Research Regarding the Influence of Hydro Technical Facilities on Jiu River Within the Control Section Vădeni-Tg-Jiu on Water Quality

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Abstract: *Within this paper, issues referring to the resistance dams in Vădeni and Tg-Jiu are exhibited and the necessity of combined operation for the two storage basins. In order to assess the changes produced by the storage plant Vădeni-Tg-Jiu, physical and chemical coefficients are relatively presented for Jiu river before the execution of establishments (1992) and their actual state within the upstream sections in Vădeni and downstream one in Tg-Jiu (2005). The coefficients significantly modified are graphically exhibited (suspensions, CBO5, solid residue, saturation, total nitrogen, total hardness).*

1. Introduction

The storage plant Vădeni-Tg-Jiu is second classified as importance (in compliance with STAS 4273-83). The storage basin in Vădeni has been brought into service in 1993, and the storage basin in Tg-Jiu in 1997. Vădeni-Tg-Jiu resistance dams are located within Gorj district, in the Subcarpathians area of Oltenia, in Tg-Jiu Depression, on Jiu River Valley. The storage basin Vădeni is located in Vădeni, 100.3 km from Jiu spring and the storage basin Tg-Jiu is located within the territory of Tg-Jiu, 100.8 km downstream the spring from the storage basin Vădeni. The total surface area of the storage plant Vădeni-Tg-Jiu covers 164 ha.

The resistance dams Vădeni-Tg-Jiu are provided with high gates, three gateways equipped with segment dams of 16.00 × 10.00 m (the case of Vădeni resistance dams) and 10.00 × 10.00 m (in the case of Tg-Jiu resistance dams).

The fillings are composed of:

- Side dams of local materials, tightened by concrete walls;
- Concrete overfall weir, provided with segment dams, some of which equipped with valves;
- Barrage type catchments which ensure the water intakes for hydro-aggregates, provided with grids, cofferdams, and plane rapid tanks, as well as the aspiring cones for the discharge of water downstream, provided with sealing cofferdams.

The combined operating of the storage basins in Vădeni-Tg-Jiu has been imposed, as after a five-year exploitation of Vădeni storage and a three-year exploitation of Tg-Jiu storage, an advanced clogging degree has been reached (of 81.2% for Vădeni storage and 10% for Tg-Jiu storage) which prevents the by-pass, downstream, safely, of the water incursions on Jiu River.

2. The assessments of the changes proposed by the storage plant Vădeni-Tg-Jiu on water quality of the Jiu River

Under the requirements of the Order 184/1997, this establishment is situated within the category of Ist level audits, by validating one of the greatest natural and regenerative richness, the energy of the flowing water Jiu. The positive effects of the establishment are three size orders greater than the negative impact on the environment. The producing technology of the electricity is the ″cleanest″ technology.

Water is part of the basic constituents of biosphere, as a specic flora and fauna are developing within, and in order to survive a very pure environment should be provided.

The modification of the physical, chemical, bacteriologica land biological coefficients of Jiu River, compared to the natural regimen is due to new pollution sources and to the enhancement of the existing ones within the hydrographic basin.

Before the execution of facilities, the pysical and chemical coefficients of Jiu River within the control sections upstream in Vădeni (table no.1) and downstream in Tg-Jiu (table no.2) have not surpassed the imposed limits, required by the legislative effective framework, due to an inferior pollution if compared to the present day pollution. Due to the geographical area and the effluent slope, water velocities were high enough in order to realize an aeration and an auto-purification within efficient parameters .

Table no.1. The physical and chemical indicators of Jiu River gathered within the control section Vădeni upstream in 1992

