Romanian Reports in Physics, Vol. 56, No. 4, P. 769-776, 2004

ON METAL POLLUTION IN COPŞA MICA AREA

D. CHICEA[1], H.BARBU[2]

[1]*Physics Department, University Lucian Blaga of Sibiu, Romania, dan.chicea@ulbsibiu.ro*
[2]*Agricultural Sciences Department, University Lucian Blaga of Sibiu, Romania, horiab@rdslink.ro*

(Received July 22, 2004)

Abstract A study of heavy metal pollution in Copşa Mica area was conducted. The Pb, Zn, Cd, Cu concentration in the Târnava Mare river and of Pb and Cd in air was monitored in the time period 1993-2001. The concentration variation is discussed in connection with the chemical plant activity.

Key words: heavy metals, pollution, concentration variation

INTRODUCTION

In Sibiu district (Romania) there does exist an extremely polluted area as a chemical plant producing heavy metals has been operational in the Copşa-Mica town for decades. 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 Copşa Mica Monitoring area and the partial results we have so far are presented in this work.

EXPERIMENTAL PROCEDURE

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

The air samples were drawn using a device composed of a gas pump, a gas volume meter and an air filter. All the aspirations lasted for 24 hours and the filters were weight and dissolved in 10 ml of concentrated nitric acid and analysed afterwards. Other method of measuring the amount of heavy metals in air is the sediment method that uses a filter type surface that is exposed in outdoor air for a certain amount of time allowing deposits to be accumulated. Later on it can be processed like the filters used in the aspiration method. In this case the concentration is calculated in mg/m^2*month.

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

concentrations are: Pb: λ = 283.3 nm [1], Zn: 213.9 nm [2], Cd: 228.8 nm [1], Cu: 324.8 nm [3].

THE HEAVY METALS CONCENTRATIONS

The concentration of Pb, Zn, Cd and Cu in the Târnava Mare river water downstream Copşa Mica town was monitored in the time period 1993-2001. The average value of the concentration of the above mentioned metals in the river water are presented in Table 1.

Table 1

Average Pb, Zn, Cd and Cu concentration in Târnava Mare, downstream Copşa Mica, over the years 1993 through 2001

Pollutant	Pb, mg/l	Zn, mg/l	Cd, mg/l	Cu, mg/l
1993	0.663	4.175	0.088	0.066
1994	0.384	1.47	0.037	0.15
1995	0.418	0.872	0.022	0.032
1996	0.104	0.487	0.029	0.037
1997	0.108	0.386	0.1	0.024
1998	0.157	0.69	0.009	0.033
1999	0.161	0.18	0.01	0.028
2000	0.191	0.401	0.023	0.045
2001	0.134	0.35	0.014	0.026

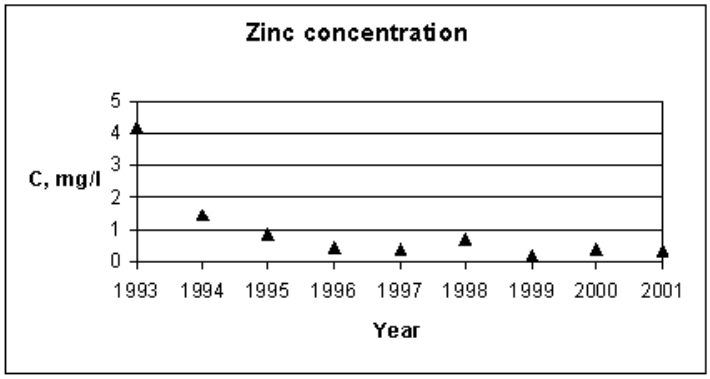

Fig 1 - Zinc concentration variation in Târnava Mare during 1993-2001.

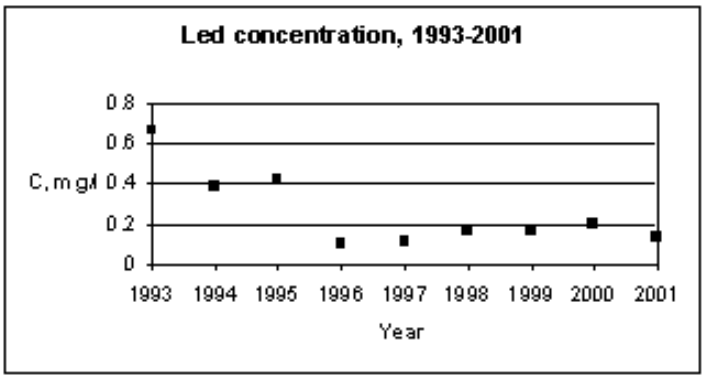

Fig. 2 - Led concentration variation in Târnava Mare during 1993-2001.

