THE EFFECT OF THE INDUSTRIAL ACTIVITIES FROM CÂMPIA TURZII ON THE QUALITY OF ARIEȘ RIVER, ROMANIA

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Abstract. Câmpia Turzii is a city in NW of Romania that lies on the Arieș River. This study included the determination of pH, EC, TDS, permanganate index and dissolved trace metals (Cu, Zn, Mg, Mn, , Pb, Al, Ni,) from water sampled from the Arieș River and its tributary. The results indicated that the river (in Câmpia Turzii area) can be framed in the highest class of quality, while its effluent is moderately polluted. Even thought, with a low flow rate, the tributary`s chemical composition does not affect the quality of the Arieș River.

Keywords: Câmpia Turzii, Arieș River, surface water, trace dissolved metals, permanganate index

INTRODUCTION

Industrial activities have a major impact on the nearby environment. Surface water is a vital resource for life and it is often affected by the pollution, being a factor that is directly touched by the negative impact generated by the industrial and domestic activities (Levei et. al., 2015, Mhlongo, et. al., 2018).

Câmpia Turzii is a city situated in the NW of Romania, in Cluj County, lying on the *Arieș River,* one of the largest river in Romania (Butiuc-Keul et. al., 2012). It was an industrial city, with many companies and industrial units, like steel and chemical industry, industries that generated a significant impact to the environmental. In the present, those production units have significantly reduced their activity.

Even so, the major impact generated on the environment is still present (Ștefãnescu et. al., 2011).

The present study wants to establish the influence of the industrial and domestic activities conducted in *Câmpia Turzii* over the quality of *Arieș River.*

In order to achieve this aim, samples of surface water was taken from seven different points to be analyzed.

MATERIALS AND METHODS

Study area and water sampling

Samples were taken from the *Arieș River*`s basin among the *Câmpia Turzii City*. The study area is situeted in the center of the *The Transylvanian Plateau*, an area characterisezed by a temperate climate with an annual air temperature average of 7-8°C (Popescu-Argeșel, 1984).

There was 7 points of sampling. The first one (S1) is located at the outskirts of the city, before the *Valea Lungă* tributary discarges into the *Arieș River*. Second sampling point

(S2) was downstream of the effluent discharge. The third (S3) and the fifth sampling point (S5) were on the main water course, upstream and downstream of an tributary stream `s discharge area.

The forth sample (S4) was taken from that tributary, an effluent of the *Arieș River* that crosses the entire industrial area. The sixth and seventh sample (S6-7) were taken from southern outskirt of the *Câmpia Turzii (*Figure 1).

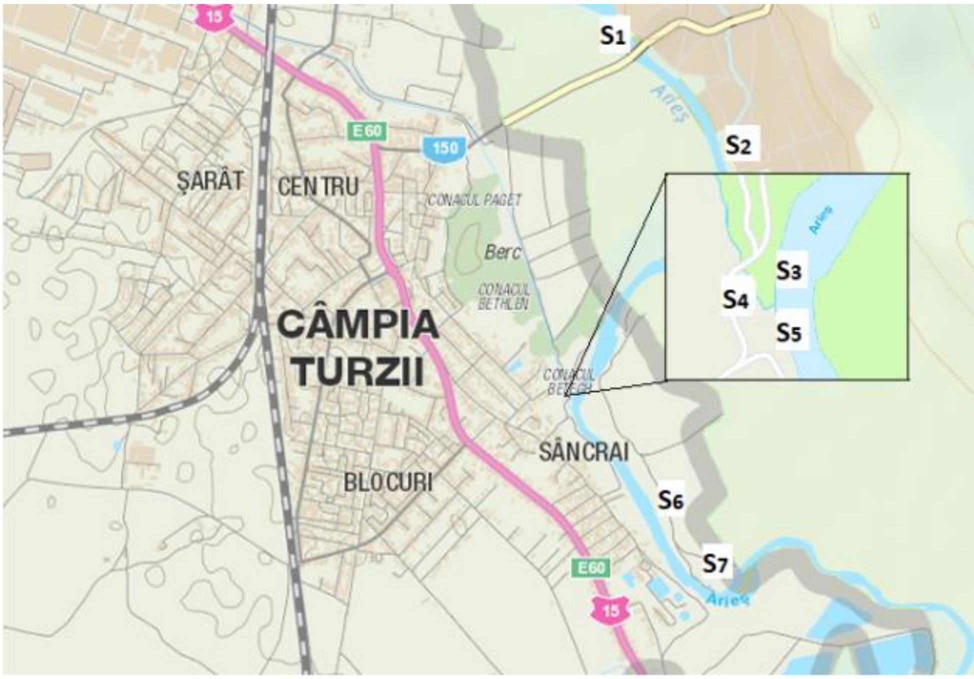

Fig. 1. Sampling area

The samples were collected during summer time in a rainy period, in prewashed polyethylene bottlesand and stored at 4 °C until the chemical analyses to be performed.

