
TOXIC METALS' CONCENTRATION IN WATER OF KRIVELJSKA REKA AND ITS TRIBUTARIES AND INFLUENCE OF WATER THERE

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ABSTRACT

Kriveljska reka is near Bor, a big mining basen in East Serbia. This river is formed from two not so big rivers: Cerova reka and Valja Mare. Kriveljska reka flow past village Veliki Krivelj. Veliki Krivelj is one of the most important mining strip in Bor area. Therefore, Kriveljska reka is the reception for waste waters of some sections of Mining Basen Bor, situated on its banks. We will present to you concentrations of 7 toxic metals, pH-value and HOD (chemical oxigen demand) in 8 points at Kriveljska reka and waste waters' influence on quality of this river's water. Based on our results, we can conclude that waste waters from Mining Basen Bor contaminate Kriveljska reka and at last we have a dead river.

Key words: river water, contamination, toxic metals, water quality

INTRODUCTION

Cerova reka and Valja Mare form Kriveljska reka near village Veliki Krivelj and flow past village. There is a big mining strip in this village. In this case, Kriveljska reka is reception for waste waters of same section of Mining Basen Bor. Each of that waste waters contaminate Kriveljska reka

Kriveljska reka is reception for three waste waters and two tributaries: Saraku potok and devijacija Borske reke. Also, tributaries are reception for waste waters of other sections of Mining Basen Bor.

Kriveljska reka flow into Borska reka near village Zagradje. It is the biggest tributary of Borska reka.

OBJECTIVE

We will present to you concentrations of 7 (seven) toxic metals (Pb, Cd, Zn, Ni, Cu, Fe and Mn), HOD and pH-value in Kriveljska reka's water and its tributaries. We also will present to you concentrations of these parameters after waste waters flow into Kriveljska reka.

MATERIALS AND METHODS

Samples of waters have been taken at the following places:

1. Cerova reka,
2. Valja Mare,
3. Kriveljska reka at the confluence of Cerova reka and Valja Mare,
4. Kriveljska reka at mining strip "Veliki Krivelj" before waste waters'contamination,
5. Kriveljska reka after contamination with flotation's waste water and before Saraku potok flows into Kriveljska reka,
6. Saraku potok,
7. Kriveljska reka after Saraku potok flows into it and before devijacija Borske reke flows into Kriveljska reka,
8. Devijacija Borske reke.

Water samples for determination of toxic metals have been treated with concentrate nitric acid when $\text{pH} < 2$. For determining pH-value and HOD we have used untreated samples. Toxic metals have been determined by atomic absorption spectrophotometric method - flame technic, after digestion. pH-values have been determined by ion-selective methods (glass electrode) and HOD has been determined after digestion with $\text{K}_2\text{Cr}_2\text{O}_7$.

DISCUSSION

Our table I present results of the analyses of water samples taken in January 1998., March, August, November and December 2000. and April 2001.

Analyses results of Valja Mare's water samples indicate that concentration of toxic metals, pH and HOD are below MAC (maximum available concentration) for I and II surface water category^{1,2}, except Fe in the April 2001.

Analyses results of Cerova reka's water samples indicate that concentration of toxic metals, pH and HOD are below MAC for I and II surface water category^{1,2}, except Fe in the samples of August 2000. and April 2001. and Mn in the sample of April 2001. (MAC for drinking water³).

Analyses results of kriveljska reka's water samples at the confluence of Cerova reka and Valja Mare indicate that concentration of toxic metals, pH and HOD are below MAC for I and II surface water category^{1,2}, except Fe and Mn in the sample of August 2001. and Fe in the sample of April 2001. HOD is above usual value in the sample of April 2001.

Analyses results of Kriveljska reka's water samples at the mining strip "Veliki Krivelj", before waste waters contamination indicate that concentration of Cu is rather above MAC in the samples of August 2000. and January 1998. Also, Fe is rather above MAC in the samples of August 2000. and April 2001. and Mn in the sample of August 2000. Concentrations of the athre parameters are below MAC for I and II surface water category^{1,2}.

Analyses results of Kriveljska reka's water samples after cotamination with flotation's waste water and before Sarku potok flows into Kriveljska reka indicate that Cu is rather above MAC for III and IV surface water category^{1,2} in all the samples. Fe is above MAC for III and IV surface water category^{1,2} in the samples of August, November and December 2000. and April 2001. Mn is rather above MAC in all the samples especially in the samples of August, November and December 2000. and April 2001. HOD is little above the usual value. Concentrations of the other parameters are below MAC for I and II surface water category^{1,2}.

