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STATISTICAL ANALYSIS OF WATER QUALITY PARAMETERS OF VELIKI BAČKI CANAL (VOJVODINA, SERBIA) IN THE PERIOD 2000-2009

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Abstract: Veliki Bački canal (VBC) in Serbia is one of the most polluted water flows in Europe. This paper observes, statistically analyses and describes certain chemical parameters as dissolved O_2, biological oxygen demand (BOD_5), chemical oxigen demand (COD), suspended solids and amount of coliform bacteria, which show canal water quality during the period of ten years (2000-2009). Authors have applied WQI (water quality index) as the most reliable indicator of the watercourses pollution for setting of surface waterflow quality. These parameters are collated to the results of SWQI set of parameters for 2009 as a control year. Results were obtained in different statistical analyses: descriptive statistical analysis, t-test for independent samples and one-way analysis of variance. Post-hok Scheffe test was applied for definition of difference significance between certain groups. Results shows very bad water quality at one observed Control point (4), near setllement Vrbas. All parameters at Control point 4 are out of permissible range, dissolved O_2 2.07 mg/l, BOD_5 93.57 mgO_2/l, COD 42 mgO_2/l, suspended solids 46.37 mg/l and amount of coliform bacteria 197545.45 n/l. Downstream from Vrbas setllement (Control point 4), SWQI set parameters of water quality at other Control points, are in range from bad to quite good.

Key words: Serbia, SWQI, Veliki Bački canal, water pollution, water quality

1. INTRODUCTION

Veliki Bački canal (VBC) represents part of hydrosystem DTD in Vojvodina – Serbia. It runs through central part of Bačka and connects the Danube and the Tisa rivers. It was made in 18 century for water supplying, navigation and drainage (Milovanov, 1986). Releasing of industrial, public utility and waste water from farms, without refining, as well as low flow level and small ecological capacity of waterflow brought about complete degradation od certain sectors downstream from the biggest polluters. VBC was officialy denoted as "dark point" of pollution in the Danube river basin. Regulations on water protection were passed on in 1978 in order to solve the problem. According to them all polluters must have devices for waste water treatment, as well as that waste water must not make recipient water quality worse than allowed class, as well as that at all releases of waste water must have been pozitioned flow measuring devices (Official Bulletin, SFRY, nb. 6/78). It should be also taken into account that the Republic of Serbia is striving towards the membership within the EU and reaching good water quality represents an important challenge (Grabić et al., 2011). The most important legal framework within the European Union (EU), which regulates water policies, is the Water Framework Directive (WFD) (Directive, 2000/60/EC). The main goal of the WFD is reaching good water quality for all water bodies in the EU member states by the year 2015. For the northern province of Vojvodina, Hydrosystem Danube-Tisa-Danube (HS DTD) represents important canal network.

In order to provide the sustainability of ecological balance, the presence and quality of water are very important (Karadavut et al., 2011) and there have been more researches based upon water quality observing (Ferenczi & Balog, 2010, Parvulescu & Hamchevici, 2010). Anthropogenic influences can cause negative consequencies in short period of time as far as water quality is concerned (Yunus & Nakagoshi, 2004), whereas waterbody pollution represents the result of human activities on one hand, and intensive urbanization development on the other hand (Dragićević et al., 2010). The organic solid load and the dynamics of its degradation are very good indicators of the anthropogenic impact on the waters (Gurzau et al., 2010). VBC is, like many other canels in developing countries, polluted because of anthropogenic influences, mostly due to release of industrial and sewer system waste water directly in water ecosystems (Jonnalagadda et al., 1991; Mathuthu et al., 1993; Jonnalagadda & Nenzou, 1996; Bordalo et al., 2001). The biggeest threat to water quality of VBC represent waste water of sugar industry, alcohol, food industry and oil, whereas their negative impact on water quality has been very well known (Contreras et al., 2000; Casani et al., 2005; Guo et al., 2006; Arvanitoyannis, 2008; Rajkumar et al., 2010).

Cadastre of polluters of VBC has been made over past 20 years. Types and amounts of polluters are registered in it. The University of Novi Sad, Faculty of Science, Department of Chemistry, formed the cadastre.