Nr. crt.	The physical and chemical indicators	Winter	Spring	Summer	Autumn
1	Flow (m^3/s)	35,8	80,5	60,67	84,5
2	Temperature (^oC)	3	20	28,7	10
3	pH	7	6,9	7	7
4	O.D. (mg/l)	8,5	8,9	7,9	8,8
5	Saturaration (%)	89,3	90	92,6	90,4
6	CBO_5 (mg/l)	5,2	5,5	6,5	5,3
7	CCOMn (mg/l)	8,7	9,8	13,3	9,9
8	CCOCr (mg/l)	6,9	7,2	6,5	6,7
9	Fixed residue (mg/l)	100	75	95	120
10	Cl^- (mg/l)	8,5	6,5	8,4	8,7
11	SO_4^{2-} (mg/l)	37	35	34	40
12	Ca^{2+} (mg/l)	31,8	28,4	40,8	53,9
13	Mg^{2+} (mg/l)	4,5	4,6	5,0	5,1
14	NH_4^+ (mg/l)	0,85	0,75	0,83	0,79
15	NO_2 (mg/l)	0,16	0,17	0,16	0,17
16	NO_3 (mg/l)	3,9	2,52	2,4	3,70
17	Total N (mg/l)	1,55	1,45	1,43	1,65
18	Total Fe (mg/l)	0,030	0,035	0,016	0,019
19	Suspensions (mg/l)	1660	1508	2000	1800
20	HCO_3^- (mg/l)	91,5	60,9	97,9	100,8
21	Total hardness (^oG)	7,50	6,70	9,55	9,25
22	Temporary hardness (^oG)	6,5	4,50	6,70	5,95
23	Permanent hardnes (^oG)	3,49	3,50	3,70	4,90
24	Alkalinity (ml HCl 0,1 n)	1,7	1,5	1,8	1,8

Table no.2. The physical and chemical indicators of Jiu River gathered within the control Tg-Jiu downstream in 1992

Nr. crt.	The physical and chemical indicators	Winter	Spring	Summer	Autumn
1	Flow (m^3/s)	33,4	79,5	63,67	82,5
2	Temperature (^oC)	4	22	26,7	9
3	pH	7	6,8	7	7
4	O.D. (mg/l)	8,2	8,5	7,2	8,1
5	Saturaration (%)	84,3	86	82,6	85,4
6	CBO_5 (mg/l)	4,9	5,1	5,9	5,0
7	CCOMn (mg/l)	8,5	9,5	12,9	9,7
8	CCOCr (mg/l)	6,7	7,0	6,3	6,5
9	Fixed residue(mg/l)	98	72	93	110
10	Cl^- (mg/l)	8,4	6,1	8,0	8,5
11	SO_4^{2-} (mg/l)	35	33	31	38
12	Ca^{2+} (mg/l)	31,0	27,3	38,8	50,9
13	Mg^{2+} (mg/l)	4,2	4,4	4,8	5,0
14	NH_4^+ (mg/l)	0,75	0,71	0,80	0,77
15	NO_2 (mg/l)	0,15	0,16	0,15	0,14
16	NO_3 (mg/l)	3,6	2,55	2,2	3,50
17	Total N (mg/l)	1,49	1,41	1,40	1,55
18	Total Fe (mg/l)	0,020	0,025	0,014	0,015
19	Suspensions (mg/l)	1020	1200	1528	1400
20	HCO_3^- (mg/l)	90,5	59,7	96,9	99,8
21	Total hardness (^oG)	7,30	6,50	9,38	9,20
22	Temporary hardness(^oG)	6,2	4,30	6,40	5,70
23	Permanent hardness (^oG)	3,40	3,39	3,50	4,70
24	Alkalinity (ml HCl 0,1 n)	1,6	1,5	1,7	1,7

The modifications incurred by the Jiu River (the execution of barrier lakes) are significant and consist in changes of the physical and chemical coefficients. The barrier lakes influence the decomposition processes of pollutants and the purification processes of Jiu River, which are slowed down due to a more diminished aeration.

The suspension colours modify the transparency and the illumination degree of the aquatic environment and the chlorophilian action is reduced and the tendency of anaerobic conditions is created.

The main impurifier of the residual waters resulted from the coal preparation process is constituted by the suspensions. Within the period 1992-2005 determinations have been performed and a reduction of the suspensions in Jiu River has been found processes of pollutants and the purification processes of Jiu River which are slowed down due to a soft aeration., within the two sections:

- for the upstream control section Vădeni, the analysis showed the fact that an increase in suspension content took place, which reached the peak in 1996, reaching the value of 1961 mg/l, followed by a decrease, which reached the value of 45 mg/l in 2005 *(fig.1)*.

