

EVALUATION OF MERCURY POLLUTION IN OLT RIVER BASIN INDUCED BY HISTORICAL AND CURRENT POLLUTION SOURCES

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Abstract

This paper aims at establishing the historical and current sources of mercury pollution, for monitoring mercury dispersion in Olt River Basin ecosystems (B.H.Olt) and development of the quality of aquatic ecosystems upstream and downstream of pollution sources investigated.

For this, samples water and sediment from spring B.H.Olt (Balan) and until it flows into the Danube, upstream and downstream of pollution sources and soil samples from industrial sites in B.H.Olt vicinity, were collected.

The degree of pollution with mercury was established and mercury pollution on ecosystems soil, water and sediment from B.H.Olt was evaluated by comparing the determined values during the investigation period, with the legislation.

Keywords: mercury detection, water surface, sediment, soil

1. Introduction

River Basin is an area of great economic and social value by supporting agriculture, industry, fishing and drinking water. All these activities are potential sources of water pollution and River sediments. Thus, supervision Olt River water quality are of special importance because it highlights, the concentrations of pollutants in the aquatic environment.

Mercury is a non-essential element with no biochemical or nutritional function to bioorganisms and is ubiquitous in the environment in its presence. Its compounds are present as trace contaminants in various biological and environmental samples such as air, water, soil, animal tissues, plant matrices and coal fly ash as a result of both natural and anthropogenic activities. Being an element, mercury is persistent. It cannot be broken down in the environment,

only its form can change. All forms of mercury are extremely toxic. Mercury in its methylated form as a trace contaminant in the environment is especially of great concern because of its toxicity and its special ability to bioaccumulate to levels as high as 100,000 in marine organisms. Despite a number of stringent regulations anthropological sources still emit quantities that result in dangerously high levels of this contaminant in the environment. Thus constant monitoring of the environment is essential.

This study aims to determine the current level of mercury in water, sediments and soils of the River Basin and to compare these values with the legislation.

2. Experimental part

2.1. Reagents and apparatus

For atomic absorption spectroscopy (AAS) measurements 10% SnCl₂ solution and concentrated nitric acid, from Merck, have been used. The measurements have been done on AAS Unicam atomic spectrometer.

The samples (water, sediments and soils) were taken and prepared in standard condition. The samples have been analysed by atomic absorption spectroscopy according to the standard procedures (SR EN 1483: 2003 and SR EN 1238:2003).

2.2. Collection and processing of samples

The Olt River basin comes from mountains Hasmasu High (Harghita county) and flows into the Danube in Turnu Magurele county. The localities where samples were taken are found in Table 1. The sampling points were chosen to cover the whole circumference of the Olt hydrographic basin. From each sampling location, one water sample and one sediment sample were collected.

Water samples were collected about 2 m from the shore to avoid various suspended objects and debris. Water samples were collected from 30 cm below the surface to avoid dead leaves and other floating debris. Sediment samples were collected from the same localities as the water samples.

The soil samples were collected from industrial site in the River basin, on three levels deep (table 2). After collection the samples were transported to the laboratory and then stored at low temperatures for further processing. Sediment and soils samples were separated from gravel (>2 mm) and were air dried at ambient temperature in a clean room. After drying to a constant weight, the samples were sieved and particles better than 100 mesh were collected and stored in polythene bottles.

The surface water and sediments samples were collected from 19 points, situated upstream and downstream of the industrial platforms (Table 1).