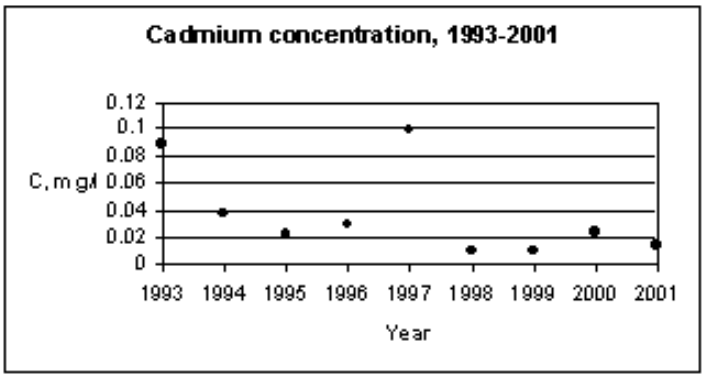

Fig. 3 - Cadmium concentration variation in Târnava Mare during 1993-2001.

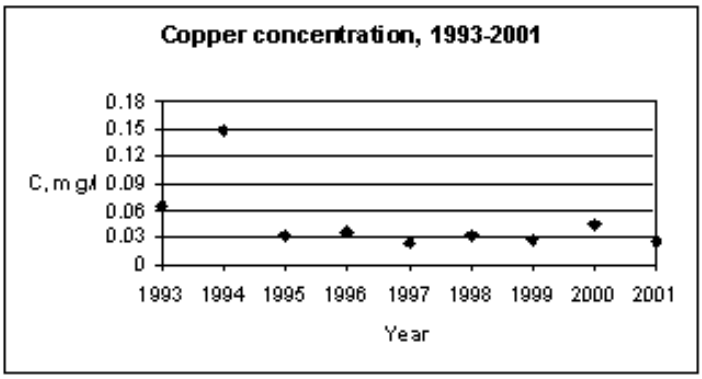

Fig. 4. - Copper concentration variation in Târnava Mare during 1993-2001.

Poluant, mg/l	Pb	Zn	Cd	Cu
Maximum admitted concentration	0.05	0.03	0.003	0.05
January	0.2	0.27	0.017	0.01
February	0.06	1.29	0.07	0.04
March	0.18	0.54	0.011	0.02
April	0.015	0.45	0.01	0.009
May	0.65	0.55	0.02	0.03
June	0.11	0.174	0.012	0.008
July	0.06	0.09	0.006	0.048
August	0.12	0.141	0.009	0.007
September	0.06	0.79	0.004	0.004
October	0.124	0.06	0.084	0.008
November	0.005	0.0075	0.003	0.003
December	0.09	0.46	0.005	0.14

Table 2 - The Pb, Zn, Cd and Cu concentration in Târnava Mare, downstream Copşa Mica, during 2001 and the maximum admitted concentrations.

Examining Table 1 and Figures 1 through 4 we notice that the concentration of al the four pollutants decreased significantly over the period the study was conducted. Among them the Zn concentration had that strongest variation. The plot of the zinc concentration variation during the time span 1993-2001 is presented in Fig. 1. Examining Fig. 1 we notice that the concentration decrease significantly during 1993 - 1995 and had an increase during 1998 and then decreased again. Table 2 presents the concentration during year 2001 and the maximum admitted concentration.

The data presented in Table 2 is plotted in Figures 5 through 8.

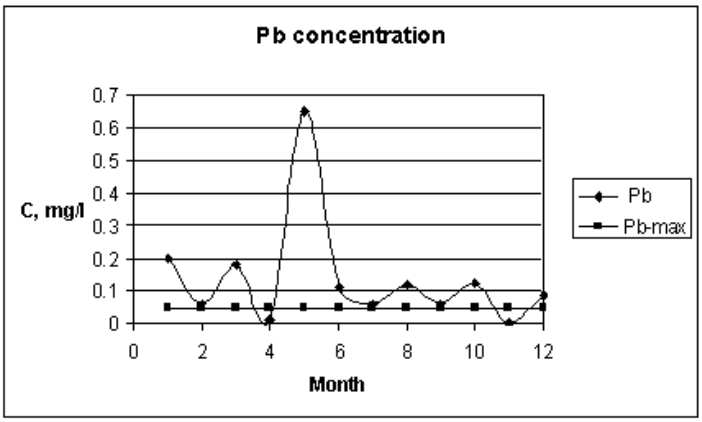

Fig. 5 - Pb, concentration in Târnava Mare, downstream Copşa Mica, during 2001.

