measurements	MDK	arithmetic mean	min	max	invalid	
							number	%
color	oPtCo	48	20	0	0	0	0	0
Taste		48	0	0	0	0	0	0
smell		48	0	0	0	0	0	0
Air temperature	oC	48	-	8,85	-4	22	0	0
Water temperature	oC	48	25	7,6	7,6	7,7	0	0
pH		46	9,5	7,93	7,6	8,07	0	0
electro conductivity	µS/cm	46	2500	217,87	194,1	259	0	0
turbidity	oNTU	49	4	1,12	0,23	8,07	3	6,12
consumption $KMnO_4$	mg/L O_2	46	5	1,14	0,82	1,54	0	0
organic carbon	mg/L	38	-	0,65	0,316	1,133	0	0
inorganic carbon	mg/L	38	-	29,23	26,54	31,77	0	0
Total hardness	mg/L $CaCO_3$	42	-	133,05	130	189	0	0
Total alkalinity	mg/L $CaCO_3$	42	-	123,05	121,3	138,3	0	0
alkalinity HCO_3	mg/L $CaCO_3$	42	-	123,05	121,3	138,3	0	0
nitrate	mg/LNO_3^-	44	50	2,89	2,28	4,64	0	0
sulphate	mg/L	44	250	3,23	2,45	5,06	0	0
lithium	mg/L	44	-	0	0	0	0	0
nathrium	mg/L	44	200	0,82	0,63	1,4	0	0
ammonia	mg/L NH4	46	0,5	0	0	0	0	0
potassium	mg/L	46	12	0,28	0	0,84	0	0
calcium	mg/L	44	-	42,83	38,82	47,64	0	0
Magnesium	mg/L	44	-	4,73	2,55	5,94	0	0
aer.mez.bacteria 22°C	UB/1ml	46	100	75,62	0	510	8	17,39
aer.mez.bacteria 37°C	UB/1ml	46	20	3,74	0	36	1	2,17
total coliforms	B/100ml	46	0	31,35	0	390	36	78,26
fecal coliforms	B/100ml	46	0	11,61	0	160	26	56,52
fecal streptococci	B/100ml	46	0	2,63	0	21	21	45,65
pseudom. aerug.	B/100ml	46	0	10,41	0	110	30	65,22

clostridium perf.	B/100ml	46	0	0,5	0	8	11	23,91

Source: http://www.kdvik-rijeka.hr

Among the springs there are no significant differences and all springs have very similar chemical and mineral composition. These physico - chemical characteristics are typical for karst drinking waters, hardness of 8 ° dH and average temperature from 7 to 11° C (Lenac, D., et al, 2011, 554) /**8**/. The main mineral component consists of Bicarbonates of calcium and magnesium which are essential for normal functioning of the human organism. In all springs increased turbidity is evident. Increased turbidity, i.e. suspended solids content in the water, which is followed by an increasing amount of the bacteria that occur during heavy rains, is associated with flushing through the layers of karst soil. Increased turbidity does not represent sanitary unsafe water, but can mean health risk because the particles that make up the turbidity can provide good conditions for the growth of microorganisms. Pumping wells along the coast, besides turbidity during periods of abundant rainfall, in the summer have a problem with salinization, which disturbs physiological - chemical and microbiological characteristics of water. Among other indicators of quality of drinking water in the Tab. 1 water hardness is extracted for its multiple effects on human health /**9**/. Thus, the World Health Organization (WHO) recommends that the water for drinking and food preparation is not subjected to the process of softening. Water hardness depends on the content of dissolved calcium and magnesium in it. It is recommended that calcium concentration is> 70 mg / L and magnesium concentration> 8 mg / L. The calcium and magnesium are essential for human health. Inadequate intake can cause damage to health. Standards for recommended daily intake of each element are set at national and international level (www.vodovod-zadar.hr) /**10**/. The recommendation leaves the possibility for the individuals to differ considerably in their needs and use of these elements.

5. THE RESULTS

Rijeka's area is supplied with water by Utility company Water Supply and Sewerage Ltd. Rijeka. The company has a concession on the springs Zvir and Zvir II and Rječina which are primary water wells, and springs Dobra, Dobrica, Perilo and pumping wells in Martinšćica which are secondary water wells.

The source of Rječina is of particular importance for the positive performance of the Company and the relatively inexpensive water. Spring is located at an altitude of 321m and consumers are at lower height. These altitude differences save the energy for distribution through the pipes because the consumers get their water on the principle of connected vessels. At time when the source of Rječina has no sufficient amounts of water the base of water supply system of the Rijeka's region is spring Zvir. This spring gains water from the area of Grobnik field and Gomance, and it is important to point out that it never dries out. It is a constant source that flows out of a submerged cave channels formed along distinct tectonic cracks in the limestone.