Table 1. Sampling points of water / sediment

Nr. Crt.	Name of sample	Sampling points of water / sediment - Sampling point
1	P ₁ / S ₁	Water/sediment samples collected from the Olt River - locality Calimanesti Caciulata
2	P ₂ / S ₂	Water/sediment samples collected from the Olt River, upstream Ramnicu Valcea town– locality Fedelesoiu
3	P ₃ / S ₃	Water/sediment samples collected from the Olt River, downstream Ramnicu Valcea town and upstream Stream Sarat and Priza Olt
4	P ₄ / S ₄	Water/sediment samples collected from the Stream Sarat – locality Stolniceni
5	P ₅ / S ₅	Water/sediment samples collected from the Stream Sarat – locality Cazanesti
6	P ₆ / S ₆	Water/sediment samples collected from the Olt River, upstream of Ramnicu Valcea paltforma - Section Priza Olt
7	P ₇ / S ₇	Water/sediment samples collected from the Olt River, downstream of Ramnicu Valcea paltforma – Section Cremenari
8	P ₈ / S ₈	Water/sediment samples collected from the Olt River, downstream of Ramnicu Valcea paltforma – Section Babeni Marcea
9	P ₉ / S ₉	Water/sediment samples collected from the Olt River , locality Zavideni
10	P ₁₀ / S ₁₀	Water/sediment samples collected from the Olt River , upstream de locality Dragasani, county Valcea
11	P ₁₁ / S ₁₁	Water/sediment samples collected from the Olt River, downstream de locality Dragasani, county Valcea
12	P ₁₂ / S ₁₂	Water/sediment samples collected from the Olt River, upstream Slatina
13	P ₁₃ / S ₁₃	Water/sediment samples collected from the Olt River, downstream Slatina
14	P ₁₄ / S ₁₄	Water/sediment samples collected from the Olt River, upstream Slatina, county Olt – locality Rusanesti
15	P ₁₅ / S ₁₅	Water/sediment samples collected from the Olt River, downstream Slatina
16	P ₁₆ / S ₁₆	Water/sediment samples collected from the Olt River, locality Islaz, county Teleorman
17	P ₁₇ / S ₁₇	Water/sediment samples collected from the Fluviul Dunarea, din locality Turnu Magurele, county Teleorman, upstream industrial area
18	P ₁₈ / S ₁₈	Water/sediment samples collected from the Govora stream, upstream Wastewater treatment plant SC OLTCHIM SA
19	P ₁₉ / S ₁₉	Water/sediment samples collected from the Govora stream, downstream Wastewater treatment plant SC OLTCHIM SA

Table 2. Soil sampling points on the industrial platform Ramnicu Valcea

Nr. Crt.	Name of sample	Sampling points of soil - Sampling point
1	S ₁ – I (0 – 10 cm)	Soil samples from the area II – The area electrolysis of mercury - Chlorosodics II : Sampling points located in the back hall Electrolysis III, south to CET – soil sample harvested in March 2013 .
	S ₁ – II (30 – 40 cm)	
	S ₁ – III (50 – 60 cm)	
2	S1 – I (0 – 10 cm)	Soil samples from the area II – The area electrolysis of mercury - Chlorosodics II : Sampling points located in the back hall Electrolysis III, south to CET – soil sample harvested in April 2013 .
	S1 – II (30 – 40 cm)	
	S1 – III (50 – 60 cm)	
3	S2 – I (0 – 10 cm)	Soil samples from the area II – The area electrolysis of mercury - Chlorosodics I : ampling point north of recovery furnace of mercury from solid waste – soil sample harvested in March 2013 .
	S2 – II (30 – 40 cm)	
	S2 – III (50 – 60 cm)	
4	S2 – I (0 – 10 cm)	Soil samples from the area II – The area electrolysis of mercury - Chlorosodics I : sampling point north of recovery furnace of mercury from solid waste– soil sample harvested in April 2013 .
	S2 – II (30 – 40 cm)	
	S2 – III (50 – 60 cm)	

3. Results and discussion

The present mercury concentrations of the soil, waters and sediment of the Olt River Basin have been determined and compared with the Normative benchmarks for classification of surface water (Ministry of Environment and Water Order no. 161/2006).

In Tables 3 and 4 are mercury limits imposed on water quality conditions and sediment according to the Order 161/2006, in Table 5 are reference values for traces of chemical elements in soil, according to Order no. 756/1997.

Table 3. Quality conditions of mercury of water samples in accordance with Order 161/2006

Nr. crt.	Quality Indicator	U.M.	The quality class of water samples				
			I	II	III	IV	V
1	Mercury	mg/l	0,0001	0,0003	0,0005	0,001	>0,001

Table 4. Allowable limit of mercury to sediment under Order 161/2006

Nr. Crt.	Quality Indicator	U.M.	Limit value (Standard Quality)
1	Mercury	mg/kg s.u.	0,3

Table 5. Values for traces of mercury in soil, according to Order no. 756/1997

Contaminated	Limits outlet	Thresholds alert (P/A) Types of uses (mg/kg D.W.)		Thresholds for intervention (P/I) Types of uses (mg/kg D.W.)	
		Sensitive	Less sensitive	Sensitive	Less sensitive
Mercury (mg/kg s.u.)	0,1	1	4	2	10

The mercury values have been determined in the Olt River Basin from water, sediment and soil and given in Figures 1, 2 and 3, respectively.

