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INTERACTION OF WATER/SEDIMENT AS A FACTOR OF ZINC DISTRIBUTION IN THE WATERS OF NERETVA

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ABSTRACT
The aim of this research is to based on previous knowledge on sediment establish if there is a connection between the content of the zinc in the water and the content of metal in the river sediment in the form of adsorption isotherms of the Freundlich type, through the data about the distribution of zinc and its sorption balance. The research covers eight sites from which the samples were collected, five of which are on the main steam and three from the tributaries of the river Neretva. The data of the metal content in the water and especially the way it binds in the sediment as well as the possibility of its mobilisation, transport and accumulation is important for grading the quality of the water and for understanding the chemism which takes place in the water system. According to the gained results the following comment can be given: the results of the research show a low level of zinc in the water and river sediments of the river Neretva and the measured values of metals were within the prescribed limits and meet the Directive of the EU Water Framework.
Keywords: interaction, distribution of metal, water, river sediment, river Neretva

1. INTRODUCTION
The Neretva river and its tributaries is a source of life for the population of Herzegovina. Monitoring the quality of the river Neretva is necessary in order to preserve this natural resource, because the water from the Neretva used for different purposes, for drinking, irrigation, industry, recreation and other purposes [1]. One of the measures of protection and conservation of the river Neretva is the implementation of the monitoring, which represents the permanent monitoring of all parameters in water, especially monitoring of hazardous and harmful substances [2, 3].

2. RESEARCH AIMS
The main motive of this study was to determine whether there is a connection between the zinc content in the water and the contents of zinc in sediment of river in the form of adsorption isotherms of the Freundlich type.
In order to achieve these aims are defined by the following tasks:

- In the investigated area of the Neretva river choose a locations for research.
- Determine the content of zinc in water and sediment of river along the Neretva river.
- Results of chemical analysis of zinc process with statistical correlation and regression analysis.
- By studying the interaction of sediment/water, over distribution of zinc and its sorption equilibrium, determine whether there is a connection between the zinc content in the water and zinc content in mobile phase of river sediment in water.

3. EXPERIMENT

In the investigated area were selected eight locations to conduct research. Looking downstream, from the Konjic town to the northern entrance of the Neretva river in Mostar city, selection of locations for sampling was as follows:

1. River Neretva (100 m above bridge „Spiljanski most“)
2. Tributary of the River Neretva names Trešanica(Mouth of Tributary in Konjic)
3. River Neretva (near the motel Konjic)
4. Tributary of the River Neretva names Neretvica (Mouth of Tributary close Butrović fields)
5. Hydroelectric power plants - Grabovica (300-400 m below the dam)
6. Drežanka (50 m, above the bridge in D. Drežnica)
7. Hydroelectric power plants - Salakovac (200-300 m, below the dam)
8. Hydroelectric power plants - Mostar (300-400 m, below the dam)

3.1. Determination content of zinc in water and sediment of river

Content of zinc in water, was determined from acid water solution, method AAS, on the instrument AAS, AA - 6200 – SHIMADZU [4]. The used standards are certified their quality: HC 766 916 for metal (Zn), manufacturer Merck. The results of analysis are presented for all samples in Tables 1, presented as the average value of three determinations. Accuracy of results is shown via standard deviation.

Table 1. Content of zinc in water [1]

	Sampling point							
	1	2	3	4	5	6	7	8
Content of zinc ($\mu g/dm^3$)	11,20 ±2,44	14,36 ±4,66	17,30 ±2,42	12,20 ±1,22	8,50 ±0,88	7,80 ±2,75	8,62 ±4,32	9,90 ±5,22

The results of research show low levels of zinc in the waters of the Neretva river. The measured values were within prescribed limits to meet the Water Framework Directive of the EU. In table 2 and 3 shows the content of zinc in the sediment of river.