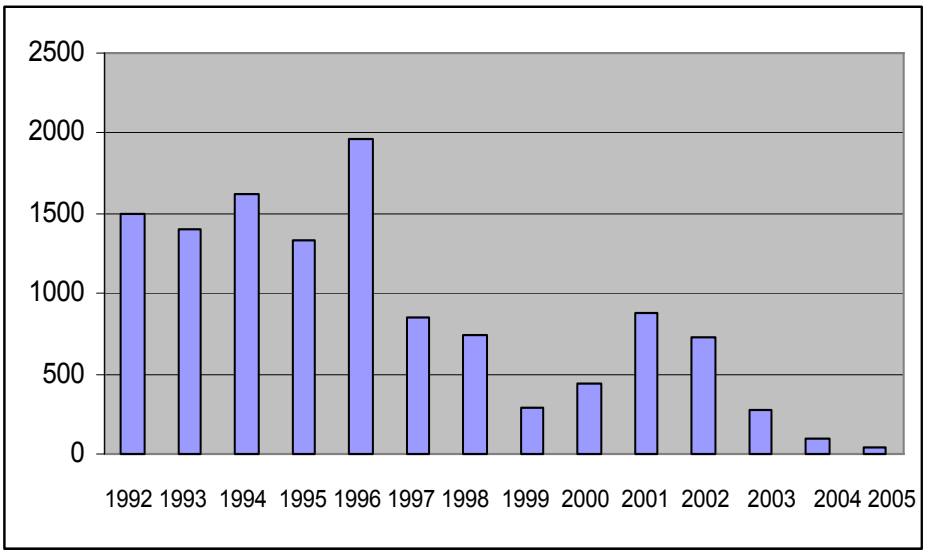

Fig. 1. The evolution of the indicator "suspensions" (mg/l) within the control section Vădeni upstream (storage) during the period 1992-2005

- for the downstream control section Tg-Jiu an increase in suspensions content has been noticed, which reached maximum values in 1992, reaching the value of 1287 mg/l, followed by a sudden decrease in 18996 (184 mg/l) and then progressively until 2005, when it reaches the minimum value of 33 mg/l. (fig.2.)

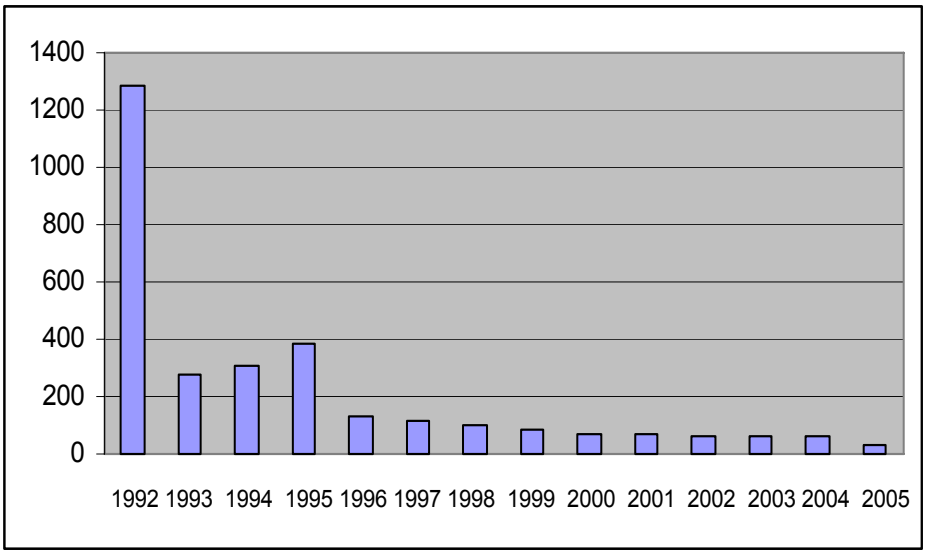

Fig.2. The evolution of the indicator "suspensions" (mg/l) within the control section Tg-Jiu downstream (storage) during the period 1992-2005

The decrease of the suspension's indicator was due to the cessation of mining activities, sedimentations and construction of water storage dams on Jiu River.

The raw materials which modify the water quality derive from the overflowing of industrial waters, as a result of coal washing.

The decrease in useful substances content and the increase of ash content of green coal forces their preparation by humid processes, which imply big water consumptions. This water is taken by the river and cleared out by the preparation unit under the form of slime pulp, with high contents of harmful substances and solid suspensions.