Republic Hydrometeorological Service is authorized for water quality, as well as for canal sediments (Likić, 2002) at control points (CP) *Sombor*, *Mali Stapar*, *Vrbas 1*, *Vrbas 2* and *Bačko Gradište*. The results are sent to authority institutions both in the Province and the Republic. Studies, such as action plan of pollution lessening at section Bezdan-Bogojevo (2005) and local ecological action plan of Vrbas Municipality (LEAP, 2005) were made in order to improve the process of observation and improvement of existing situation.

Researches show that Vrbas-Bezdan canal, at section of 6 km represents the most polluted waterflow in Vojvodina, whereas Serbia helds the third place according to nutrient level, with 45 critical positions, according to the data of International Committee for the Danube Protection (ICPDR).

2. MATERIAL AND METHODS

2.1. Sampling Area

The canal which connects the Danube and the Tisa rivers from Bezdan to Bečej represents part of complex hydrosystem and it consists of several canals connected with floodgates and locks (Likić, 2002). VBC in middle Bačka is 123 km long. Republic Hydrometeorological Service registers certain physical and chemical parametres at five profiles which have been analyzed in this paper. Control point 1 (CP 1) is situated at Sombor, Control point 2 at Mali Stapar, Control point 3 at Vrbas 1 (upstream from floodgate), Control point 4 at Vrbas 2 (downstream from floodgate) and Control point 5, at Bačko Gradište (Fig. 1).

Database of Republic Hydrometeorological Service for period of 2009 (RHMS, 2009) was used to present the existing state of water quality of VBC. Waterflows in Serbia are divided in I, IIa, IIb, III and IV classes according to set limit values of quality markers (Official Bulletin of SFRY nb. 6/78).

The authors have applied WPI (water pollution index) (Liu et al., 2011), RHS (river habitat survey) method for the classification and assessment of physical characteristics of running waters and determining the ecological status of river habitats (Kamp, 2007) as well as WQI (water quality index) as the most reliable indicator of the watercourses pollution (Córdoba et al., 2010; Srebotnjak et al., 2012) for setting of surface waterflow quality.

The water quality index (WQI) sets criteria for surface water classification based on the use of standard parameters for water characterization (House & Newsome, 1989; Smith, 1989; Melloul & Collin, 1998; Nives, 1999; Pesce & Wunderlin, 2000; Swamee & Tyagi, 2000; Cude, 2001; Nagel, 2001; Liou et al., 2003). Basically, the WQI provides a mechanism for presenting a cumulatively derived, numerical expression, defining a certain level of water quality (Miller et al., 1986; Hambright et al., 2000; Jonnalagadda & Mhere, 2001). None single parameter can adequately describe water quality. The evaluation of overall water quality is not an easy task particularly when different criteria for different uses are applied (Hambright et al., 2000). Moreover, the classification of water quality follows various definitions with respect to the contents of different water parameters (Greve, 1990), and dozens of variants have been developed (Smith, 1989; Wang, 2001).

2.2. Data and Methods

Serbian Water Quality Index (SWQI) was used for description of water quality. This system of surface waterbodies quality description represents the way of quality estimation for certain paramteres group, whereas earlier researches and studies show that this method ensures general overwiev of surface water quality at certain place (Veljković et al., 2000;

