THE WATER QUALITY OF THE RIVER VIT DURING ITS CONFLUENCE INTO DANUBE RIVER

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Abstract: The Vit River flows out from the main Stara Planina mountain chain. It streams down the Northern slope of the Zlatishko-Tetevenska Mountain, collects the waters from the front parts of Stara Planina Mountain and flows along the Danube river lowland.

The Vit River is of a great importance for the development of the main villages along its river valley – Teteven, Pleven, Dolni Dubnik, Dolna Metropolia and Guliancy.

The specific climatic, hydrological, hydro geological, hydrographical features of the river basin are examined in the current explanation. Its water uses for drinking water supply, irrigation and production of electricity are detailed described.

The water quality is determined on the base of four numbers of hydro-chemical stations. Great attention is given to the station of the Vit River in Goliancy village. It is considered as a main point before the river's confluence into the Danube River. The indexes examined in the report are: mineral composition, oxygen regime, biogenic elements and Special indexes.

The annual and seasonal alteration of each of these indexes is given for the period 1999-2003year. The results of the analyses show that there is a tendency for the reducing of the values of the observed elements. This is explained with the termination of the activities of many of the industrial enterprises in the region.

WASSERQUALITÄT DER FLUSS WIT BEI IHRE EINMÜNDUG IN DONAU.
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Zusammenfassung: Fluss Wit entspringt in Gebirgekette der Haupt Stara Planina und fließt durch die Donau Ebene.

Wit hat große Bedeutung für die Entwiklung der Hauptsiedlungen der Ebene und für die Städte Teteven,Pleven Dolni Dabnik, Dolna Mitropolia und Gulanzi.

In die forliegende Untersuchung sind die klimatische, hydrografishe, hydrologische Sonderheiten des Flussbett gegeben.

Die schätzüng der Wasserqualität bei Witteimmündung ist mit folgende chemische kennziffer gemacht:

- Kennziffer der organische Verschmutzung und Sauerstoffregime.
- Kennziffer der Mineralinhalt
- Kennziffer für Verschmutzung mit biologische Bestaudtteile(komponente).

1. Basic information about the river

The river Vitt is situated in the Danube region of the pool operation. Its water collecting area is bounded from the west of the watershed of the Iskar river, and from the east correspondingly from the Osam river. For the origin of the river is concerned its main tributary – the river Beli Vitt, which estuary is below the town Teteven and into the river Cherni Vitt. Both tributaries rise from the North Slope of the Zlatishko-Tetevenskata part of Stara Planina. After leaving the mountain, the river flows at the northwest direction and after the village Glojene, it undertakes in northeast direction till it's flowing in the river Danube at Somovit. The total length of the river is 189kilometers, and its average slope is 9,6%. Its water collecting region, with area of 3220 square kilometers is very oblong with small average width (25 km), which constrains the development of more dense river network – its density is only 0,5 km/km^2. The number its tributaries are small. The river Vitt has about 10 tributaries with length of 10 km, the largest of which are the river Kamenska with length of 49 km and area of the water collecting pool 500km^2, the river Kalnik with length of 41 km and respective area of the water pool of 260km^2 . The river Tuchenitza is with length of 35km and area of 215km^2 .

2. Hydrological scheme of the river

The river Vitt is of great importance to the development of the main cities, which are, situated near it such as: Teteven, Pleven, Dolen Dubnik, Dolna Metroplia and Guliantzi and also the near villages. Its water terrace is a basic water source, which is used for the industrial needs of more than 50 populated locations. In It's middle and lower flow there is fertile soil from which form gradually "The big irrigating system of the Vitt river' (GVNS) and "the small irrigating system of the Vitt river' (MVNS). The can be irrigated for more than 23000ha.

3. Afforestation of the Vitt river

The shore area of the river Vitt is taken by forests, which take about 30% of the whole area. The mountain area (Tetevenski Balkan) is one of the most preserved and forested regions. The forests in this Balkan consist mainly of beech trees. 600km^2 are occupied with the beech trees and therefore they take 86% of the whole area. The pine trees are mainly situated in the upper flow of the Ribaritza river. The pine forests lay in the lower parts of the mountain Stara Planina. After the pine forests there are low stem forests which take the area of 20-40km^2 and reach the Sadovetz village. The percent of the forests watered by the river is very significant – about 60%. The willow trees and the bushes are situated only in the area near the shores of the river.

