

ON HEAVY METAL LEVELS VARIATION IN TARNAVA MARE RIVER DURING 2003[★]

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An extensive monitoring of the heavy metal concentration in Tarnava Mare river was conducted. The Pb, Zn, Cd, Cu concentration in the river water upstream and downstream Copsa Mica and in the non-ferrous metal plant effluent was monitored during 2003. The average monthly concentrations are presented and compared with Romanian maximum admitted values.

Key words: heavy metals, pollution, concentration monitoring.

1. INTRODUCTION

The Copsa Mica area in Sibiu district is a very polluted area as a consequence of the decades of operations of the chemical plant producing heavy metals. An extensive study is carried on to assess and to monitor the variation of the concentration of several heavy metals in water, air and soil in the Copsa Mica. Monitoring area and the partial results we have so far concerning the Cd, Cu, Pb and Zn in the Tarnava Mare river are presented in this work.

2. MATERIALS AND METHODS

The water samples were drawn in teflon containers carefully cleaned using diluted nitric acid in double deionised water. The water samples were filtered and than were stabilised by adding nitric acid up to pH = 1. The samples that were used to measure the lead and the cadmium concentration were filtered after adding nitric acid. The samples that were used to determine the zinc concentration were filtered through filter paper having big porosity and than were stabilised by adding nitric acid up to a pH 1÷3.

The samples were analysed using a PERKIN ELMER 403 S atomic absorption spectrometer, with cavitory cathodes. The wavelengths that were uses

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to analyse the concentrations are: Pb: $\lambda = 283.3$ nm [1], Zn: 213.9 nm [2], Cd: 228.8 nm [1], Cu: 324.8 nm [3]. Details of the procedure are presented in [4] and [5].

3. THE HEAVY METALS CONCENTRATIONS

The concentration of Cd, Cu, Pb and Zn in the Tarnava Mare river water downstream Copsa Mica town was monitored during 2003. The monthly average concentration values of the above mentioned metals in the river water upstream Copsa Mica are presented in Table 1 and the concentration downstream Copsa Mica in Table 2 and plotted in Figs. 1 through 4 together with the maximum admitted concentrations (hereafter MAC). The last but one line of the table presents the average concentration values for the year 2003. The last line presents the ratio of the average concentration to the maximum admitted concentration for that specific metal in water.

Table 1

The Cd, Cu, Pb and Zn, concentration in Tarnava Mare, upstream Copsa Mica, during 2003 and the maximum admitted concentrations

Pollutant, mg/l	Cd	Cu	Pb	Zn
January	0	0.001	0.11	0.017
February	0	0.003	0	0.008
March	0.0003	0.007	0.02	0.004
April	0.001	0.003	0.07	0.012
May	0.0005	0.001	0.06	0.08
June	0.0004	0.002	0.02	0.015
July	0.0003	0.003	0.01	0.017
August	0.0012	0.001	0.011	0.023
September	0.0011	0.001	0.012	0.01
October	0.002	0.001	0.0009	0.013
November	0.003	0.015	0.01	0.012
December	0.001	0.004	0.01	0.017
MAC, mg/l	0.003	0.05	0.05	0.03
Average concentration for 2003, mg/l	0.0009	0.0045	0.027825	0.019
Average/MAC	0.3	0.07	0.56	0.63

It can be noticed that Cd concentration downstream the plant had a big variation during 2003 and it stayed bigger than the MAC most of the time. The Cd concentration downstream the plant was lower than the MAC.