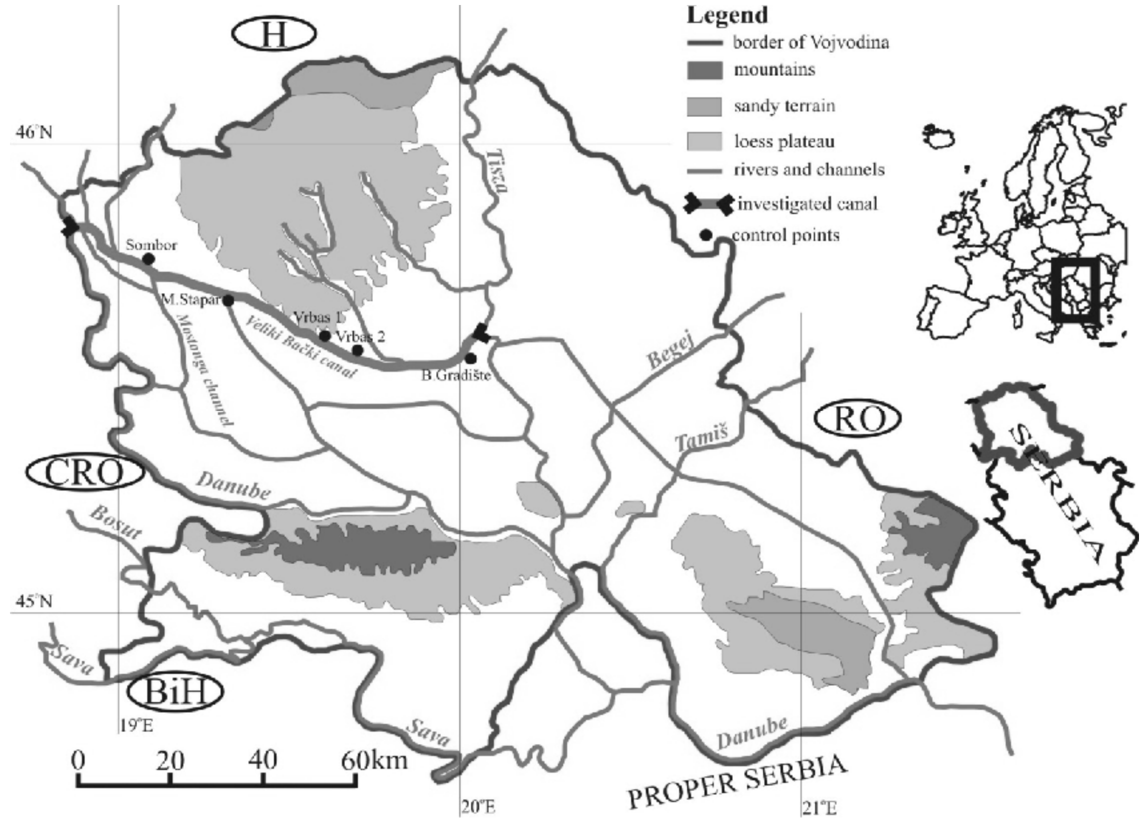

Figure 1. Geographical location of the research area and Control points at Veliki Bački canal

Veljković & Jovičić, 2007; Đurašković & Tomić, 2009; Takić et al., 2010). This method is based upon the fact that ten chosen parameters (oxygen saturation, BOD, ammonium, Ph value, total oxidised nitrogen, orthophospates, suspended solids, temperature, conductivity and coliform bacteria) with their quality (*qi*) represent features of surface water reducing them at one index number. Influence of each of ten chosen parameters on general water quality is not the same, so that each of them was assigned the wieght (*wi*) and score of points according to their contribution to water quality endangering. The result (*qi*x*wi*) gives the index100, as an ideal summation of weights of all parameters (Oregon Water Quality Index Summary Report, 1996-2005*)*. Index points from 0 to 100 will be assigned to particular waterbody according to the points assigned to particular parameters. Formula used for SWQI calculation is:

$$SWQI= 0.18\%O2 + 0.15BPK5 + 0.12NO4 + 0.09pH + 0.08N + 0.08PO4 + 0.07SM + 0.05t + 0.06\mu S + 0.12MPN$$

2.3 Statistical Analysis

Presented results were obtained according to several different statistical analyses applied in similar researches: descriptive statistical analysis (Maguire & Klobučar, 2011), t-test for independent samples (Córdoba et al., 2010) and one-way analysis of variance (ANOVA) (Xiaolong et al., 2010; Pârvulescu et al., 2011, Paillisson et al., 2011). Post-hok Scheffe test was applied for definition of difference significance between certain groups (Banha, 2011).

Descriptive statistical analysis was applied for definition of parametres mean values according to profiles and time periods.

T-test for independent samples is used for comparison of mean values of results and definition of statistical significance of their differences. Independent samples are samples that do not have any correlation after the measurement (Turjačanin & Čekrlija, 2006). Risk possibility level of 5% and 1% was taken into account in the process of definition of statistical significance of obtained results, whereas limit is based on freedom degrees were interpreted according to t-tables.

At examined sample at significance level of 5% ($p<0.05$) or less, t value must be at least 1.96, whereas at significance level of 1 % ($p<0.01$), t must be at least 2.58 (Stojković, 2003).

One-way analysis of variance is statistical procedure which ensures difference testing between several arithmetic means. If certain result deviations from total arithemtic mean are squared (squared deviations), and these squared are summed ("square sums" in variance analysis), total square sum (SS) is obtained, which can be divided in two square "subsums“: square sums within the group and square sum between the groups.