The residual waters from the installations of coal preparation are strongly polluted by making use of coal-clay suspensions. Besides the technological water which is evacuated from the

concentration operations under the form of sterile slime, there are also the used waters for the platform washing and equipment cooling, which are polluted with fine suspensions and mineral oils.

Within Vădeni-Tg-Jiu section a pollution of organic nature is signaled (due to insufficiently purified waters from ISCIPJC-Iezureni and EGCL Tg-Jiu), a Fe pollution, detergents (1.28 mg/l), suspensions.

Is presented the actual state of physical and chemical coefficients within the upstream sections Vădeni (table no.3) and downstream section Tg-Jiu (table no.4)

Table no.3. The physical and chemical indicators of Jiu River gathered within the control section Vădeni upstream storage in 2005

Nr. crt.	The physical and chemical indicators	Winter	Spring	Summer	Autumn
1	Flow (m^3/s)	39,5	83,5	54,0	90,0
2	Temperature (^oC)	6	10	18	14
3	pH	7,77	7,58	7,74	7,90
4	O.D. (mg/l)	12,54	11,76	9,80	9,98
5	Saturaration (%)	92,3	93	93,4	92,5
6	CBO_5 (mg/l)	2,89	2,90	3,10	3,20
7	CCOMn (mg/l)	5,70	3,90	4,92	4,55
8	CCOCr (mg/l)	6	7	6	6
9	Fixed residue(mg/l)	175	124	150	198
10	Cl^- (mg/l)	11,9	6,7	9,35	11,5
11	SO_4^{2-} (mg/l)	41	40	40	62
12	Ca^{2+} (mg/l)	39,8	25,4	36,8	51,4
13	Mg^{2+} (mg/l)	5,9	5,9	5,9	5,4
14	NH_4^+ (mg/l)	0,70	0,61	0,60	0,78
15	NO_2 (mg/l)	0,19	0,16	0,17	0,18
16	NO_3 (mg/l)	3,50	2,30	2,35	3,00
17	Total N (mg/l)	1,75	1,20	1,40	1,80
18	Total Fe (mg/l)	0,016	0,015	0,011	0,013
19	Suspensions (mg/l)	48	55	58	40
20	HCO_3^- (mg/l)	92,5	50,8	95,4	105,7
21	Total hardness (^oG)	6,59	4,67	8,74	8,58
22	Temporary hardness (^oG)	4,4	2,54	4,02	4,96
23	Permanent hardness(^oG)	2,65	2,55	2,35	3,60
24	Alkalinity (ml HCl 0,1 n)	1,6	0,9	1,5	1,8

Table no.4. The physical and chemical indicators of Jiu River gathered within the control Tg-Jiu downstream storage in 2005

Nr. crt.	The physical and chemical indicators	Winter	Spring	Summer	Autumn
1	Flow (m^3/s)	38,5	82,5	53,0	87,0
2	Temperature (^oC)	4	9	17	13
3	pH	7,56	7,38	7,54	7,87
4	O.D. (mg/l)	11,84	10,66	8,90	9,69
5	Saturaration (%)	90,2	92	91,4	91,4
6	CBO_5 (mg/l)	2,42	2,66	2,29	2,31
7	CCOMn (mg/l)	4,97	3,4	3,95	3,63
8	CCOCr (mg/l)	5	6	5	5
9	Fixed residue(mg/l)	155	104	139	188
10	Cl^- (mg/l)	11,7	6,3	9,21	10,6
11	SO_4^{2-} (mg/l)	39	38	38	59
12	Ca^{2+} (mg/l)	36,8	22,4	34,8	50,4
13	Mg^{2+} (mg/l)	5,8	5,8	5,8	5,3
14	NH_4^+ (mg/l)	0,68	0,51	0,56	0,74
15	NO_2 (mg/l)	0,18	0,14	0,16	0,16
16	NO_3 (mg/l)	3,4	2,2	2,15	2,96
17	Total N (mg/l)	1,65	1,12	1,20	1,60
18	Total Fe (mg/l)	0,014	0,014	0,010	0,012
19	Suspensions (mg/l)	27	35	40	20
20	HCO_3^- (mg/l)	91,7	48,8	85,4	103,7
21	Total hardness (^oG)	6,49	4,47	8,64	8,28
22	Temporary hardness (^oG)	4,2	2,24	3,92	4,76
23	Permanent hardness (^oG)	2,29	2,29	2,24	3,52
24	Alkalinity (ml HCl 0,1 n)	1,5	0,8	1,4	1,7