In figure 1 are the concentrations of mercury for water samples taken from the Olt River Basin. As seen in this figure, the concentration of mercury exceeds the limit imposed under Order 161/2006 in the localities Ramnicu Valcea, Cremenari, Marcea, Slatina and Islaz. It also notes that in March concentrations of mercury found in water samples are in general higher than in April.

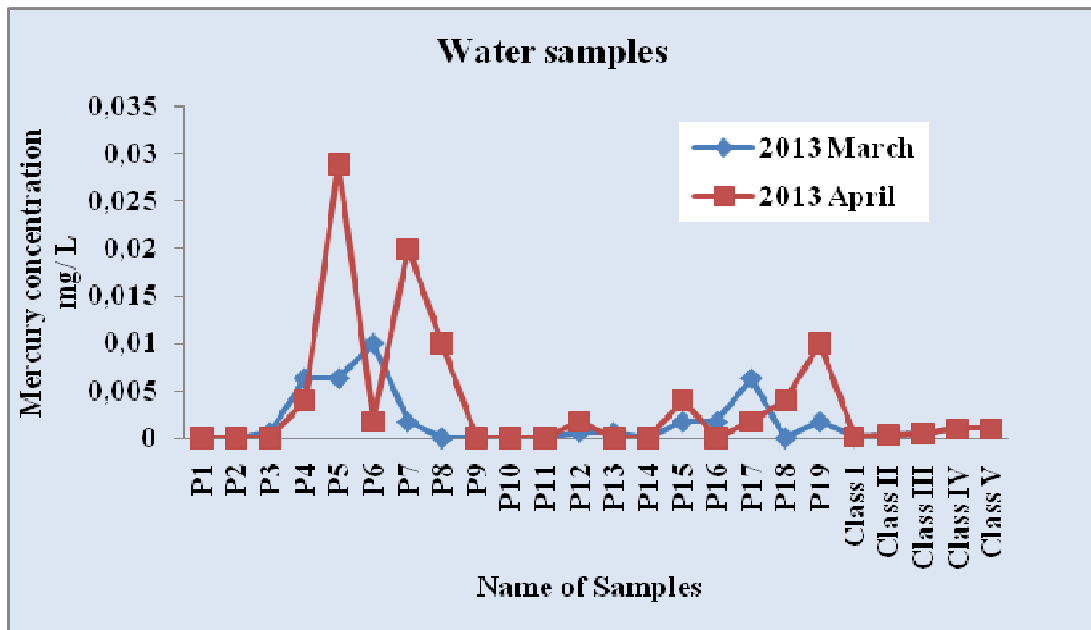


Figure 1. Variation of mercury concentration for water samples collected from the Olt River Basin

Sediment samples (Figure 2) taken from the Olt River Basin of the same points as the water samples, exceed the limit allowed under Order 161/2006 nearly all localities where samples were taken in March and April. But much higher mercury concentrations than the limit allowed under law in vigoare, sediment samples were found in localities Ramnicu Valcea, Cremenari, Zavideni, Strejesti, Dragasani, Slatina and Islaz.

