THE MONITORING OF THE PHYSICO-CHEMICAL PARAMETERS OF CRIŞUL REPEDE RIVER

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ABSTRACT. The monitoring of the physico-chemical parameters of Crişul Repede River. The aim of this work was to study the anthropogenic influence on surface waters quality. 130 surface water samples were collected from various sites from Crişul Repede River for 10 months (February 2013-November 2013). A portable multiparameter model WTW 320i was used to determine the physico-chemical parameters such as: temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), oxidation-reduction potential (ORP) and salinity of the collected water samples. The analysed parameters did not present values above the maximum admissible limit according to the Romanian Water Law (161/2006).

Keywords: surface water quality, Crişul Repede River, physico-chemical parameters

1. INTRODUCTION

Water is an important resource but at the same time it is also limited. Natural water quality gradually deteriorated mainly due to human activities (Patih and Patil, 2013). The surface water quality may be affected due to anthropogenic activities such industrialization, urbanization or other uncontrolled activities (Jena et al, 2013).

The aim of the present study was to evaluate the anthropogenic influence on Crişul Repede River, an important river from Transylvania-Romania, which should be permanently monitored. Crişul Repede River springs from the Gilău Mountain from an altitude of 710 m, near the Izvorul Crişului town, from a hilly area on the northern edge of the Depression Huedin. The total length of the Crişul Repede River is 209 km (171 km is in Romanian territory). This river has a surface of about 3354 km^2. The Crişul Repede river tributaries are: Secuieu, Drăganul, Iadul, Valea Leşului, Brătcuţa, Borodul, Gropanda, Nedeşul, Tăşadul, Peţa River (www.rowater.ro).

2. STUDY AREA

The study area has a total length of 41 km, starting with Oradea Town to Aleşd Town. It was chosen this sector of Crişul Repede River because of the anthropogenic pollution sources from the area, which can have a significant impact

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on water quality. Along this sector there are important quantities of waste which is discarded by the local people and by the economic agents from the area (Holcim cement plant). Between Aleşd Town and Oradea Town (study area) Crişul Repede River can be polluted because it receives a number of small tributaries such as: Gropanda, Nedeşul, Tăşadul and Peţa River (Vigh, 2012; www.rowater.ro).

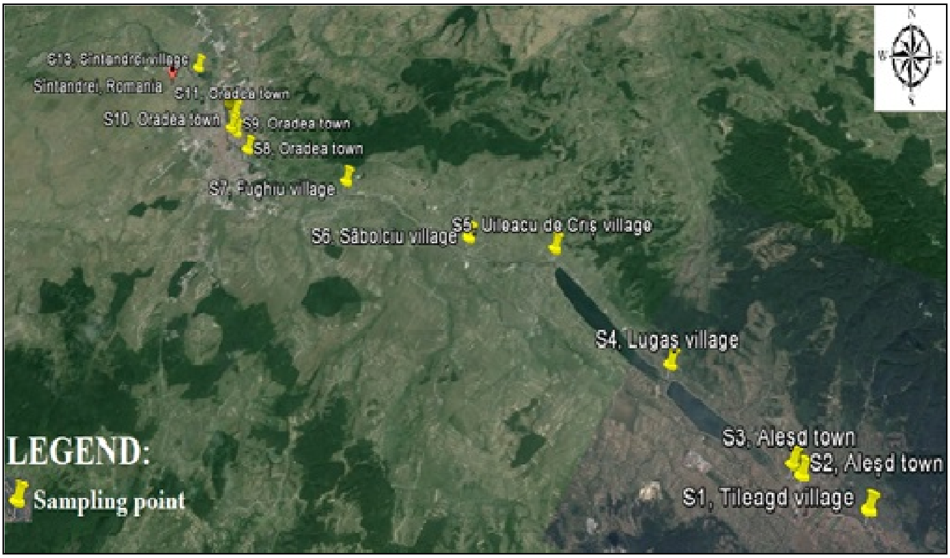


Fig. 1. Study area with sampling points

The aim of this work was to study Crişul Repede water quality, by taking surface water samples from various sites along this river and by analysing the physico-chemical parameters of surface water samples. The surface water quality parameters were monthly monitored during February 2013 to November 2013.

3. EXPERIMENTAL

130 surface water samples were collected from various sites from Crişul Repede River for 10 months (February 2013-November 2013). A portable multiparameter model WTW 320i was used to determine the physico-chemical parameters such as: temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), oxidation-reduction potential (ORP) and salinity.