However, definition of SS within and between the groups does not enable us to conclude if variability is greater within or between the groups, since square sum amount depends upon the number of results. Therefore, variance is taken as variability measure. Variance value is obtained when each SS values is divided with corresponding number of freedom degrees. This expression is called middle square (MS).

Freedom degrees for SS within groups are calculated when number of groups is substracted from general number of results (since there are N-1 freedom degress in each group). Freedom degrees for SS between groups are calculated when 1 is substracted from number of groups.

Post-hok Scheffe test: If F-test proves there are statistically significant differences, it is important to define the groups among which there are statistically significant differences. The results of F-test can only prove significance of difference between the groups with the lowest and highest arithmetic means.

Difference significance between particular groups can be defined according to post-hok test, i.e. technique for systematic error risk lessening,whereas the error can be caused by greater number of comparisons between two arithemtic means. Scheffe post hok test, as one of the most strict and most often applied tests, was used in this research. Procedure included following steps (Petz, 1981):

1. After F values in variance analysis has been defined, following formula is applied for each pair of arithemtic means:

$$F = \frac{(M_{a\,i} - M_b)^2}{MS_{wg}(N_a + N_b) \div N_a N_b}$$

2. F value for needed significance level for freedom degrees (($k - 1$) and ($N - 1$)) is read from F table.

3. Set F valueismultiplied with (k – 1), and new limit value (F') is obtained.

4. F is calculated according to above-mentioned formula for all pairs of arithmetic means and obtained value is compared with F'. If F is higher than F', that difference can be considered to be statistically significant at significance level set in step 2.

The sample fulfills basic conditions for parametre test application, i.e. data used in analysis originate from interval scale and they are normally distributed.

3. RESULTS AND DISCUSSION

Mean values for five chemical parametres (dissolved O_2, BOD_5, COD, suspended solids and amount of coliform bacteria) for observed ten-year long period (2000-2009), as well as the results of ANOVA test for all five CP (Sombor, Mali Stapar, Vrbas 1, Vrbas 2 and Bačko Gradište) are presented in table 1. Differences between values of observed chemical parametres according to period of year for ten year long period are presented in table 2 according to t-test. WQI values for 2009 for complete waterflow of VBC are presented in table 3.

ANOVA was used to define if there is statistically significant correlation between dependent variables (parametres: *dissolved* O_2, BOD_5, *COD, suspended solids* and *amount of coliform bacteria*) and independent variable (CP). Post-hok Scheffe test was applied to define significantly different variables.

3.1. Dissolved oxygen

Statistical analysis of *dissolved* O_2 for all CPs (Table 1) shows significant differences at significance level $\boldsymbol{p < 0.01}$ (F=76.961, p=0.000). The highest values of *dissolved* O_2 are registered at CP 3. Slightly lower values were registered at the CP 1, CP 2 and CP 5. There are no significant deviations between these values. The lowest values are registered at CP 4 (Vrbas 2) and these values significantly deviate from registered values at other CPs. The results of post-hok test confirm statistically significant differences between the values of *dissolved* O_2, whereas the highest differences are those between CP 3 and CP 4.

Table1. Mean values of chemical parameters which show water quality for five CP at VBC and ANOVA results

Parameters	***CP 1***	***CP 2***	***CP 3***	***CP 4***	***CP 5***	***ANOVA result***	
						F	***p***
dissolved oxygen (mg/l)	9.22	9.03	10.41	2.07	9.74	76.961	**0.000***
BOD_5 (mgO_2/l)	2.91	2.72	3.43	93.57	13.70	27.092	**0.000***
COD (mgO_2/l)	6.29	6.35	8.08	42	12.86	23.662	**0.000***
suspended solids (mg/l)	11.87	10.61	13.35	46.37	31.24	41.607	**0.000***
coliform bacteria (n/l)	22953.13	15377.78	28183.64	197545.45	31174.86	43.862	**0.000***

Note: $\boldsymbol{*p< 0.01}$; $F>3.32$;

According to regulations stated in Regulation on water classification, VBC water quality should be in IIa or IIb solvency class. Results for ten year period of time show that there are no significant deviations at CP 5, CP 3, CP 2 and CP 1, as well as that dissolved oxygen values are higher than 5 mg/l, i.e 6 mg/l, as it is necessary for IIa or IIb solvency classes. Deviations, i.e. extremely low values are registered at CP 4 and they show considerable amount of water pollutuon at this sector. Bettter water quality and highest values of *dissolved* O_2 are registered in March, January and February of 2005 (Fig. 2). The amount of *dissolved* O_2 at CP 4 is below biological minimum during whole year, and similar results are confirmed in researches conducted during the 80s and 90s of the last century (Nadj, 1985).