4. Valley and bed of the Vitt river

In the upper flow (above Ribaritza village) the riverbed is rocky and completely stable. The shores are sheer and in places they are covered with vertical rocks. Downhill from the Ribaritza village the rocky river bed is covered with large pieces of river gravel. The gravel does not stand in the way of the riverbed because the vegetation in the river and the inclination of the upper stream don't cause torrent. There can't be noticed any signs of torrential slopes in this part of the river. The local inhabitants affirm that when a strong rain occurs and in the spring snow fusion period it the river flow great quantities of water. However the water does not get turbid. The turbidity only occurs after the Kalnik river, which comes from Goliama Jeravna village pores into theVitt river. The turbidity reaches Sadovetz village when the river flows only in the north. There is also a small turbidity between the Glojene and Peshterna Villages when the river diverts from this direction. Up to the Glojene village the characteristics of the water collecting area are almost the same as the characteristics of the Beli

Chernii Iskar (when the two rivers blend together). The vegetation in this area is still good but it becomes more sparse low stemmed. The main cause for this is probably the big exploitation of the forests in the past. The valley in this area is narrow and has a sheer and rocky (at places) shores. There are almost no tributaries, only sheer and short shores which in the summer period have almost no running water. The riverbed is covered with stone blocks and big pieces of river grave. Downwards from Glojene village the river valley becomes wider and the shores become smaller and sloping. Near Sadovetz the diametrical profile of the valley becomes bed-like. The river starts to bendaring and the slope decreases considerably. In Peshterna village the river enters narrowness – Boaza. After Vitt exits the river Boaza it becomes planer-small inclination, small hills, and almost no vegetation near the water collecting area. The characteristics of the river are the same till it enters the Danube river. It is significant to note that the inclination is that small that the current can hardly be noticed.

When the river reaches Glogene village a great amount of its water is lost. It is determined that it inflows in the **carst s**pring of the river Zlatna Penega. A lot of researches are made in order to determ ine whether the all the amount of water of the river Zlatna Penega comes from Vitt.

5. Average, maximal and minimal drain

The average drainof the Vitt river according to the statistics of the hydrological stations varies between 3,06m^3/s (96,5. 10^6m^3), when the river reaches Cherni Vitt to 15,09m^3 /s (475,9. 10^6m^3), when the river reaches Iasen Village and 19,18m^3/s (604,9. 10^6m^3), Vitt enters the Danube river. In the period between 1961 and 1998 it varies between 1,182- 4,428 m^3/s and 6,321- 30,072 m^3 in its extreme points. The average square diversion of the average value varies between 0,760 and 5,934m^3 for the same area. The coefficient of variation (Cv) is between 0,249 and 0,309 and the value of the coefficient of asymmetry (Cs) is between –0,622 and –0,344.

The draining modules give information about the intensity of the formation of the drains in the water collecting area of the main river vary from 19,661/sec km^2 (Cherni Vit) to 5,951/sec km^2 (in the mouth of the river). The biggest draining modules of the river are situated in the upper mountain area where the average heights of the water collecting areas of Beli and Cherni Iskur reach highest points.

The river mountains and the bigger water collecting areas have a more controlled river drain which is the main reason for the lower coefficients of variation (0,249 – 0,2790). These variations are typical for the upper shores of the river Vitt. The tributaries of Kalnik and Kamenitza rivers have the biggest provisional variations, which are situated, in the low zone of the water collecting area. They have coefficients of variation 0,343 and 0,546.

The statistics of the hidrometrical station of the Vitt **river are shown in table 1**

Basic statistic characteristics of Vitt River during the period of 1961-1998 **Table 1**

River, Point	Area A	Annual Value						
		$\overline{Q}_{1961-98}$	$\overline{M} = \overline{Q} / A$	$\overline{Q}_{\min}^{annual}$	$\overline{Q}_{\max}^{annual}$	σ	Cv	Cs
	km²	**m³/sec**	**1sec/km²**	**m³/sec**	**m³/sec**	**m³/sec**		
Main River								
Vitt River – mouth of the river	**3225.0**	**19.180**	**5.947**	**6,321**	**30,072**	**5,934**	**0,309**	**-0.344**

Percent extension of the drain

River, point	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average amount

Vitt River- Mouth of the river	5.36	8.63	11.67	16.43	15.94	12.46	7.50	4.95	4.78	3.50	3.81	4.96	100

Tributaries														
1	Kalnic river – Golqma Jelezna village	4.95	8.54	11.49	19.68	16.18	11.84	5.56	4.92	8.26	2.85	3.07	2.68	100
2	Kamenitza River – Bejanovo village	6.21	12.43	16.16	15.64	14.19	10.77	6.60	3.83	3.20	2.92	3.29	4.74	100