4. RESULTS AND DISCUSSIONS

The average values of the monitored physico-chemical parameters are presented in Table 1. The analysed water samples proved to be neutral to slightly basic, having the pH between 7.4 and 7.93.

Table 1. The average values of the monitored parameters

Sample	pH	ORP (mV)	EC (µS/cm)	TDS (mg/L)	Salinity (‰)
1	7.93	-57.75	184.19	117.85	0
2	7.73	-49.27	187.07	128.08	0
3	7.72	-53.37	192.43	131.64	0
4	7.68	-51.90	226.86	145.20	0
5	7.63	-46.76	186.12	119.16	0
6	7.66	-48.46	174.01	111.32	0
7	7.68	-50.66	248.00	158.69	0
8	7.63	-47.35	265.00	169.69	0
9	7.64	-49.08	232.93	156.71	0
10	7.40	-34.43	270.34	182.41	0
11	7.60	-49.52	246.85	155.79	0
12	7.56	-42.01	199.81	135.56	0
13	7.66	-44.1	271.01	174.75	0

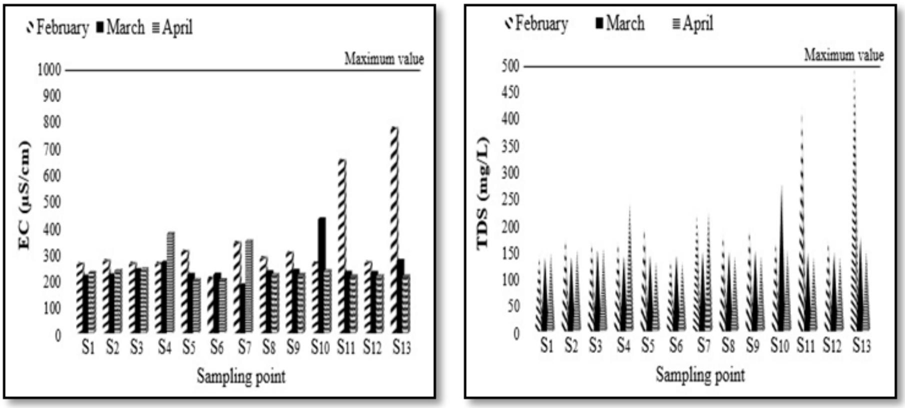
The monthly fluctuation of the investigated parameters is shown in Fig. 2, 3 and 4. The analysed water samples proved to have a relatively low EC, with the average levels between 174.01 and 271.01 µS/cm. All the analysed water samples had the EC lower than the maximum permissible limit of 1000 µS/cm imposed by the international legislation (EPA's recommended maximum value, www.epa.gov). Based on the EC classification (Handa, 1969) listed in Table 2, most of the analysed waters belong to excellent water quality, having the EC below 250 µS/cm, while only few waters samples (S8, S10 and S13) can be classified as good quality, having the EC between 251 and 750 µS/cm.

Table 2. Classification of waters based on of EC (Handa, 1969)

EC (µS/cm)	Salinity hazard class	Water salinity
0–250	C1	Low (excellent quality)
251–750	C2	Medium (good quality)
751–2250	C3	High (permissible quality)
2251–6000	C4	Very high
6001–10000	C5	Extremely high

The average TDS level ranged between 111.32 and 182.41 mg/L. All the analysed water samples had the TDS level lower than the maximum permissible limit of 500 mg/L imposed by the international legislation (EPA's recommended maximum value, www.epa.gov).

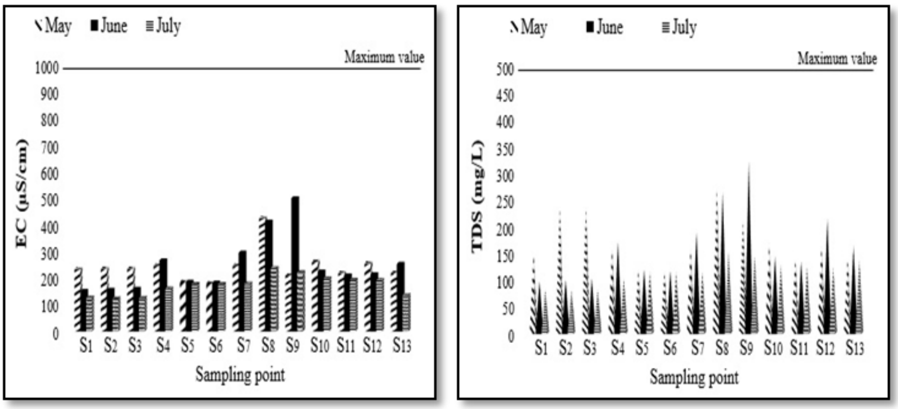
The low level of water conductivity and total dissolved solids reflects the presence of low concentrations of inorganic dissolved solids such as chloride, nitrate, sulphate, phosphate or sodium, magnesium, calcium, iron and aluminium. Conductivity in surface waters is affected especially by the geology of the area, temperature or waste waters discharges. The highest EC and TDS levels were registered in sampling points S8-S11 and S13. The high conductivity and TDS is correlated with the location of these sampling points, downstream of discharge points for municipal wastewaters. Sampling point S2 is located downstream of the discharge point for waste waters generated from a cement and aggregates (crushed stone, gravel and sand) factory, while sampling point S3 is located downstream of a waste sortation station. The results indicated that the anthropogenic activities developed in the close vicinity of sampling points S2 and S3 do not have a significant impact on the water quality.