Analytical methods and materials

The *pH* and *electrical conductivity (EC)* were measured by a portable WTW 350I multiparameter (Xylem, New York, USA).

Total dissolved solids (TDS) was determined by evaporate a 100 mL of filtered water samples. To remove the particles from the water samples, 0.45 µm membrane filters were used (Atekwana et. al., 2004).

The permanagant index from samples was analyzed by a volumetric method, according to international standard ISO 8467:1993. All the reagents used were of analytical grade and they were purchase from Merck (Darmstadt, Germany).

Heavy metals concentration was determined by ICP mass spectrometry (ICP-MS) using the ELAN DRC II Spectrometer (Perkin-Elmer Sciex, Toronto, Canada). Previously, the samples were filtered with a 0.45 µm filter and mineralized with 5 mL ultrapure grade 65 % HNO_3 (Merck, Darmstadt, Germany) to 100 mL water sample, accordint to ISO 17294-2:2016.

RESULTS AND DISCUSSIONS

The results of the analyses for pH, EC, TDS and permanganate index are presented in table 1. The pH values were in the neutral range, slightly alkaline. The EC of the main stream were in the range of 223-523 µS/cm, while the tributary stream was characterized by a much bigger values of EC: 1456 µS/cm. Even though a high value was recorded for the effluent (S4), the main stream was not affected by it, due to the tributary's reduced flow rate.

In all the sampling sites, the value of TDS was quite constant, ranging between 86.3 to 102 mg/L. These values are attributed to a high class of surface water quality.

The permanganate index present in the analysed samples was quite different from one sampling site to another. While the value of the O_2 from the first three points of sampling (S1, S2 and S3) had values between 3.9-4.2 mgO_2/L, after the tributary stream (S4) discharges in the *Arieș River*, the value corresponding to the concentration of oxygen in water increased, almost reaching the MAC established by the Romanian legislation for surface water suitable for drinking. Downstream (S6 and S7), the values of permanganate index decreased.

Table 1

The analysed parameters according to the seventh sampling points

Parameters	S_1	S_2	S_3	S_4	S_5	S_6	S_7	MAC*
pH [pH unit]	7.4	7.2	7.6	7.6	7.3	7.4	7.6	8.5
EC [µS/cm]	356	280	223	1456	423	523	502	-
TDS [mg/L]	86.3	88.9	94.5	102	95.3	98.7	95.3	500
Permanganat index [mgO_2/L]	4.0	3.9	4.2	14.4	4.9	4.6	4.4	5

* MAC establish by the Romanian legislation for surface water suitable for drinking according to Order 161/2006

Trace metals concentrations are illustrated in fig. 2. The Cu concentrations had similar values for all the sampling areas (with the exception of area S5), while some values presented a wide variation. The highest variation along the sites analysed was found for Zn, Mg, Mn and Ni. The values corresponding to the tributary stream (S4) were: 9.6-10.3 - for Zn, 2.5-2.8 - for Mg, 143-189 - for Mn, and 6.9-9.8 - for Ni, times higher than the values corresponding to other sites of sampling (from the main stream). The values for Pb and Al were higher in the water samples taken from the main stream (S1, S2, S3, S5, S6, S7) compared to the concentration identified in the tributary stream (S4).

According to the Romanian legislation (Order 161/2006), surface water is divided in five quality classes: excellent water (1st class), good water (2nd class), moderate polluted water (3rd class), polluted water (4th class) and extremely polluted water (5th class).

The water taken from the first three sampling points of the main stream can be framed in the first class of quality, having some particularities that make them suitable for drinking. The tributary (S4) that drains into the main stream, on the other hand, due to the high values of permanganate index and Zn ions concentration reported, can be included only in the 2rd class of quality. After the affluent stream is drained, the *Arieș River*`s quality remains almost the same as before the spill of the tributary and the water samples taken from S5, S6 and S7 points of sampling, can be, also, framed at the first class of water quality. A possible explanation for this fact is the small flow rate of the tributary.