Because of the lacks of water, which appeared in the late seventies of the 20th century, pumping wells Zvir II were built and connected to water supply system of Rijeka. The area of catchments are located under the massif Kozala.

The Utility company Water and Sewer divide the structure of water consumers into households and the economy. In year 2010 households spent 72.1% of total water consumption and the economy 27.9%. Within the economy the largest consumer drinking water is INA while tourism accounts for about 3% of consumption.

5.1. INFORMATIONAL MANAGEMENT OF WATER CONSUMPTION IN HOTELS

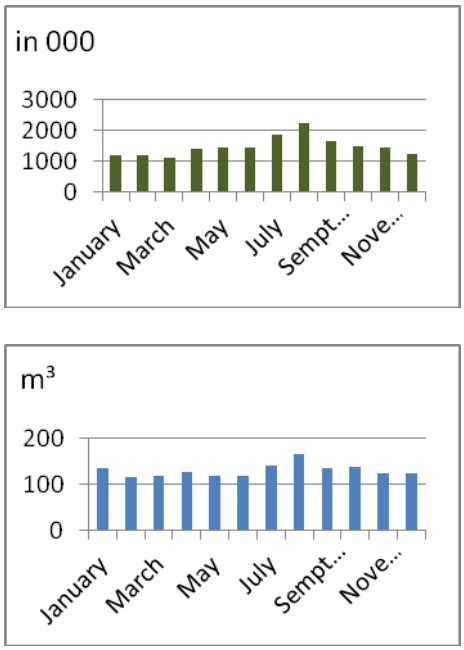
The prevalent opinion (Argyro et.al, 2005) /**11**/ is that daily consumption of drinking water per tourist, in the Mediterranean region, ranges from 101 to 158 liters. Within the structure of consumption the most of the water is spent on showering (38 L) or bathing (57-95 L), while much less is spent on washing and cleaning (18 L), body care (15 L) and the rest (10 L). Increased consumption of water per

tourists is during summer season and lower during the winter when it is cold. Also, less of water is spent in mountain destinations and more in the coastal. To these amounts must be added also the water consumed in technological processes as well as water that is spent on environmental sustainability.

Water consumption in hotels in Rijeka we researched fits in that scheme up to some point, although it is not the same for all hotels, and depends on the type of customer, facility location, and its rank, tradition, etc. It should be noted that in this paper was considered water consumption in smaller capacity hotels, because bigger hotels did not respond to our interview.

Construction of Hotel Continental (1888) occurred at the beginning of the construction of water supply system so the plumbing installation was installed later. These changes did not affect so much the building that became a monument of culture and the visual symbol of Rijeka. After reconstruction in 1989, the hotel disposes with 38 rooms, four hospitality suites and wide range of contents. Visitors that come to Continental are mostly business people and visitors who want to visit the old part of the city. Hotel operates all year round, and its tourist traffic does not have amplitudes as some other hotels. Despite the constant tourist traffic connection between overnight stays and water consumption on example of this hotel is obvious. According to the data, collected by interviews, in that hotel foreign tourists spent a lot of water in sanitary purposes and drinking water is mainly purchased in stores. Maximum of water consumption is in August when it reaches an average of 166 m³ (Fig. 2).

Figure 2: Graphical representation of the average number of overnight stays (a) and water consumption (b) per month in Hotel Continental (2000 and 2010)



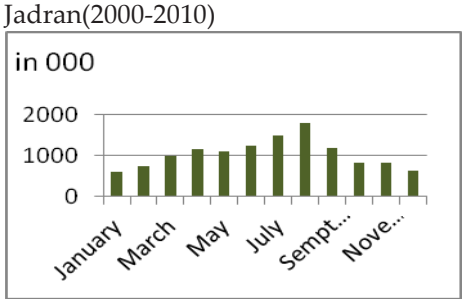
Source: Jadran Hotels

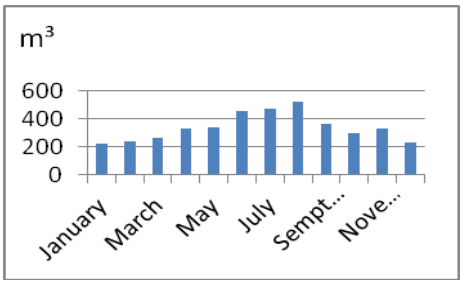
This corresponds with the highest average number of overnight stays, so the highest average water consumption per tourist is 13.49 m³. The lowest average consumption of water is in February, 114.33 m³, while the lowest average number of overnight stays is in March.