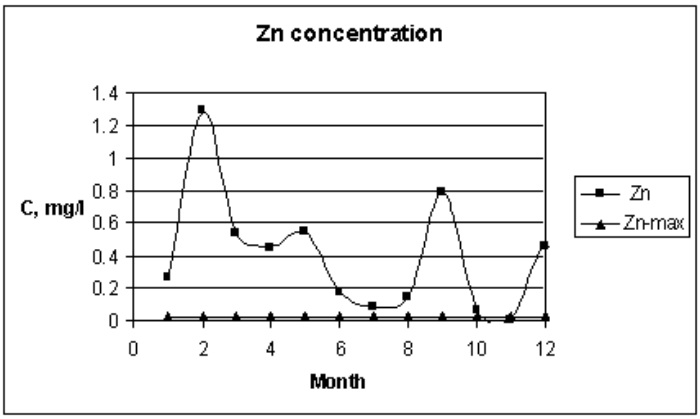

Fig. 6 - Zn concentration in Târnava Mare, downstream Copşa Mica, during 2001.

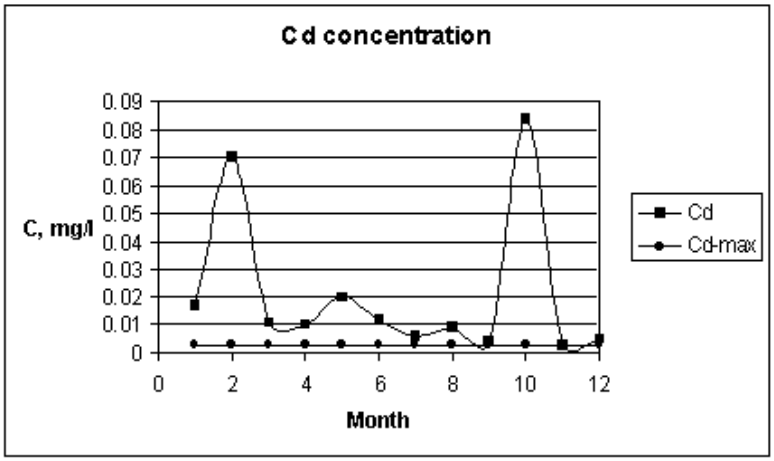

Fig. 7 - Cd concentration in Târnava Mare, downstream Copşa Mica, during 2001.

It can be noticed that Cu had a small variation during 2001 and that the Cu concentration remained lower than the maximum admitted concentration. Cd concentration had a bigger variation during 2001 and it oscillated around the maximum admitted concentration. The Zn concentration variation was bigger and the concentration values were oscillating around the maximum admitted value, being significantly above it many times. Pb concentration had a more uniform variation but more than half of the values were bigger than the maximum admitted concentration.

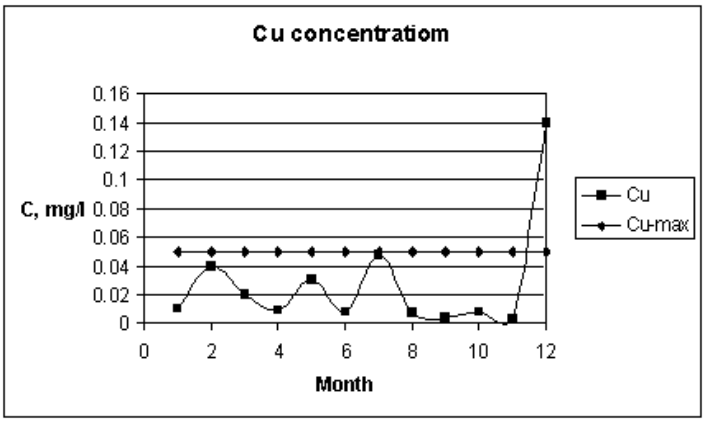

Fig. 8 - Cu concentration in Târnava Mare, downstream Copşa Mica, during 2001.

The Pb and Cd concentration in air was monitored over the years 1993 through 2000 using the sediment method and the results are presented in Table 3 and Figures 9 and 10. Examining Table 3 and Fig. 9 and 10 we notice that the Pb and Cd concentration in air over the years 1993 through 2000 has the same pattern as the concentration variation in Târnava Mare river downstream Copşa Mica, which proves that the concentration assessment is accurate and that the pollutant source is the same, i.e. the chemical plant.