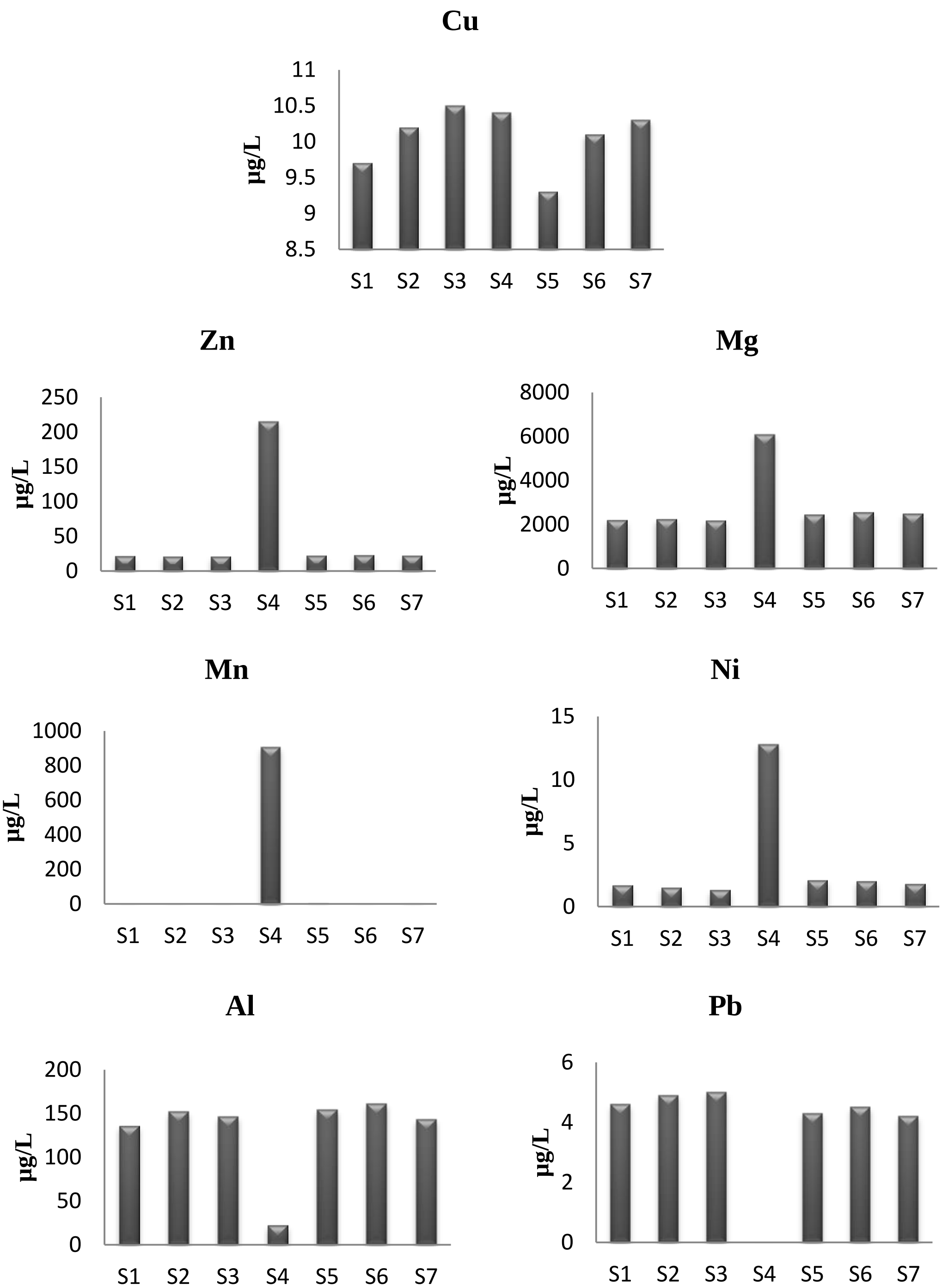

Figure 2. Trace metals concentration presented in the Arieș River and its tributary stream

CONCLUSIONS

Câmpia Turzii is a city with a significant industrial history and all the effects of the industrial activities remained impregnated in the entire environment. In this paper, the authors tried to establish the water quality of *Arieș River,* (a river that crosses the city) and its tributaries stream and frame them to the quality classes established by Romanian legislation. The samples were collected in the summer time, but in a rainy period. The results of the study revealed that the main stream can be enclose to the 1st class of quality (excellent water), while the tributary stream, that came from the industrial area, can be framed in the 2rd class of quality (good water). In addition, the study showed that the main stream is not influenced by the chemical composition of the effluent, due to the low tributary flow rate.

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