Hotel Jadran (1914), after reconstruction, was re-opened in 2005. Hotel capacity is 66 rooms and three luxury suites.

Considering that it is a modern, luxurious and above all (due to the location by the sea) very attractive hotel, it is not surprising that increase of tourists is reported in summer when the beach tourism is in full swing. There is a great difference between tourist traffic and consequently the movement of water consumption between Jadran hotel and Hotel Continental (Fig. 3).

Figure 3: Average number of overnight stays per month and water consumption in hotel Jadran(2000-2010)



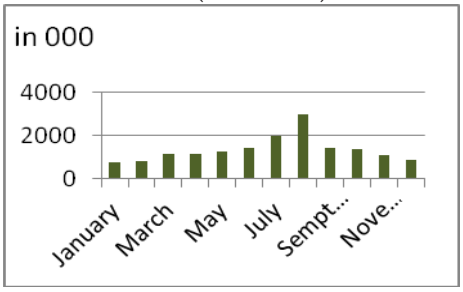


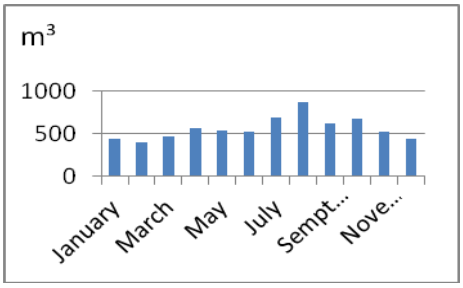
Source: Jadran Hotels

In the hotel Jadran seasonal effect on the tourist traffic and consumption is accentuated. The greatest number of overnight stays is realized in August and the lowest in January. The amount of consumed water follows this trend. The greatest average water consumption is in August when it reaches an average of 521.8 m³. In August, the average water consumption per tourist is 3.41 m³. The lowest average consumption of water is in January when is 223 m³, when the lowest number of overnight stays is recorded and the lowest average spending per tourist is 2.66 m³.

Accommodation Lucia Kostrena due to its position at sea is oriented to the beach tourism, and recreation tourism (walking along the sea) out of tourist season. In the number of overnight stays and in water consumption the role of August is emphasized (Fig. 4).

Figure 4: Average number of overnight stays and water consumption per month in Accommodation Lucia (2000-2010)





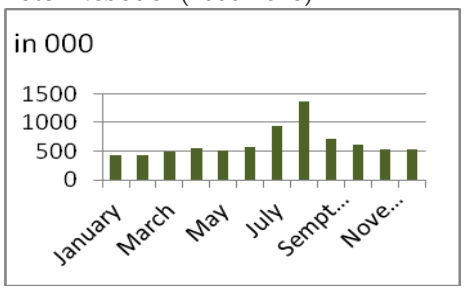
Source: Jadran Hotels

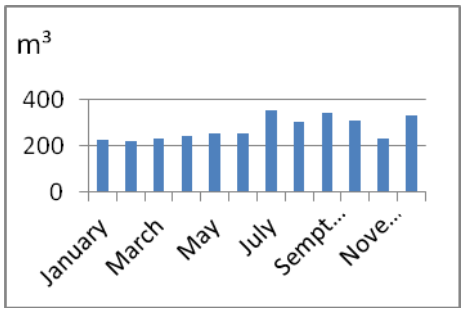
In August, an average quantity spent is 868.6 m³ and the average water consumption per tourist is 3.44 m³. In winter period the lowest water consumption and minimum number of overnight stays do not completely correspond. The lowest average consumption of water is in February 390.6 m³, or average per tourist 2.05 m³, while the minimum overnight stays are realized in January.

Hotel Neboder (1939) takes part in the group of urban hotels (more known as skyscraper from Sušak). Hotel dominates with the height in the urban environment causing tourists use it as a viewpoint. Reconstruction of hotel was completed in 2007.

Trend of the tourist traffic is similar in other hotels. The average number of overnight stays is the highest in August and the lowest in February (Fig. 5).