Analyses results of Saraku potok's water samples indicate that Zn and Cu are above MAC for I and II surface water category^{1,2} (Zn) and III and IV surface water category^{1,2} (Cu). Cd is above MAC (I and II category^{1,2}) in the samples of November and December 2000. Fe is above MAC for III and IV surface water category^{1,2}, except Fe in the sample of January 1998. and March 2000. Mn is above MAC in all the samples. pH is below MAC (III and IV category^{1,2}) in the samples of August, November and December 2000. HOD is as usual. Concentrations of the other parameters are below MAC (I and II category^{1,2}).

Analyses results of Kriveljska reka's water samples after Saraku potok flows into Kriveljska reka and before devijacija Borske reke flows into Kriveljska reka indicate that Cu is above MAC (III and IV category^{1,2}) in all the samples. Fe and Mn are above MAC (III and IV category^{1,2}) in all the samples, except Mn in the sample of March 2000. pH is OK. HOD is little above usual value in the samples of December 2000. and April 2001. Concentrations of the other parameters are below MAC (I and II category^{1,2}).

Analyses results of devijacija Borske reke's water samples indicate that Cd is above MAC (I and II category^{1,2}) in all the samples, except August and December 2000. Zn is above MAC (I and II category^{1,2}) in the samples of January 1998. November 2000. and April 2001. Ni is above MAC (I and II category^{1,2}) in the sample of November 2000. Cu is rather above MAC (III and IV category^{1,2}) in all the samples, especially in the samples of January 1998., November 2000. and April 2001. Fe and Mn are above MAC (III and IV category^{1,2}) in all the samples. pH-value is rather below (acid water) MAC (I and II category^{1,2}) in the samples of January 1998., November 2000. and April 2001. HOD is above the usual value in the sample of January 1998. Concentrations of the other parameters are below MAC (I and II category^{1,2}).

CONCLUSION

The presented analyses results indicate that:

- Pb and Cd concentrations aren't increased after contamination with waste waters.
- Zn concentration is increased after contamination with mining strip "Veliki Krivelj" waste water. Major Zn concentration is present in Saraku potok's water and devijacija Borske reke's water which are tributaries of Kriveljska reka.
- Cu concentration is rather increased after contamination with mining strip "Veliki Krivelj" waste water. Also, Cu concentration is increased after Saraku potok and devijacija Borske reke flow into Kriveljska reka.
- Fe and Mn concentration are increased after contamination with mining strip "Veliki Krivelj" waste water. Concentrations of these metals are increased after Saraku potok flows into Kriveljska reka. Major Fe and Mn concentrations are present in devijacija Borske reke's water.
- pH-value in Kriveljska reka's water samples are about 8, after Saraku potok (pH about 4) flows into Kriveljska reka , pH-value is about 7.
- HOD isn't changed after contamination with waste waters.

Finally, contamination of natural clean waters with nonpurified waste waters produce river's water of IV category. These rivers aren't for bath and sport.

REFERENCE

1. Book of regulations for categorisation of waters (No. 5/68.),
2. Book of regulations for toxic materials in waters (No. 31/82.),
3. Book of regulations for drinking water (No. 42/98.).

Table I - Toxic metals' concentrations (mg/l) in water of Kriveljska reka and its tributaries