Minimal tributary of the Vitt river in the period of 1961 - 1998

River, point	**Yearly value**			Monthly value		
	$\overline{Q}_{min}$	$k = \overline{Q}_{min} / \overline{Q}$	$M = \overline{Q}_{min} / A$	$\overline{Q}_{min}$	$k = \overline{Q}_{min} / \overline{Q}$	$M = \overline{Q}_{min} / A$

	m^3/s	m^3/s	$1/sec.km^2$	m^3/s	m^3/s	$1/sec.km^2$

River Vitt - mouth of the river

Min	2.591	3.020	5.796	12.15	7.679	7.259	2.338	1.666	1.976	1.868	2.314	3.260	6.321
Max	26.48	50.88	60.89	111.4	112.9	68.40	71.71	63.59	95.82	96.71	25.89	31.69	30.07
Avg	12.34	19.87	26.86	37.80	36.68	28.67	17.27	11.39	11.0	8.059	8.771	11.42	19.18

6. Evaluation of the condition of river water discharge into the Vit river and correspondingly into the Danube river

The quality of the rivers is examined in the period of 1994 to 2003. Main indicators are organic contamination and the oxygen regime.

For the amount of organic substances the following indicators are of importance: solute oxygen (O_2), permanganent oxygen (Ok), and the biological need of oxygen (BPK_5). The doubled value of the indicator Ok is examined approximately in order to give an account about the contents of the organic matter in the water. The dynamic of the modifications of the oxygen regime and the amount of the organic substances is in dependency of the hydrological and temperature peculiarities. Another big factor is also the river current, which depends on the regime of omitted wastewater.

The statistics of table 2 show availability of organic pollution. A tendency of its decrease is observed. This tendency can be explicable after some of the biggest industrial undertakings in this region have been closed.

Table 2

Chemical composition of the River Vit water during its confluence for the period 1994-2003			
Indexes	**min**	**max**	**Avg.**
O2 mg/l	6,03	14,02	8,45
BOD5 mg/l	1,96	7,50	4,59
OK mg/l	1,68	5,28	3,34
HCO3 mg/l	155,55	387,5	298,30
SO4 mg/l	13,4	48,00	24,00
Cl mg/l	5,6	54,20	31,19
Ca mg/l	24,8	53,70	40,20
Mg mg/l	5,8	32,10	19,60
Fe mg/l	0,04	0,18	0,09
Na + K mg/l	33,2	109,1	73,04
NO2	0,01	1,63	0,313
NO3	0,99	13,74	6,08
PO4	0,06	0,80	0,315
SUM mg/l	247,00	654,0	500,46
PH	6,3	8,3	7,4
H	6,72	12,79	10,38

6.1. Indicators of the mineral composition

The main ions, which characterize the mineral composition of the waters of river Vitt, are the hydrocarbons (HCO_3), the sulfates (SO_4), the chloride (Cl), calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K). The results of the researches are shown in table 2 as an average value and range of modification in the years between 1993 and 2003. The waters of the river near the shores have an expressive hydro carbonic characteristic. There is a tendency of the decrease of their value in the year of 1998 and preservation of the same values in the period of 1998-2003.

6.2. Indicators of contamination with biogenetical elements

Main sourses of biogenetical elements in the riverflows are the snow-rain waters, the underground waters and the wastewaters (on life,animalgrowing farms, enterprises, and food wastes and etc). The amount evaluation of the biologocal elements is given

through the nitrates (NO_3), nitrits(NO_2), ammoniac (NH_4) and the fosfate ions (PO_4). According to biogenetical elements shown on table 3 the waters of Vitt river distinguish because they have a significant amount of waste. The examined period shows that there is a tendency of decreasing the quantity of these biological elements. The phosphate ions make an exception.

7.Conclusion

In conclusion of the previously mentioned facts the following deductions can be made:

1. In result of the industrialization and the peasant economy, the natural water of the river Vitt has been changed in a quality aspect comparing to its natural condition.
2. There is a tendency of decreasing the pollution in the examined area of the river.
3. The results give a reason to reckon that the pollution of the waters has not reached the limits, which can prevent their utilization for watering and kinds of technical water supply.
4. The waters of river Vitt are not appropriate for drinking supplies.
5. The results of the examinations can be used as well-founded reason of the importance of building water-cleaning equipment.

8. References

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