Figure 5: Average number of overnight stays and the consumption of water per month in hotel Neboder (2000-2010)





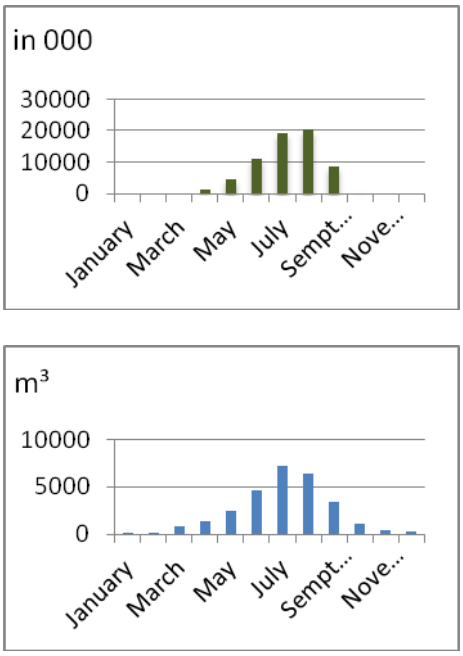
Source: Jadran Hotels

Water consumption does not fully follow the amount of realized tourist traffic in summer, and the highest average consumption is in July when it reaches 353.4 m³ and per tourist is 2.68 m³. The lowest average consumption of water is in February when it reaches 217 m³, and per tourist is 2.02 m³.

Tourist resort Uvala Scott (1967) is pavilion-type of accommodation and it has the most

beds among structures considered in this paper. The resort village consists of two areas of apartments that have seventeen sequences with total of 298 rooms. Tourist resort Uvala Scott is open only during summer seasons which is a crucial fact when focusing tourist traffic and water consumption (Fig. 6).

Figure 6: Average number of overnight stays and water consumption per month in the Tourist Resort Uvala Scott (2000 - 2010)



Source: Jadran Hotels

The lowest average number of overnight stays is recorded in October, when is also the end of the season and the highest average number of overnight stays is recorded in August. In this case, consumption of water goes up and down with the number of overnight stays, but during the off season when there are no tourists, and when the resort is closed, maintenance works and restoration are performed, so water consumption in the months without guests is recorded. The values of the tourist traffic and water consumption are not entirely consistent, because the highest average water consumption is in July and it reaches 7159.2 m³, and per tourist is 2.66 m³. The lowest average consumption of water is realized in the months when there are no guests, so it has no comparable value.

5.2. RECOMMENDATIONS

Tourism is becoming more and more important economic sector of Rijeka and it is a well known fact how much tourist activity is sensitive to the amount of water and its quality. Therefore, the available amount of water that should be sufficient for all purposes including tourism is determined. After several years of measurements, Utility company Water Supply and Sewerage Ltd. determined that during the lowest quantity all sources that are used in water supply give 4 250 l / s.

However, in some periods there were problems with poorer water supply. The cause is non-uniform inflow, poorer quality and accelerated pollution of the springs. Reduced discharge at springs in Rijeka's region was recorded during dry summers and very cold winter periods, which is connected with a lower inflow from the hinterland. Winter minimum does not represent big problem to water supply system because water consumption is then reduced, but summer droughts due to increased consumption of water can cause problems from insufficient quantity of water to its sanitary inadequacy due to salinization /**12**/. Besides that in Rijeka's area extreme climate values and higher sea levels are expected more frequently in the future. There are several models of expected climate changes that predict increasing of temperature from 1 to 3.5° C by the year of 2100. Along with decreasing precipitation this could lead to a significant reduction in renewable water resources at the catchment area. Sea level rising would overflow the lower bed of Rječina and salinization would endanger the springs Zvir and Zvir II. International pressures should be taken into consideration because healthy sources of water are limited, and the number of the world's population is constantly growing. For Rijeka's water supply system a significant fact is that most of the city and all the suburbs are built on the catchment areas of previously mentioned springs. This makes their protection from faecal pollution and industrial wastewater, and uncontrolled dumping of waste harder, and there is a risk of accidental pollution (eg. oil products and other hazardous substances traffic). Some springs

from Preluka to Kraljevica have already been polluted. Of the many dangers that threat crucial springs of Rijeka's water supply system, a greater impact may have excavation of sand, building new industrial capacity and poor maintenance of existing one, rail container port, garbage collection because of the creation of "wild" dumps, sewer made of concrete elements with leaking connections, as well as situations which are not predictable. When epidemics, which are transmitted by water, occur it is very likely that they will first appear in the hotels. For some of them (legionella) the probability of being so is 80% /**13**/. In Rijeka's area epidemics, spread through contaminated water are already recorded, so it is difficult to argue that they will not repeat. The only difference is that pathogens will mutate and that they will appear in an entirely new circumstances.