3. Conclusions

The coefficients which have been significantly modified are:

a) Suspensions *(fig.1* and *fig. 2)*
b) CBO_5 (*fig.3*)

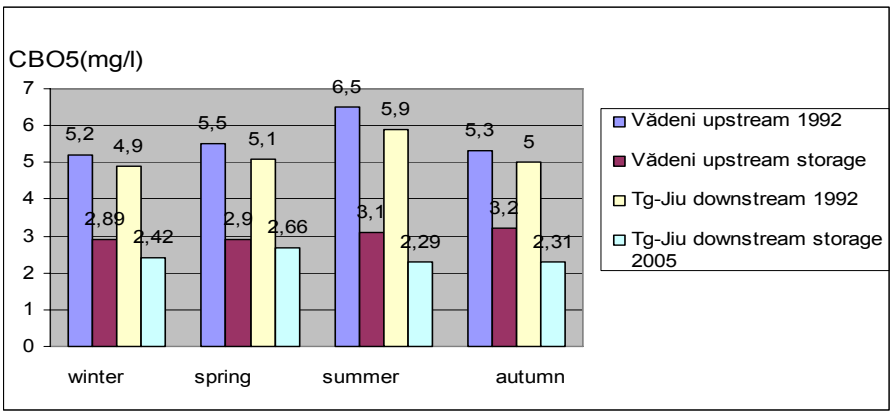

Fig. 3. The evolution of the indicator "CBO5" (mg/l) within the control section Văden upstream (storage) and Tg-Jiu downstream (storage) in 1992 and 2005

c) Fixed residue (fig. 4)

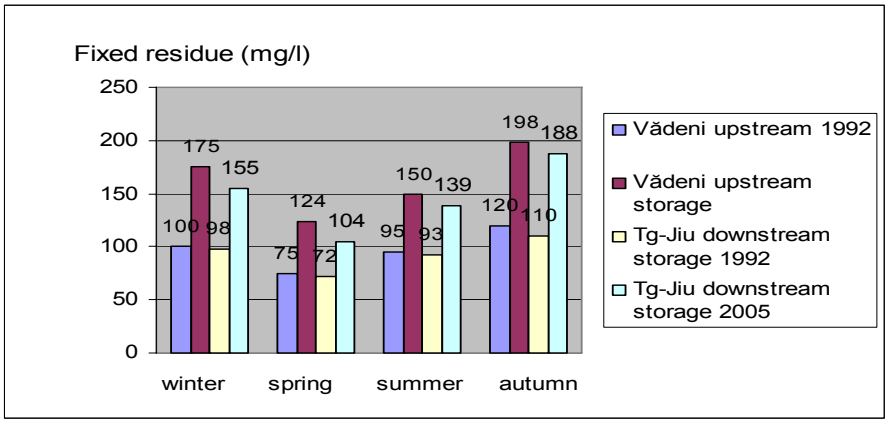

Fig.4. The evolution of the indicator „fixed residue"(within the control section Vădeni upstream (storage) and Tg-Jiu downstream (storage) during the period 1992-2005

d) Total nitrogen (fig.5)