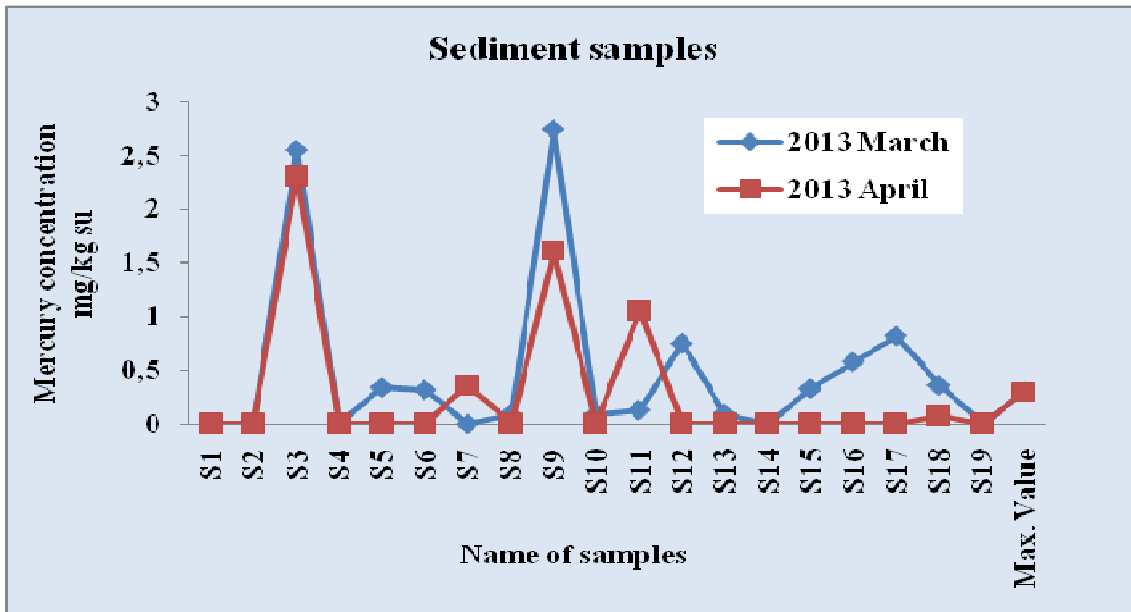


Figure 2. Variation of mercury concentration of sediment samples collected from the Olt River Basin

Regarding the mercury concentration in soil samples collected, it falls under Order 756/1997 in the “Intervention thresholds / less sensitive types of use” for samples taken from area Chlorosodics II in April (level II). The concentration of mercury in soil samples investigated in other areas generally fall in the “Alert threshold / types of use areas”.

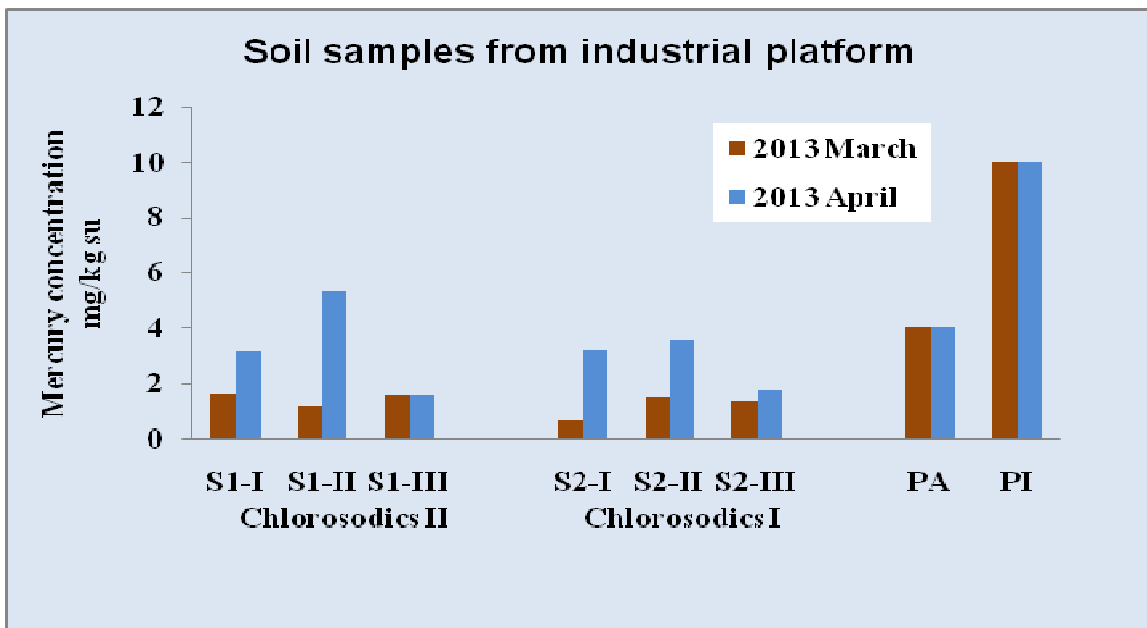


Figure 3. Variation of mercury concentration for soil samples collected

4. Conclusions

In this work, we analyzed samples collected in March and April 2013 to determine the extent of mercury pollution in water samples and sediments from Olt River basin, and also in soil samples from the industrial platform Ramnicu Valcea. The mercury pollution on ecosystems evaluated soil, water / sediment from Olt River basin was determined by comparing the values obtained with the current legislation.

The levels of mercury found in water samples collected from Olt River basin are generally low and is due to high average flow of the Olt River. Although concentrations of mercury water samples are small we can see that in sediment samples collected mercury concentration was above the permissible under the law in current, which confirms accumulation of mercury in sediments.

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