The first infectious diseases were observed in the time when Rijeka was supplied with drinking water from springs and wells located in the city centre. It is assumed that t Rijeka and Croatian Istria was struck by black death (plague) already in 1348 based on the grounds that Dalmatian towns and Koper, Piran and Venice also suffered this epidemics /**14**/. The earliest written mention of the plague epidemic in Rijeka, dates back to 1599 and it was recorded in the Book of the City Council. The first case of disease emerged in a leather factory, on the 15th of June. Plague in Rijeka then lasted from June to September, and more than three hundred people died (one eighth of the population). Significant health problems in Rijeka during the 18th and 19th century besides the epidemic of plague were cholera epidemics (great epidemics in 1836. and in June 1849), endemic malaria and the "škrljevo disease" in the wider area of the city. Because of the traffic increase in port and the danger of spreading infectious diseases by seamen, in 1726 the first quarantine station was built and it operated till 1833. After, a quarantine was built in the bay of Martinšćica and the latest, in the sixties of 20th century, on the break - water in the port of Rijeka /**15**/. The last notable contamination of the springs occurred in 2008 and 2009. In both cases of turbidity, increased chlorine dioxide disinfection measures were taken and increased monitoring of water quality at the sources, in the water reservoirs and in water supply network was more frequent. Preventive measure, after the pollution, was boiling water and flushing water reservoir and water supply network through the hydrants. There are several reasons why, diseases transmitted by water, first appear in the hotels. The main are:

- the development of disease is easier in warm, moist habitats
- an important source are water supply systems and equipment for air conditioning
- seeds easier accommodate in inactive hotel installation in periods while hotels do not work and expand when the conditions improve
- improper plumbing installations where defects occur and water reservoirs that are not in use
- taps, showers and pools where the water is spread in droplets
- social contact (aerosol transmission of infectious bacteria)

Good results for reducing disease risk in hotels can be achieved by a variety of preventive measures. The hotels that operate seasonally, before the guests arrive, can take precautions like:

- Empty the sediment from boilers and the tanks in the system of hot water consumption and the drinking water consumption. Then clean sediment in the grid of pipes and showers sieves. Nets and sieve often oxidize and the oxides of metals and the acidity promotes growth and multiplication of bacteria.
- Flushing the installation of hot and cold water, and fire hydrants.
- Flushing only hot installations with water in the boiler which is heated to high temperatures. At higher temperatures bacterial growth slows and on high it ends.
- Maintain hot water temperature at 50 ° C and above on mouth of the faucet during the operational period of the hotel.
- Keeping cold water after flushing, at temperature below 20 ° C.

When water is in the water supply system, and before that has already passed sanitary

control, its most sensitive points are ruptured pipes, and mixing flow and stagnant water. A potential causes can also be hot water that occurs in the pipes that are buried shallow (in Rijeka's area, heat is transferred by conduction to a depth of 12.5 cm) and alcatel pipes which remain on the surface because they are used to bypass the defects.

CONCLUSION

This paper discusses the fund of drinking water in the area of Rijeka and considering the amount and characteristics of water consumption in. The paper deals with four hotels and one hotel resort which constitute 60% of all hotel facilities in the observed area. This topic is not common among researchers because the connections between tourism and recreation, navigation, sensory and health characteristics of water are mostly explored. The links between tourism and thermo mineral and sea water are more often mentioned then relations between tourism and drinking water and therefore they are less researched. It was found that none of the hotels encouraged consuming tap water, because the sale of bottled water is more profitable, and foreign guests, who make more than 90% of guests are accustomed to the bottled water. Hotels are one of the consumers of the water fund and the largest individual consumer is INA. For tourism, being a consumer it is important to have enough water of good quality. The annual level of drinking water balance is positive, which means that the inflow is greater than consumption. The situation is been favourable when we consider monthly consumptions because the minimum water inflow is in August and the greatest tourist traffic which generates the highest amount of consumed water takes part in the same month. Therefore, preventing measures of saving drinking water are often carried out in August. Hotels are a suitable place for the formation and development of microorganisms that cause certain diseases. The risk group includes hotels that operate seasonally while those that operate all year round are less risky. Global climate changes in 21st century, will have negative impact on links between drinking water and hotels. That means those will be less drinking water and the conditions of sustainability will be more and more difficult. Subjects that manage water, as well as hotels being one consumer rely on the existing condition which is considered as good. One of the main disadvantages is that they have no established methodology for the avoidance and reducing of risks that will come along with global climate change.

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