The comparison of sediment quality in the rivers the Eastern Slovakia by Potential ecological risk index

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Abstract

The current pollution of sedimentary environment is very serious and exceeds load capacity limit and it is influenced by other external factors such as climate, hydrodynamic conditions, pH, salinity, Eh, temperature and other. This influences can cause the heavy metals are re-released from the sediments which were long-term accumulated what can lead to the deterioration of ecological environment and even pose a threat to the organisms through the food chain.

Distribution, enrichment characteristics of heavy metals (such as lead, cadmium, copper, zinc, mercury and arsenic) in the sediments in the rivers of Eastern of Slovakia, were measured and analyzed in 2017 and 2018. River sediment quality in the territory of East of Slovakia, representing the water basins of the rivers Hornad, Laborec and Torysa, was investigated. Sampling points were selected based on the current surface water quality monitoring network.

The aim of the study is compare sediment quality of monitored rivers between 2017 and 2018 by method Potential Ecological Risk Index Method (PERI).

Keywords: heavy metals, pollution, potential ecological risk index

1. Introduction

Trace metals entering the river originate from either natural or anthropogenic sources (Adaikpoh et al., 2005; Akoto, 2008). In unaffected environments, the concentration of most metals is very low and is typically derived from mineralogy and the weathering processes (Karbassi et al., 2008).

Consequently, comprehensive monitoring programs that include frequent water sampling at numerous sites and include a full analysis of a large number of physicochemical parameters designed for the proper management of water quality in surface waters. Available literature show exploitation various analyses for water and sediment pollution by heavy metals (Balintova et al., 20112; Singovszka et al., 2016; Balintova et al., 2016; Singovszka et al., 2017). The PERI is based exclusively on chemical parameters of sediments because sediment data show mean integrated values in time, with higher stability than water column parameters; sediments are easily sampled at field work; sediment samples are more representative for time and space scales and analytical data are easily obtained,

especially because sediments present high concentrations of contaminants, decreasing the possible errors due to detection limits of the applied analytical method. The aim of this paper is to study the changes in sediment quality in 2017 and 2018 using by PERI.

2. Materials and Methods

2.1. Study area and sampling preparation

Hornad, Laborec and Poprad are the rivers in the eastern Slovakia. Hornad and Laborec River belongs to basin of Danube and Poprad River belongs to basin of Vistula. The detailed information of study area and its mostly polluted resources are in Singovszka, 2019. Sediment sampling was carried out according to ISO 5667-6 Water quality. Sampling Part 6: Guidance on sampling of rivers and streams. Monitoring was carried out in the spring on 2017-2018. The chemical composition of sediments was determined by means of X - ray fluorescence (XRF) using SPECTRO iQ II (Ametek, Germany)

Figure 1. Study area – East Slovakia

2.2. Potential ecological risk index (PERI)

The Potential Ecological Risk Index (PERI) is method for evaluate the potential ecological risk of heavy metals. This method comprehensively considers the synergy, toxic level, concentration of the heavy metals and ecological sensitivity of heavy metals (Singh et al., 2010; Douay et al., 2013). PERI is can be obtained using three basic modules: degree of contamination (CD), toxic-response factor (TR) and potential ecological risk factor (ER). The Hakanson calculation procedure is given in Singovszka and Balintova 2019.

3. Results and Discussion

Results of XRF analysis of sediments were compared with the limited values according to the Slovak Act. No. 188/2003 Coll of Laws on the application of treated sludge and bottom sediments to fields. It can be state that limit values comparing with Slovak legislation weren't exceeding in all sediment samples in rivers in East of Slovakia. Based on the monitoring data of sediment quality in the study area, a quantitative analysis of heavy-metal pollution in sediment was conducted using the method of PERI. The results show on the basis on potential ecological risk index that the quality of sediment in 2018 is better than 2017. The worst result shows the River Hornad in 2017. Significant improvement occurred at the sampling point S2 in River Hornad in 2018. The best results show River Laborec in 2018.The results show (table 1) on the basis on potential ecological risk index that quality of sediment in 2018 is better 2017.

Table 1. Statistical results of potential ecological risk index and risk grade

			R^i	Risk Grade
2017	Hornad	S1	263.36	Moderate risk
		S2	1077.51	Very High risk
		S3	255.21	Moderate risk
		S4	269.19	Moderate risk
	Poprad	S1	372.85	Considerable risk
		S2	338.86	Considerable risk
		S3	576.33	Considerable risk
		S4	445.38	Considerable risk
	Laborec	S1	497.34	Considerable risk
		S2	325.91	Considerable risk
		S3	335.27	Considerable risk
		S4	301.59	Considerable risk
2018	Hornad	S1	111.80	Low risk
		S2	116.06	Low risk
		S3	107.15	Low risk
		S4	196.12	Moderate risk
	Poprad	S1	108.92	Low risk
		S2	147.50	Low risk
		S3	212.89	Moderate risk
		S4	108.57	Low risk
	Laborec	S1	138.21	Low risk
		S2	121.67	Low risk
		S3	101.09	Low risk
		S4	147.96	Low risk

4. Conclusion

Quality is one of the most important risk indicators in river basins. Therefore, monitoring and evaluating water and sediment quality has a very important role in process of risk management. The aim of the monitoring is provide for the sustainability of water bodies and these results are the basis for the risk management in the river catchment area. The results of sediment quality evaluated by method PERI revealed that the quality of sediment in 2018 was better than 2017.

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