Table 2

The Cd, Cu, Pb and Zn, concentration in Tarnava Mare, downstream Copsa Mica, during 2003 and the maximum admitted concentrations

Pollutant, mg/l	Cd	Cu	Pb	Zn
January	0.003	0.11	0.14	0.19
February	0.003	0.049	0.22	0.06
March	0.007	0.028	0.3	0.25
April	0.01	0.02	0.18	0.54
May	0.011	0.005	0.012	0.087
June	0.015	0.003	0.06	0.168
July	0.013	0.003	0.06	0.165
August	0.032	0.011	0.07	0.34
September	0.044	0.001	0.05	0.03
October	0.023	0.002	0.03	0.079
November	0.006	0.04	0.02	0.072
December	0.001	0.008	0.02	0.068
MAC, mg/l	0.003	0.05	0.05	0.03
Average concentration for 2003, mg/l	0.014	0.023	0.097	0.171
Average/MAC	4.7	0.47	1.94	5.69

Cd, 2003

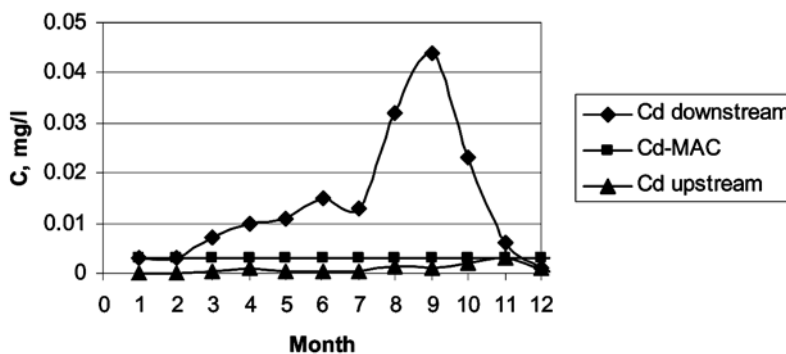


Fig. 1 – Cd, concentration in Tarnava Mare, during 2003.

Cu concentration downstream the plant remained lower than the maximum admitted concentration, except for the beginning of the year. The Cu concentration downstream the plant was considerably lower than the MAC.

Pb concentration downstream the plant during the first half of 2003 was considerably bigger than the MAC and oscillated close to the MAC for the rest of the year. Pb concentration downstream the plant oscillated around the MAC.

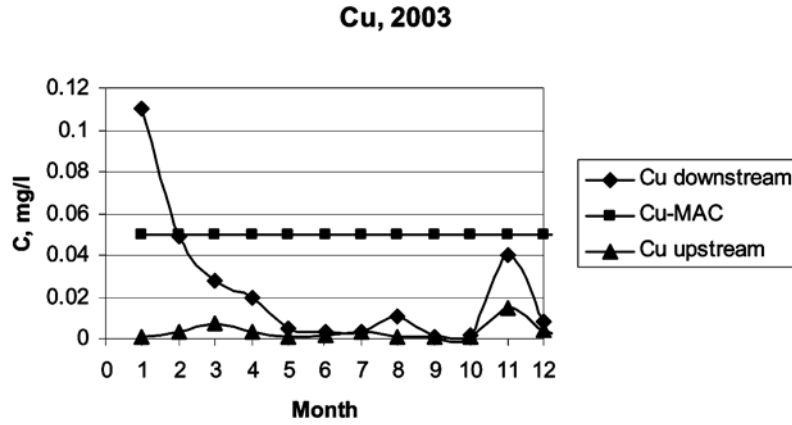


Fig. 2 – Cu concentration in Tarnava Mare, during 2003.

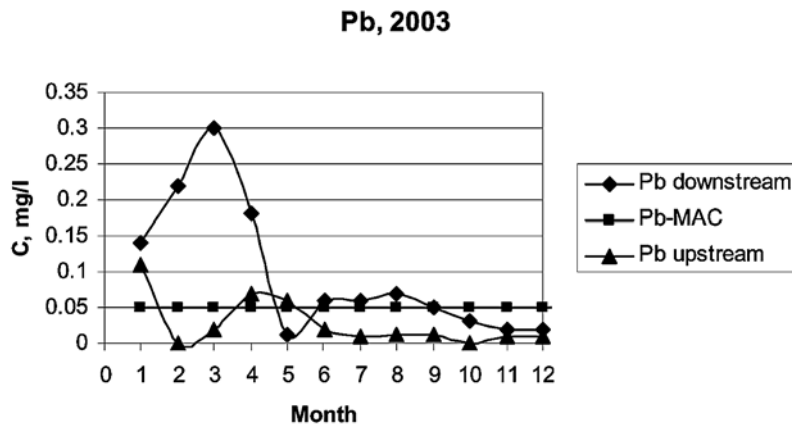


Fig. 3 – Pb concentration in Tarnava Mare, during 2003.