Table 3
Pb and Cd concentration in air over the years 1993 through 2000

Year	Pb, mg/m2*month	Cd, mg/m2*month
1993	0.002509	0.000101
1994	0.001885	0.000051
1995	0.002107	0.000075
1996	0.002134	0.000062
1997	0.001952	0.000069
1998	0.002635	0.000089
1999	0.003025	0.000091
2000	0.002321	0.000080

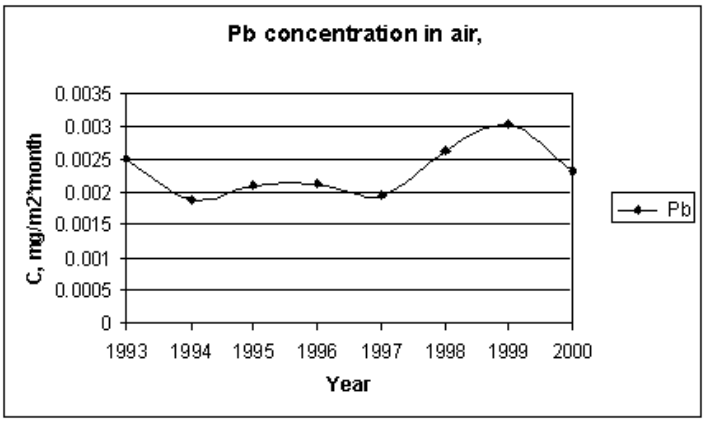

Fig. 9 - Pb concentration in air during time period 1993 through 2000.

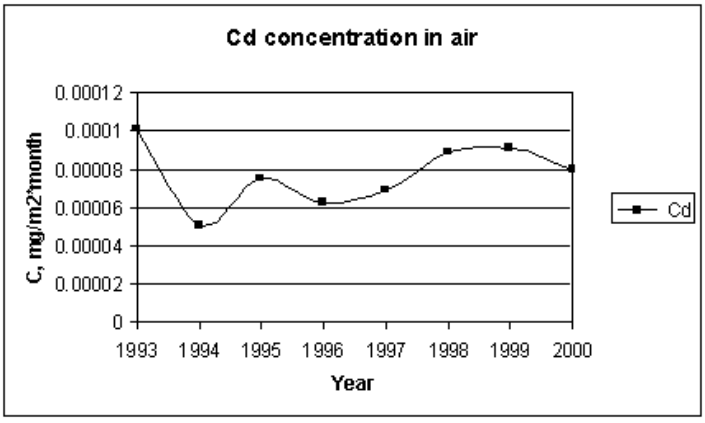

Fig. 10 - Cd concentration in air during time period 1993 through 2000.

DISCUSSION

The results of this study reveal a considerable decrease of the concentration of the Pb, Zn, Cd, and Cu in the Târnava Mare river down-stream Copşa Mica. The decrease was strong during 1993 to 1995, was followed by a small increase and then by small variations. Even with the considerable decrease that was notices over the last decade, the Pb concentration remains more than twice as much as the maximum admitted value (MAV), Zn almost ten times, Cd is close to MAV and Cu concentration is about half of the MAV. The Pb and Cd concentration in air was monitored over the same period and the variation is similar with the concentration variation in water. 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 Copşa Mica area remains a very polluted area. This results are similar

with what is reported in [4] and [5] that states that Pb is the most frequent pollutant in US waters, Zn the fourth, Cd the fifth, Cu the sixth.

REFERENCES

1. I. READER AND C. H. CORLISS, Editors, *CRC Handbook of Chemistry and Physics*, 79th Edition, CRC Press, Boca Raton, FL, 1998.
2. J. SUGAR AND A. MUSGROVE, Energy Levels of Zinc, Zn I through Zn XXX, J. Phys. Chem. Ref. Data 24, 1995, pp. 1803.
3. J. SUGAR AND A. MUSGROVE, Energy Levels of Copper, Cu I through Cu XXIX, J. Phys. Chem. Ref. Data 19**,** 1990, pp. 527.
4. C. H. BARBU, L. OPREAN, D. CHICEA, A. MĂRCULESCU, E. MOLDOVAN, The Influence of Natural Zeolites on the Containment of Heavy Metals in Soil, 12th International Biodeterioration and Biodegradation Symposium, Praga, August 2002.
5. D. A. DZOMBAK, Remediation of Metals-Contaminated Soils and Ground Water, Advances in Inovative Ground Water Remediation Technologies Conference, Boston, MA, 2000, pp. 1.
6. DAN CHICEA, HORIA BARBU, ADRIANA MORARIU, On Heavy Metals Pollution In Copşa Mica Area, proc. of The Impact of Physical and Bio-Geo-Chemical Factors on the Sustainable Development, May 15-16 2004, Simleul Silvaniei.