

STUDY OF SELECTED WATER PARAMETERS FROM THE ENVIRONMENTAL LOAD SLOVINKY

Lubica Kozakova, MSc., PhD., Tomas Bakalar, MSc., PhD., and Miroslav Zelenak, MSc.

The Technical University of Kosice, Faculty of Mining, Ecology, Process Control and Geotechnology, Institute of Montaneous Sciences and Environmental Protection, Park Komenskeho 19, 043 84 Kosice, Slovakia

e-mail: lubica.kozakova@tuke.sk, (corresponding author) +421 6022969, tomas.bakalar@tuke.sk, +421 6022958, miroslav.zelenak@tuke.sk, +421 6022969

ABSTRACT

Environmental loads represent a serious environmental problem in Slovakia. Heaps and sludge beds as remnants of long-term mining and mineral processing activities belong to these environmental loads. Sludge bed Slovinky in Eastern Slovakia is the locality where the flotation waste from mineral processing of sulphide ores and industrial slag from metallurgical processing in fine-grained form were deposited. Previous studies confirmed increased concentrations of certain heavy metals in sludge bed materials.

The aim of our research was focused on the study of selected characteristics in water samples, especially on pH, determination of heavy metals concentration, determination of cations and anions. The samples were taken from the stream flowing out of the sludge bed Slovinky.

The concentrations of selected heavy metals were estimated by atomic absorption spectrometry (AAS). The determination of nitrates and ammonium was realized by means of Palintest 7500. The pH values of the water samples were measured using a pH meter OAKTON 110 Series. The total content of calcium and magnesium was determined by complexometric titration.

The experimental results showed that the water samples had alkaline character, the pH values range from 7.58 to 8.05. The concentrations of copper, cadmium, iron and zinc did not exceed the limit values for surface water according to prescribed legislative regulations. The measured concentration of cadmium allocated increased values compared with the limit values which may be related to increased levels of this element in the material of sludge bed. Other indicators (nitrates, ammonium, calcium, magnesium) did not exceed the relevant limit values.

Keywords: environmental load, sludge bed, selected heavy metals, pH values

INTRODUCTION

Environmental loads represent a major risk to the environment and human health. They are a part of serious environmental problems in Slovakia in recent years. Heaps and sludge beds belong to the group of environmental loads. They are remnants of mining and mineral processing activities especially of ore raw materials.

Waste from these mining and mineral processing operations was deposited on sludge beds. Sludge beds were used to fine-grained waste disposal, the most common gangue mixed with some amount of water. Sludge beds contain a number of pathogenic microorganism and heavy metals in the form of various chemical compounds (Angelovicova et al., 2013).

Sludge bed Slovinky (Eastern Slovakia) (Fig.1) is one of these environmental loads and involves flotation waste from mineral processing of sulphide ores and industrial slag from metallurgical processing in fine-grained form. The surface layer is formed by dark gray colour material (Kozakova, Zelenak, M. & Zelenak, F., 2012).

From the works of several authors (Toth et al., 2012, Angelovicova et al., 2013, Findorakova et al., 2013, Petrak et al., 2011) it is clear that the sludge bed material contains heavy metals (As, Cu, Ni, Pb, Sb and Zn) in increasing concentrations. Environmental Department in our country included

sludge bed Slovinky among the eight most vulnerable areas that require regular monitoring. Drainage water flowing out of the sludge bed along with other waste water from the old shafts and tunnels caved gradually flow into Slovinky and Porac stream and they can be a source of surface water contamination.

Slovinky municipality is located in the eastern part of Slovakia. It is surrounded by beautiful countryside, picturesque valleys and hills of limestone rocks, which are incorporated into protected territories. The nature is exceptional by its fauna and flora, rarely growing vegetation and forests and rare species of animals are occurred there (Perhacova et al., 2011).

The aim of this work was therefore to appreciate if the stream flowing out of the sludge bed and passing through the forest alongside the village poses a great load on the environment and human health.

Because of the specificity of the area and the water flow we chose the following indicators which were observed in samples taken from the stream flowing out of the sludge bed Slovinky: nitrates, ammonium, water reaction (pH), selected heavy metals (Cu, Cd, Fe, Ni and Zn).



Fig. 1 View of the top of sludge bed Slovinky

MATERIAL AND METODS

Our research was focused on the assessment of surface water quality in mining village Slovinky. Surface water samples were collected in autumn and winter 2013. We sampled from two different places at each sampling. Place A (samples 1a and 1b) is located closer to the sludge bed and place B (samples 2a and 2b) is about 20 meters further (Fig. 2). It was cold and damp in the period of the first sampling. The weather was sunny and less snow cover was around the stream during the second sampling. Common beech, white fir, common spruce, western larch and mountain oak are occurred near the stream.