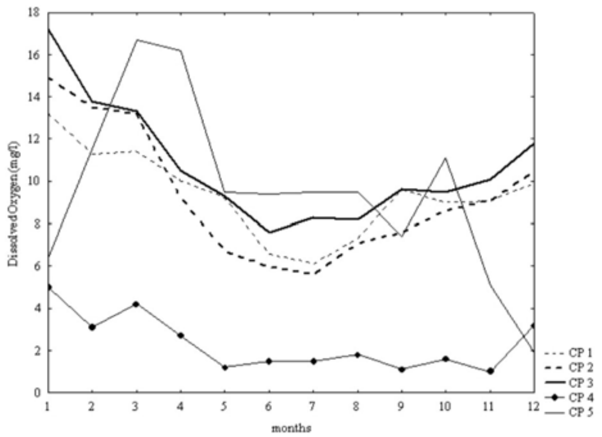

Figure 2. Mean monthly values of Dissolved Oxygen (mg/l)

3.2. Biological Oxygen Demand (BOD_5)

The results of values of BOD_5 are different at different CPs (Table 1). Statistically significant differences at significance level $\boldsymbol{p < 0.01}$ (F=27.092, p=0.000) are defined according to this parametre. The highest values of BOD_5 are registered at CP 4 and they show very high level of pollution. The lowest values are registered at CP 1 and CP 2, and values of BOD_5 belong to demanded water solvency class. The results of post-hok tests show statistically significant difference between BOD_5 values at CP 4 as well as at other observed profiles, but they also show that these differences are greatest between CP 4 where high level of pollution is registered, and CP 2, where water quality could be described as satisfactory according to this parameter. Observation of BOD_5 values by months (Fig. 3) shows noticeable rise of this parameter in the period from September to December. The highest BOD_5 values are registered in 2006 and 2005. The lowest values of BOD_5 parameter were registered in 2009. Organic pollution represented by BOD_5 parameter shows that water quality to lock at Vrbas belongs to II class, water quality from lock to the bridge in Srbobran belongs to the category out of class, and water quality downstream from this place belongs to III or IV categories.

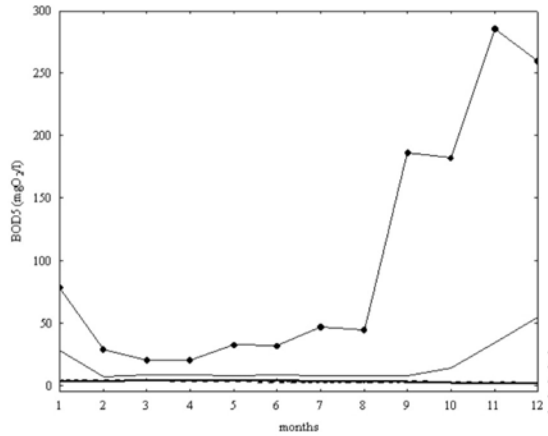

Figure 3. Mean monthly values of Biochemical Oxygen Demand (BOD5) (mgO$_2$/l)

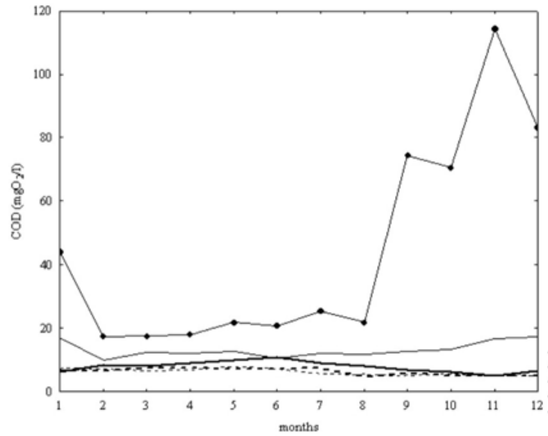

Figure 4. Mean monthly values of Chemical Oxygen Demand (COD) (mgO$_2$/l)