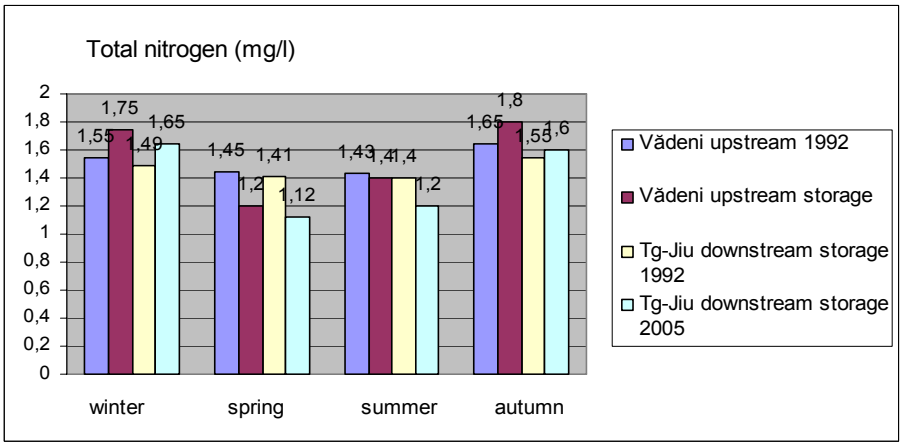

Fig.5. The evolution of the indicator „total nitrogen"(mg/l) within the control section Vădeni upstream (storage) and Tg-Jiu downstream (storage)in 1992 and 2005

e) Saturation (fig.6)

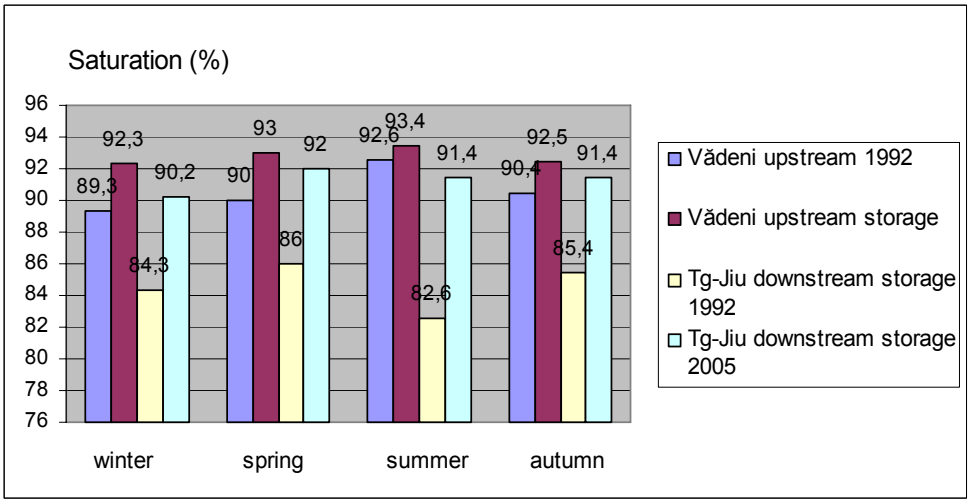

Fig. 6. The evolution of the indicator „saturation" (%) within the control section Vădeni upstream (storage) and Tg-Jiu downstream (atorage)in 1992 and 2005

f) Total hardness (fig.7)

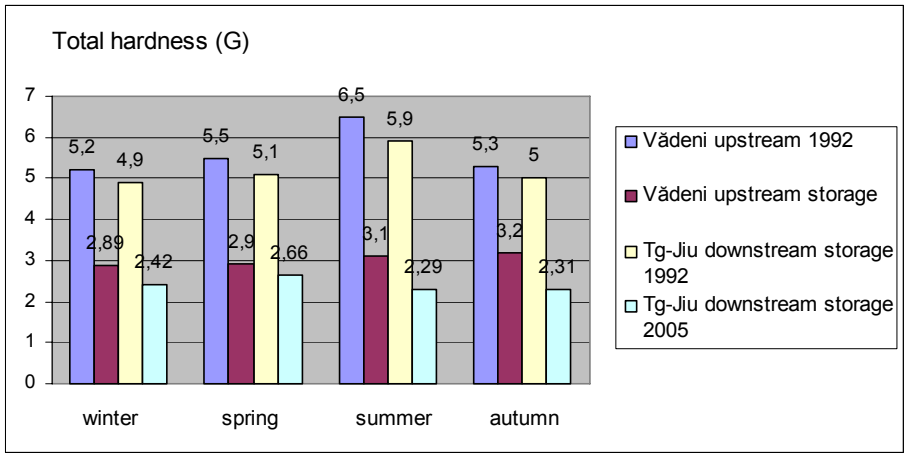

Fig. 7. The evolution of the indicator „total hardness”(G) within the control section Vădeni upstream (storage) and Tg-Jiu downstream (storage)in 1992 and 2005

4. References

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