The concentrations of selected heavy metals were determined by atomic absorption spectrometry (AAS) performed using iCE 3300 (Thermo Scientific, USA). AAS is an optical method based on absorption of electromagnetic radiation in the range of wavelengths 190 to 850 nm and is ranked among the most common methods for the determination of heavy metals in environmental samples. Heavy metals contents – copper, cadmium, iron, nickel and zinc were measured in the extracts.

The determination of nitrates and ammonium was realized by means of Palintest 7500. Palintest is a fully integrated system of water analysis, which offers a wide range of water tests.

The pH values of the water samples were measured using a pH meter OAKTON 110 Series.

The total content of calcium and magnesium was determined by chelatometric (complexometric) titration.

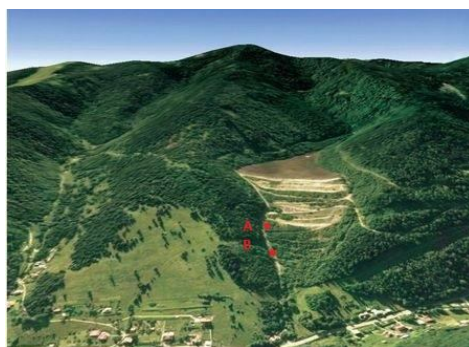


Fig. 2 Localization of water sampling

RESULTS AND DISCUSSION

The concentrations of copper, cadmium, iron, nickel and zinc measured by means of AAS are presented in the Table 1. These values were compared with the limit values according to the Slovak legislation (Act No. 269/2010, appendix 5). It is clear that with the exception of nickel all selected metals did not exceed the limit values.

Jurkovic et al. did not detect overrun of monitored heavy metals. Perhacova et al. is also supported by lower levels of certain heavy metals.

Elevated concentrations of nickel in the sludge bed material extracts were found in the study of his physico-chemical properties (Strbakova, 2013).

Table 1 The concentrations of selected heavy metals by means of AAS

The concentrations of heavy metals [mg.l⁻¹]					
Samples	Cu	Cd	Fe	Ni	Zn
1a	0	0	0.0043	0.0462	0
1b	0	0	0.0130	0.0496	0
2a	0	0	0.0305	0.0372	0
2b	0	0	0.0148	0.0224	0.0018
Limit values for surface water [mg.l⁻¹]					
	0.02	0.0015	2	0.02	0.10

Mass concentration of nitrates and ammonium in the water samples are shown in the Table 2.

Our test samples did not exceed the limit values according Slovak legislation (Act No. 269/2010, appendix 5).

Table 2 Mass concentrations of nitrates and ammonium

Mass concentration [mg.l ⁻¹]	Samples				Limit values
	1a	1b	2a	2b	
NO ₃ ⁻	1.896	0.1525	1.927	0.1225	5.0
NH ₄ ⁻	0.32	0	0.33	0	1.0

The results of pH measurements (Table 3) were complied with the limit values for surface water. Jurkovic et al. presented the pH values 7.6 to 7.7. Perhacova et al. declared the lower pH values 6.7 to 7.5.

Table 3 The determination of pH values

Determination	Samples				Limit values
	1a	1b	2a	2b	
pH	7.58	7.78	8.05	7.66	6 to 8.5

The results of mass concentrations of calcium and magnesium shows, that in the sample (1a) which was collected from the nearest distance of sludge bed the increased value of magnesium was detected. The remaining measurements did not show overrun of the limit values for surface water. Jurkovic et al. presented lower average values 47.7 mg.l⁻¹ of Ca and 65.7 mg.l⁻¹ of Mg.

Table 4 Mass concentrations of calcium and magnesium

Mass concentration [mg.l ⁻¹]	Samples				Limit values
	1a	1b	2a	2b	
Ca ²⁺	71.1	77.1	69.1	168.2	200
Mg ²⁺	100.8	80.2	93.5	77.7	100

CONCLUSION

The issue of environmental problems solution is now necessary and urgent. Environmental loads after mining and mineral processing activities are potential sources of risks to human health and of the environment. Public authorities, institutions and the media are focused on the solving of this topic. Sludge bed Slovinky belongs to the group of high-risk areas and it is included in regular monitoring. The aim of this work was therefore to assess the quality of surface water in the stream flowing out of the sludge bed. Selected water parameters were studied. The concentrations of copper, cadmium, iron and zinc measured by means of AAS did not exceed the limit values for surface water according Slovak legislation. The measured concentration of cadmium allocated increased values compared with the limit values which may be related to increased levels of this element in the material of sludge bed.

Other indicators (nitrates, ammonium, calcium, magnesium) did not exceed the relevant limit values, pH values were in the alkaline sphere.

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