3.3. Chemical oxygen demand (COD)

The results of ANOVA test (Table 1) show statistically significant dfferences (F=23.662, p=0.000) at all CPs. The highest values of *COD* are registered at CP 4 and the lowest at CP 1 and CP 2. According to post-hok tests it can be concluded that there are most noticeable differences at CP 4 and other observed CPs, as well as that there are the greatest differences between CP 4 and CP 1. *COD* average values show that the biggest pollution starts in September, reaches its climax in November and December and becomes smaller in the spring (Fig. 4). According to research done by Nadj (Nadj, 1985), during the 80s and the 90s of the last century, it can be noticed that parameter values are very similar, and that the same probelms have been occuring during the last 30 years. The highest *COD* values were registered in 2006, and two times smaller in 2009. High values for relation *COD/BOD* were defined at CP 4, which show organic pollution which could not be bilogically dissolved.

3.4. Suspended solids

Suspended solids are closely linked to nutrient transport (phosphor, especially), metal, industrial waste and chemicals used in agriculture transport (Dalmacija & Tumbas-Ivančev, 2004). Mean monthly values of *suspended solids* during ten year period are presented in figure 5.

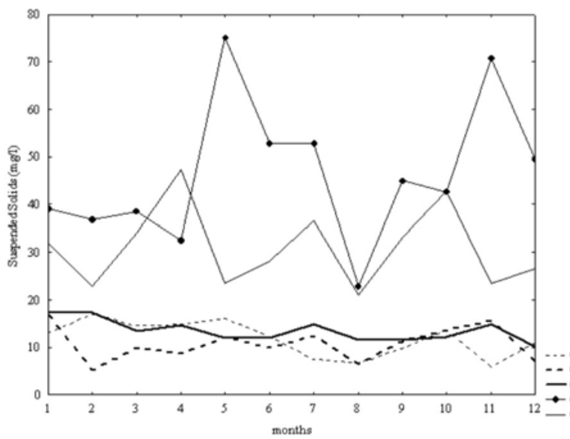

Figure 5. Mean monthly values of Suspended Solids (mg/l)

Statistical analyses (Table 1) show significant difference between observed CPs (F=41.607, p=0.000), at significance level $p < 0.01$. Extremely high values of *suspended solids* are registered at CP 4 and CP 5. The results of post hok tests show statistical significance between these two control points and CP 1, CP 2 and CP 3, where lower values of this parameter have been registered. The highest differences between this parameter values were registered between the CP 4 and CP 2. The highest values of this parameter were registered in 2000 and 2005, and they mostly exceeded allowed value for IIa and IIb classes of water solvency. The lowest values of *suspended solids* are registered in 2002 and 2009.

3.5. Coliform bacteria

Excessive feces water pollution is registered at certain CPs of VBC during the whole year period. Statistical analysis (Table 1) shows significant differences (F=43.862, p=0.000) between observed profiles. Greatest *amount of coliform bacteria* is registered at CP 4 and the lowest at CP 1 and CP 2. Post-hok test defined statistically significant difference between the CP 4 and CP 2. The lowest values of this parameter are registered in the April (Fig. 6). The greatest *amount of coliform bacteria*, which shows greater water pollution, was registered in 2001, when their amount exceeded 240000/l.

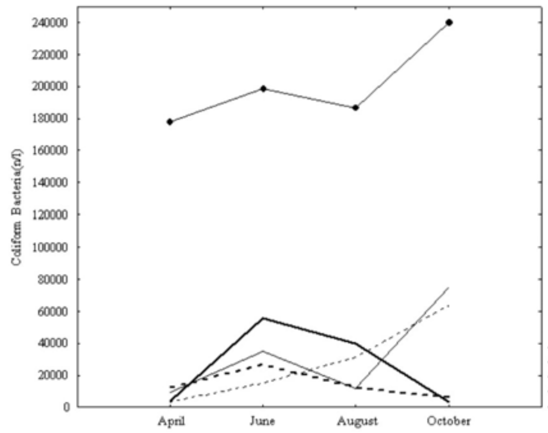

Figure 6. Mean monthly values of Coliform Bacteria (n/l)

3.6. Chemical parameters analysis according to the period of year

T-test for independent samples is used for comparison of mean values of results and definition of statistical significance of their differences (Turjačanin & Čekrlija, 2006). Independent sample T-test was applied in order to compare arithmetic means of two groups – parametre values in warmer and colder periods of year.