		January '98	March '00	August '00	Novem. '00	Decem. '00	April '01	
CEROVA REKA	Pb	0.010	<0.010	0.020	0.032	<0.010	<0.010	
	Cd	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	
	Zn	0.022	<0.001	0.020	0.019	0.017	0.047	
	Ni	<0.005	<0.005	<0.005	0.008	0.005	0.009	
	Cu	0.018	0.007	0.052	0.018	0.013	0.169	
	Fe	<0.050	<0.050	0.359	0.140	0.248	0.726	
	Mn	<0.025	<0.025	0.029	0.014	0.020	0.065	
	pH	7.80	7.96	8.19	7.85	8.20	8.22	
	HOD	10.87	19.84	15.10	3.05	1.99	15.43	
	Pb	<0.010	<0.010	0.018	0.028	<0.010	<0.010	
	Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
	Zn	0.041	<0.001	0.017	0.086	0.026	0.008	
	Ni	<0.005	<0.005	<0.005	0.019	0.007	0.005	
Cu	0.026	0.007	0.028	0.063	0.035	0.011		
Fe	<0.050	0.140	0.285	0.298	0.220	0.494		
Mn	<0.025	<0.025	0.026	0.018	0.014	0.023		
pH	7.20	7.44	8.01	7.49	7.93	8.54		
HOD	15.22	7.94	21.81	3.05	3.98	13.50		
Kriveljska reka at the confluence Cerova reka and Valja Mare	Pb	0.015	0.010	0.012	0.021	<0.010	<0.010	
	Cd	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	
	Zn	0.004	<0.001	0.062	0.028	0.014	0.014	
	Ni	<0.005	<0.005	0.007	0.009	0.006	0.014	
	Cu	0.055	<0.004	0.641	0.031	0.038	0.035	
	Fe	<0.050	0.060	0.709	0.242	0.141	1.049	
	Mn	<0.025	<0.025	0.081	0.028	<0.025	0.045	
	pH	7.50	7.55	8.18	7.95	8.46	7.97	
	HOD	15.22	11.90	23.49	39.63	7.95	125.40	
	Pb	0.010	0.014	0.017	0.015	<0.010	<0.010	
	Cd	<0.001	<0.001	0.001	<0.001	0.001	<0.001	
	Zn	0.024	0.085	0.076	0.020	0.014	0.013	
	Ni	0.005	<0.005	0.012	0.010	0.009	0.011	
Cu	0.513	0.065	4.036	0.096	0.019	0.036		
Fe	<0.050	0.140	2.351	0.181	0.150	1.049		
Mn	<0.025	<0.025	0.444	<0.025	<0.025	0.044		
pH	7.50	7.97	8.36	8.21	8.24	7.83		
HOD	15.22	9.92	18.46	4.75	7.95	21.22		
Kriveljska reka at mining strip "Veliki Krivelj" and before waste waters' contamination	Pb	<0.010	0.024	0.017	<0.010	<0.010	<0.010	
	Cd	0.003	0.002	0.006	0.012	0.010	0.003	
	Zn	0.275	0.326	0.646	1.164	0.832	0.119	
	Ni	0.037	0.026	0.095	0.218	0.184	0.021	
	Cu	24.330	17.625	55.188	92.400	71.275	9.092	
	Fe	<0.05	0.210	14.158	33.035	31.000	12.548	
	Mn	1.800	1.400	5.388	9.860	8.018	0.284	
	pH	6.40	7.33	4.03	4.09	4.26	7.74	
	HOD	2.17	23.81	8.39	15.24	9.94	9.65	
	Kriveljska reka after Saraku potok flow into it and before devijacija Borske reke flows into K. reka	Pb	#	0.010	0.023	<0.010	0.010	<0.010
		Cd	#	<0.001	0.002	0.002	0.001	0.001
		Zn	#	0.063	0.166	0.192	0.206	0.068
		Ni	#	0.006	0.028	0.033	0.020	0.008
Cu		#	1.889	10.230	8.955	6.895	1.698	
Fe		#	0.760	17.640	13.030	29.800	13.525	
Mn		#	<0.025	2.185	0.890	1.378	0.192	
pH		#	7.86	6.69	7.16	6.91	7.88	
HOD		#	21.83	25.17	3.05	73.56	63.67	
DEVJACIJA BORSKE REKE		Pb	0.012	0.010	0.024	<0.010	<0.010	<0.010
		Cd	0.012	0.010	0.002	0.019	0.002	0.011
		Zn	1.020	0.112	0.162	3.148	0.071	1.256
		Ni	0.032	0.020	0.010	0.186	0.012	0.041
	Cu	23.765	0.676	0.978	100.750	0.680	46.925	
	Fe	15.000	1.670	4.800	159.750	3.090	224.000	
	Mn	#	0.900	1.375	8.631	0.513	2.202	
	pH	4.50	8.24	7.73	2.91	8.05	3.13	
	HOD	157.49	7.94	16.78	64.02	5.96	17.36	
	Kriveljska reka after contamination with flotation's waste water and before Saraku potok flows into K.rek	Pb	0.010	0.010	0.018	0.026	<0.010	<0.010
		Cd	0.001	<0.001	0.001	<0.001	<0.001	0.001
		Zn	0.146	0.121	0.109	0.073	0.064	0.044
		Ni	0.007	0.007	0.016	0.013	0.007	0.029
Cu		3.890	0.535	4.682	0.655	1.015	0.536	
Fe		<0.050	0.280	12.655	8.302	15.560	10.220	
Mn		0.080	<0.025	2.625	0.284	0.369	0.147	
pH		7.20	8.00	8.04	8.15	8.25	7.95	
HOD		26.08	39.68	11.74	18.29	49.70	25.08	

#- there isn't result