(a) **(b)**

Fig. 2. Monthly variation of EC (µS/cm) (a) and TDS (mg/L) (b) February, March and April

As it could be seen in figures 2 (a) and (b) 76% of surface water sampling points have higher values in February than in March, 53% of samples have higher values in March than in April and 85% of samples have higher values in February than in April. Only one sample (S13-February) has a value of total dissolved solids close to maximum admissible value (see Fig. 2 (b)).



(a) **(b)**

Fig. 3. Monthly variation of EC (µS/cm) (a) and TDS (mg/L) (b) May, June and July

Figures 3 (a) and (b) show that 69% of surface water samples have higher values for electrical conductivity and total dissolved solids in May than their values in June, 100% of samples have higher values in June than their values in July and 92% have higher values in May than their values in July.

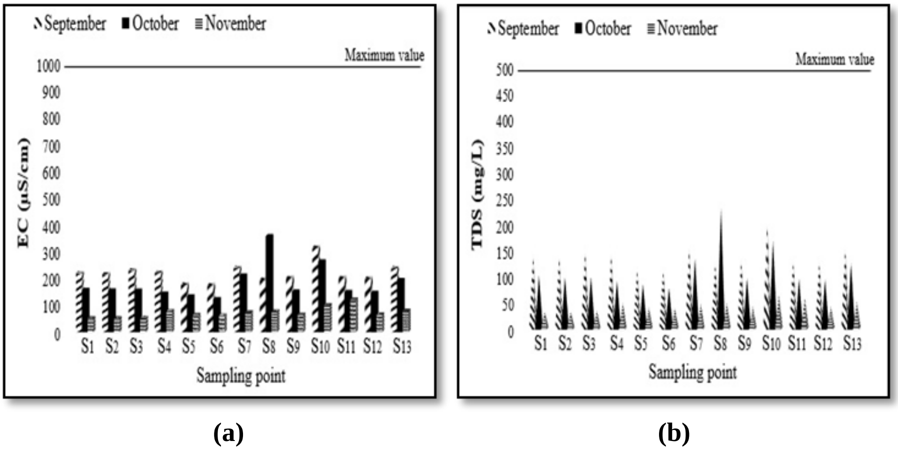


Fig. 4. ***Monthly variation of EC (µS/cm) (a) and TDS (mg/L) (b) during September, October and November***

We can observe in figures 4 (a) and (b) that 92% of the investigated water samples have higher values for EC and for TDS in September than in October and 100% of samples have higher values in September and October than in November.

5. CONCLUSIONS

The analysed water samples proved to be neutral to slightly basic, having the pH between 7.4 and 7.93. The water samples had a relatively low EC, with the average levels between 174.01 and 271.01 µS/cm. The average TDS level ranged between 111.32 and 182.41 mg/L. All the analysed water samples had the EC and TDS lower than the maximum permissible limit of 1000 µS/cm and respectively 500 mg/L imposed by the international legislation.

The low level of water conductivity and total dissolved solids reflects the presence of low concentrations of inorganic dissolved solids such as chloride, nitrate, sulphate, phosphate or sodium, magnesium, calcium, iron and aluminium (Jena et al, 2013; Ugwu et al, 2012; Atekwana et al, 2004; www.water-research.net).

The monthly variation indicated that the highest levels of EC and TDS were registered during February. The highest EC and TDS levels were registered in sampling points S8-S11 and S13, located downstream of discharge points for municipal wastewaters.

Based on the levels of the measured physico-chemical parameters, it can be concluded that the Crişul Repede River water quality is good and the anthropogenic activities do not have a significant negative impact on river water quality.

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