Table 2. The content of zinc in dissolved fraction of HCl in the sediment of river [1]

	Sampling point							
	1	2	3	4	5	6	7	8
Content of zinc (mg/kg)	23, 4	35,8	26,0	35,4	24,8	9,2	23,0	28,5

"Dissolved" fraction of metals represents HCl extract, which is from river sediment isolated treatment with a solution of 2M HCl.

Table 3. The content of zinc in the $MgCl_2$ - fraction in the river sediment of the river Neretva [1]

	Sampling point							
	1	2	3	4	5	6	7	8
Content of zinc (mg/kg)	0,08	0,14	0,24	0,12	0,11	0,03	0,08	0,12

"Easy to move" fraction of metals, represents MgCl2 - extract, which is from river sediments isolated with solution of 2M MgCl2.

4. DISCUSSION OF RESULTS

In the diagram (Figure 1) shows the Freundlich's adsorption isotherm, which correspond to a given population samples. All three regression lines have the correlation coefficients are statistically significant for p> 95%. Basic isotherm corresponding to the analyzed samples along the river course, and is defined by the formula:

$$\log[Zn_s] = 1{,}7013 \log[Zn_v] - 2{,}7601, \quad (1)$$

with $K_F = 0{,}0017$ mg/kg and slope of the isotherm n=1,7013.

The other two partial isotherms represented by the formulas:

$$\log[Zn_s] = 2{,}294 \log[Zn_v] - 3{,}473, \quad (2)$$

with $K_F = 0{,}00033$ mg/kg and n = 2,294, and

$$\log[Zn_s] = 5{,}169 \log[Zn_v] - 5{,}973, \quad (3)$$

with $K_F = 0{,}00001$ mg/kg and n = 5,169.

Based on the statistical significance of regression real, it can be concluded, to the river system of Neretva river basin establishes equilibrium sorption of zinc. The values of KF and (n), and the arrangement of points covered by the isotherms in the diagram, indicates that the affinity of tested sediments for adsorption of zinc, and the intensity of that adsorption of individual parts, partly different.

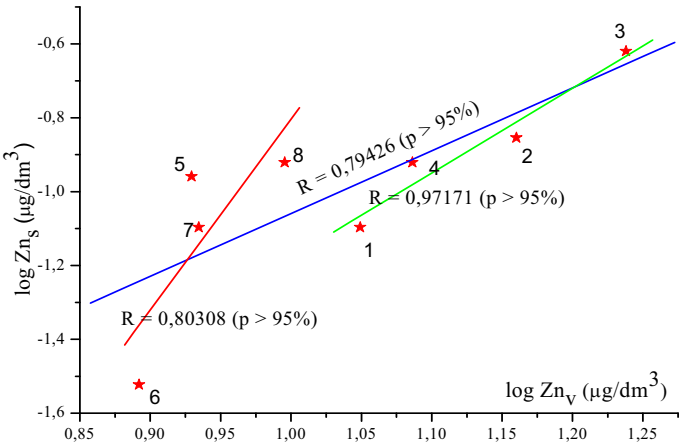

Figure 1. Isotherm of zinc in the Neretva river basin [1]

5. CONCLUSION

Based on the collected data of research can be carried out following conclusions:

- The sorption-exchange content "easy-movable" fractions in the sediments of the Neretva river and its tributaries, varies from location to location, and was in range: Zn (0,03-0,24 mg/kg).
- Oscillations in relations sorption bound zinc and zinc levels in the HCl fraction, are a result of different mineralogical composition of the surrounding rocks, differences in the chemical and grain-size composition of the sediment, as well as the different effects of erosion in some locations.

- Determining the connection between the content of Zn in water and content of Zn in the river sediment by adsorption isotherms, it was found that for the investigated metal, in the waters of the Neretva river basin, there is a balance Freundlich's type.
- The existence of sorption equilibrium of Zn presents evidence that the sorption of metal ions on the sediments of the Neretva dominating mechanism for the distribution of Zn in the aqueous medium. It also represents a strong indication of undisturbed or natural state of water in the Neretva river basin.

6. REFERENCES

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