The results obtained at all CPs show that particular parameter values are different in different periods of year, like at the Grand Canal, China (Xiaolong et al., 2010). During the colder period, from October to April, values of *dissolved* O_2 are higher at all CPs and they mostly belong to allowed II water solvency class.

According to the results of t-test (Table 2) we can state that these differences are statistically significant at significance level $p<0.01$ (t=-4.456, p=0.000). Values of dissolved $p<0.01$ (t=-4.456, p=0.000) are lower in warmer period, from April to October, i.e. during the spring and the summer.

As far as BOD_5 parameter is concerned, its values are higher during the autumn and the winter, which is confirmed by the results of t-test (Tab. 2) at significance level $p< 0.05$ (t=-2.479, p=0.014).

As far as *COD, suspended solids* and *amount of coliform bacteria* are concerned, their values are higher in colder period, during the autumn and the winter. However, these differences are small and they are not statistically significant

3.7. Water Qualiy Index (SWQI)

According to SWQI category, values for SWQI descriptive quality indicator are defined as follows: *very bad* – 0-38; *bad* – 39-71; *good* – 72-83; *very good* – 84-89 and *excellent* – 90-100 (Veljković, 2000).

SWQI values at CP 1 (Table 3) range from *bad* (70) in summer period to *excellent* (93) in the autumn. The highest values of SWQI are registered at CP 2. Water quality is described as *good* (SWQI=83) only in the summer, whereas during the winter and the spring it is *very good* (SWQI=88; 85), and in the autumn it is *excellent* (SWQI=90). High SWQI values are registered at CP 3, especially during the autumn and the winter. The study shows that SWQI is below 38 in all observed periods at CP 4, i.e. it belongs to category – *very bad*. Alarming situation and extremely low SWQI values are registered during warmer months. At the donwnstream part of VBC, at CP 5 (Table 3), SWQI values are quite low and during the spring, summer and autumn they belong to category – *bad* (SWQI=65; 67; 65). In the autumn these values are slightly higher and they belong to category – *good* (SWQI=73). If SWQI>80, there are life conditions and water can be used for navigation, irrigation, recreation (swimming), or even water supply if it is refined (Yunus & Nakagoshi, 2004).

Temperature can also have influence on water quality. If water tempereature in canal is higher, there is intensive biological activity and dissolved oxygen concentration lessens (Sa´nchez, 2007). Therefore, water quality is worse in warmer period, i.e. in the spring and summer, than in the autumn and winter. Numerous researches stated the same trend, Suquia River, Argentina (Pesce & Wunderlin, 2000), Odzi River, Zimbabwe (Jonnalagadda & Mhere, 2001), Bangpakong River, Thailand (Bordalo et al., 2001), San Vicente Bay, Chile (Rudolf et al., 2002), Pampa Murillo, Mexico (Herna´ndez-Romero et al., 2004).

According to statistical data processing we can state that water quality of VBC at CP 1, CP 2 and CP 3 alows its exploitation. Since water quality at the CP 4 is extremely bad, that part of VBC is completely degraded and useless (Fig. 7).

Organic pollution which depends upon polluter location, production intensity, quantiative and qualitative characteristics of waste water, their direct or indirect placement and upon their entrance to the recipient (with or without previous refining). Canal pollution does not represent just a local problem, since it flows into the Tisa and brigns polluters into this river, and in the Danube, too.

This research, as well as numerous earlier researches, showed that water quality of VBC downstream from Vrbas is relatively bad, even though there is no direct influence of waste water in this section. Most factories release waste water first into lateral canals which flow into VBC, downstream from lock.