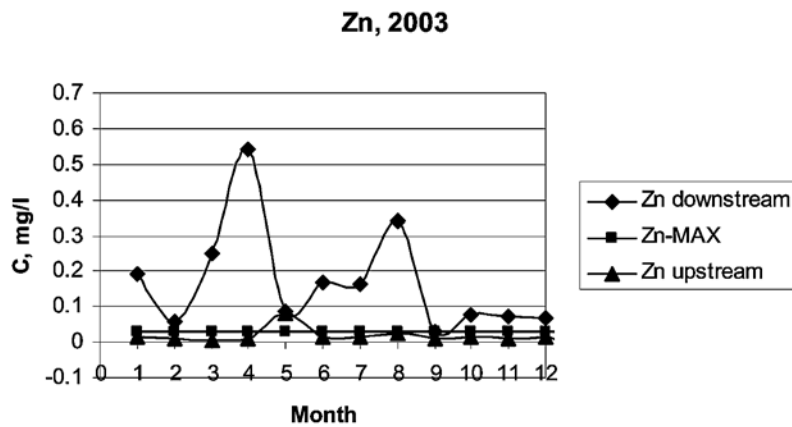


Fig. 4 – Zn concentration in Tarnava Mare, during 2003.

This is a clear indication that there is another Pb polluting source upstream Copsa Mica, besides the plant.

The Zn concentration variation downstream the plant was bigger and the concentration values were significantly above the MAC during the whole 2003 except for September when they were slightly below the MAC. The Zn concentration downstream the plant was oscillating around the MAC.

The average concentration of Cd, Cu, Pb and Zn in Tarnava Mare river during 2003, upstream and downstream Copsa Mica are presented in Table 3 together with the concentration of the above mentioned elements in the plant effluent.

Table 3

The average concentration of Cd, Cu, Pb and Zn in Tarnava Mare river over 2003

Average on 2003	Cd, mg/l	Cu, mg/l	Pb, mg/l	Zn, mg/l
Upstream	0.0009	0.0035	0.0278	0.019
Effluent	5.142	1.2	2.25	5.8
Downstream	0.014	0.0233	0.0968	0.1708
MAC, mg/l	0.003	0.05	0.05	0.03

4. DISCUSSION

The results of a previous study revealed a considerable decrease of the concentration of the Pb, Zn, Cd, and Cu in the Tarnava Mare river down-stream Copsa Mica [4]. The decrease was strong during 1993 to 1995, was followed by a small increase and then by small variations [4]. Even with the considerable decrease that was noticed over the last decade, the Pb concentration remains about twice as much as the admitted value (MAV), Zn more than five times, Cd concentration is almost five times the MAV and Cu concentration is about half of the MAV.

Examining Table 3 we notice that the Pb, Zn, Cd, and Cu concentration in the plant effluent is huge as compared with the MAV for each element. The time variation over 2003 of the concentration of the above mentioned elements is not directly correlated with the variation of each element concentration in the effluent, because the water flux in the river has a strong variation with the season. Examining the averages of the concentrations upstream and downstream we notice that the plant is the main pollutant of the Tarnava Mare river.

In spite of closing some facilities of the chemical plant and of the anti-pollution upgrading that was done at the facilities that are still operational, the Copsa Mica area remains a very polluted area. During 2003 in Tarnava Mare river the Zn concentration excess, as compared with the Zn MAV was the biggest, followed by Cd and Pb. Cu average concentration did not exceed the Cu MAV. These results are different of what is reported in [6] and [7] that states that Pb is the top pollutant in US waters, Zn the fourth, Cd the fifth, Cu the sixth.

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