Table 2. T-test analysis – for certain chemical parameters which show water quality in warmer and colder periods at complete waterflow of VBC

Parameters	***Period of year***	***M***	***σ***	***t-test***	***p***
Dissolved O2 (mg/l)	W	7.12	4.448	-4.456	**0.000***
	C	9.15	5.582		
BOD5 (mgO_2/l)	W	15.60	71.728	-2.479	0.014**
	C	35.09	98.295		
COD (mgO_2/l)	W	13.00	26.495	-1.811	0.071
	C	18.93	43.193		
Suspended solids (mg/l)	W	23.06	31.672	-0.303	0.762
	C	23.83	23.855		
Amount of coliform bacteria (n/l)	W	58178.71	92987.138	-1.387	0.167
	C	86567.41	110963.586		

Note *:* ***$p < 0.01$; **$p<0.05$;*** W-warm period; C-cold period

Table3. SWQI for 2009 for five CPs at VBC

	CP 1	**CP 2**	**CP 3**	**CP 4**	**CP 5**
Spring	81	85	86	28	65
Summer	70	83	81	25	67
Autumn	93	90	92	37	73
Winter	85	88	90	32	65
Legend	*Excellent*	*Very good*	*Good*	*Bad*	*Very bad*

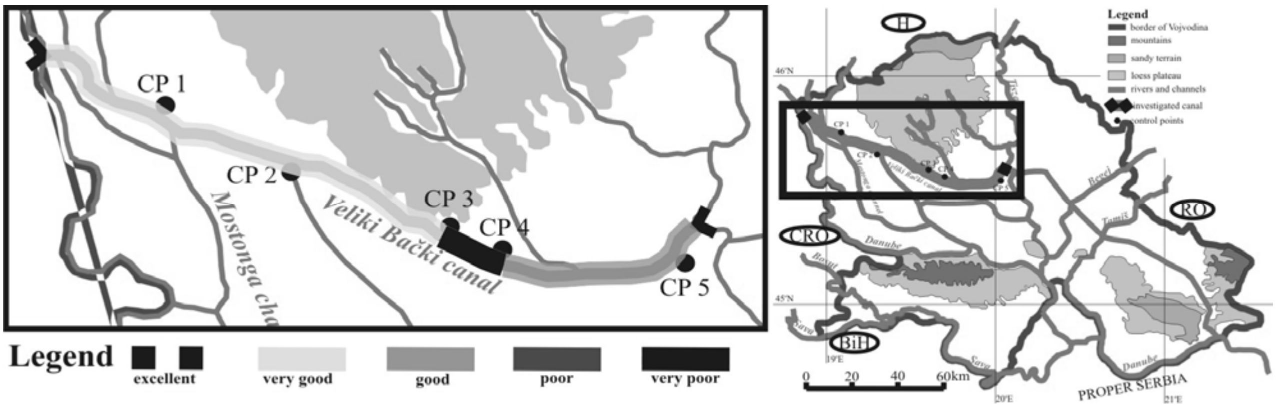

Figure 7. Location of the Control points at Veliki Bački canal andwater quality according to SWQI on these locations

After the lock, downstream from Vrbas, waste water from the left and right lateral canals which bring polluters from the municipality of Kula, flow into VBC (Nadj, 1985). Even though there are no significant industrial polluters at the last section of VBC, water pollution is present even to Bečej, because of significant pollution level at previous section (Fig. 7).

Season and natural factors such as air temperature, do not have significant influence on VBC pollution. Certain parameters can have better or worse qualities over the period of year, but it is usually associated with intensity of industrial production.

According to SWQI values for 2009 we can notice deviations in comparison to mean values from earlier ten year long period of time. SWQI values for 2009 are significantly higher which leads us to the conclusion that there have been slight improvement and pollution lessening at some sections of VBC.

4. CONCLUSION

The canal is polluted directly or indirectly due to lateral canals. The main problems of pollution are connected to organic solid release that use oxygen from canal water for particle releasing which fill the canal with sediments, as well as to nutrient release which cause the growth of algae and plants. Pollution is mostly organic, but pesticides, heavy metals nonorganic solids and other harmful supstances are also present. SWQI shows that water quality of VBC upstream from Vrbas (CP 1, CP 2 and CP 3) is *quite good* and *good*. At these sections water can be used for sport, recreation, irrigation, cattle watering and navigation. Downstream from Vrbas (CP 4), VBC is turned into open collector of waste water of food industry, farms and settlements of Crvenka, Kula and Vrbas. According to SWQI classification that section is *very bad*. Water quality is slightly improved downstream, and according to SWQI classification it is *good*, with higher BOD_5, organic solids of protein origin and greater *amount of coliform bacteria*, especially in the autumn.

If main sources of pollution can be controlled, the present situation can be improved by releasing of greater amount of water from water system. Thus, VBC could become healthy water flow and fulfill the needs of users at all sections.

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