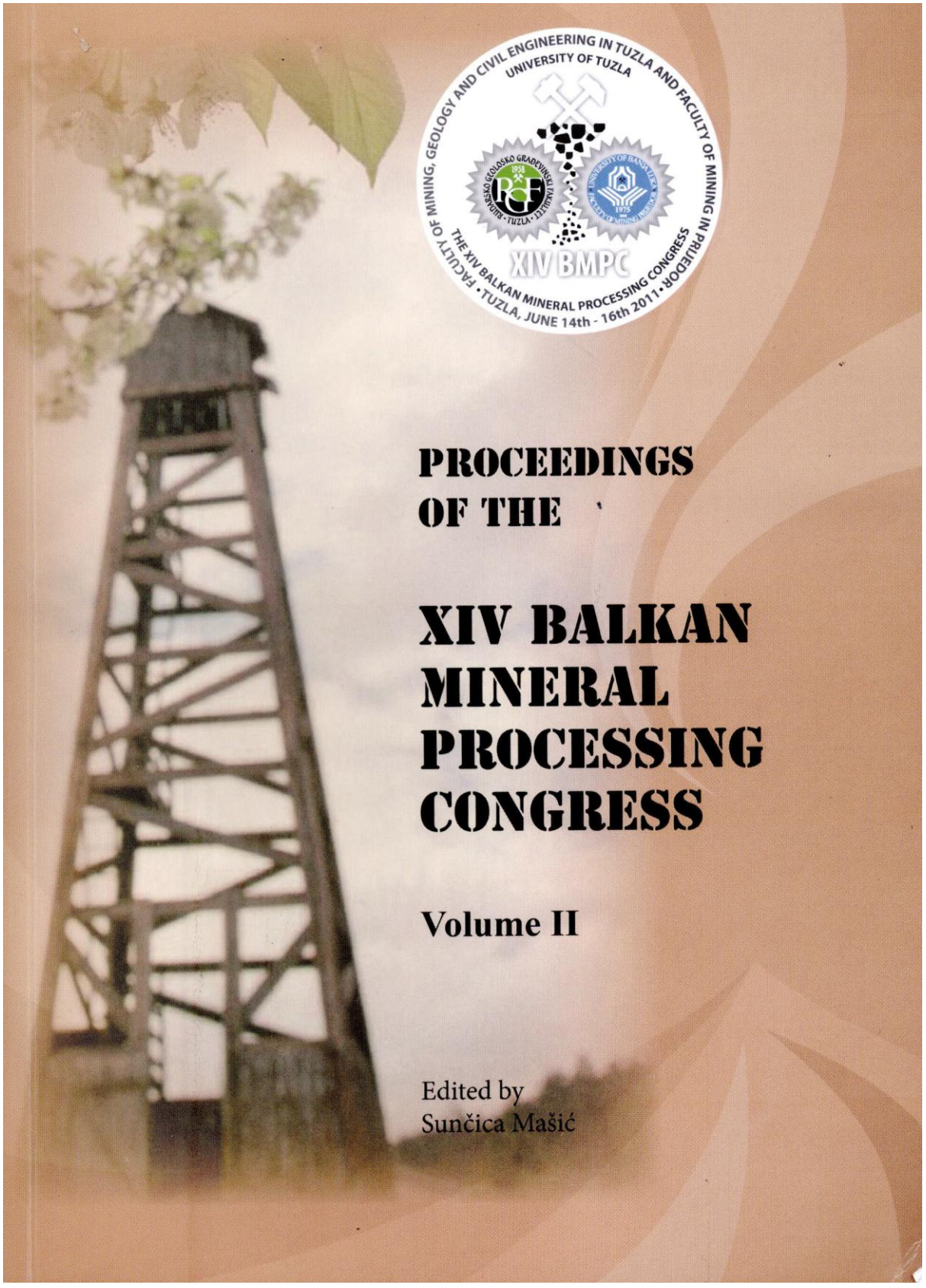


# PROCEEDINGS OF THE

# XIV BALKAN MINERAL PROCESSING CONGRESS

## Volume II

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Sunčica Mašić

***UNDER THE AUSPICES OF:***
***Chairman of Bosnia and Herzegovina Željko Komšić***

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# THE IMPACT OFTAILING DAMOF SASA MINEON THE QUALITY OF THE SURROUNDING WATERS

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***Abstract:****The most serious problem from the ecological aspect, associated with the storage of flotationslag, is release of contaminated water into surface and groundwater flows, the more complex is in the surface flows.The paper shows results of tests on water quality in the Sasa Mine,along the Kamenicka and Bregalnica riversflows into the Vardar River. Also completed is compared with the results obtained from tests in 2004/2005, which are obtained unambiguous information about the mobility/fixation of the elements that constitute risk to health.*

***Key Words:*** *heavy metal,water, tailing dam, environmental*

## 1.INTRODUCTION

Flotation tailing dams affect the environmental through the soil, the water and the air, and in that way, they affect the plants and animal, and also the people.

The most serious problem from the ecological aspect, associated with the storage of flotationslag, is release of contaminated water into surface and groundwater flows, the more complex is in the surface flows.

As a result of the long time releasing of contaminated water,dangerous substances are deposited on the sides of the river-bed and around it, which leads to contamination of the surrounding soil.

Often in practice, due to various objective and subjective factors, uncontrollable situations arise, that lead to increased emission of dangerous substances in the water for a short period of time.The reason for that are minor or major problems in the flotation slag transport system or defects of other ancillary systems of the tailing dam. Especiallydangerousis if the flotation slag flowdirectly in the rivers.

Analyses of water quality showsthe contamination with heavy metals and according these results can be decided which methods and ways should be undertaken to improve their quality and their protection from further contamination.

## 2. RESEARCH

In the Sasa mine (Pb-Zn ore), the water from the deposition lake on tailing dam No.3 – phase II (second phase) is released through the overflow collector in river Kamenichka.

A small part (filtration and leaching water) are released as drainage water. Part of it is filtered into the groundwater flows. Despite all control measures to improve the water quality of the deposition lake on tailing dam ofSasa mine (clarifywith more days staying, return line for water), sometimes is possible releasing of contaminated waters.

The quality of the overflow and drainage waters is subject to the control measurements including determination of their physical-mechanical purity (solid residue), toxic chemical elements and pH value. Control measurements are performed every month.Maximum allowable concentrations of heavy metals for water of III category are:

| | mg/l |
|---|---|
| Pb | 0,1 |
| Zn | 1,0 |
| Cu | 0,1 |
| Cd | 0,01 |
| Mn | 1 |
| Fe | 1 |
| As | 0,05 |
| Cr | 0,1 |
| Co | 2 |

The purpose of this paper is evaluationof water qualityin the vicinity of the Sasa mine, according to the concentration of heavy metals and to determine adverse impact on mine and tailing dam on the environment.

For this, series of activitieswere performed:

- Preparation of topographic map;
- Twenty samples of water were taken in the area of Sasamine, along the rivers Bregalnicaand Kamenichka, until the river Bregalnicaflows into the river Vardar.Specifically, 3 samples over tailing dam system along the confluents of the river Kamenichka, 5 samples along the river Kamenichka (evenly distributed to the inflow into the lake Kalimanci), 2 samples in the lakeKalimanci and 10 samples along the river Bregalnica (from the village Istibanja to the village Ubogo). These samples are marked on a topographic map with markings from 1 to 20 (Figure 1);
- Preparation of samples for analysis and
- Analysis of heavy and toxic metals on collected samples (Pb, Zn, Cd, As, Cr, Fe, Mn, Cu) using the methods of ICP-AES, ICP-MS.

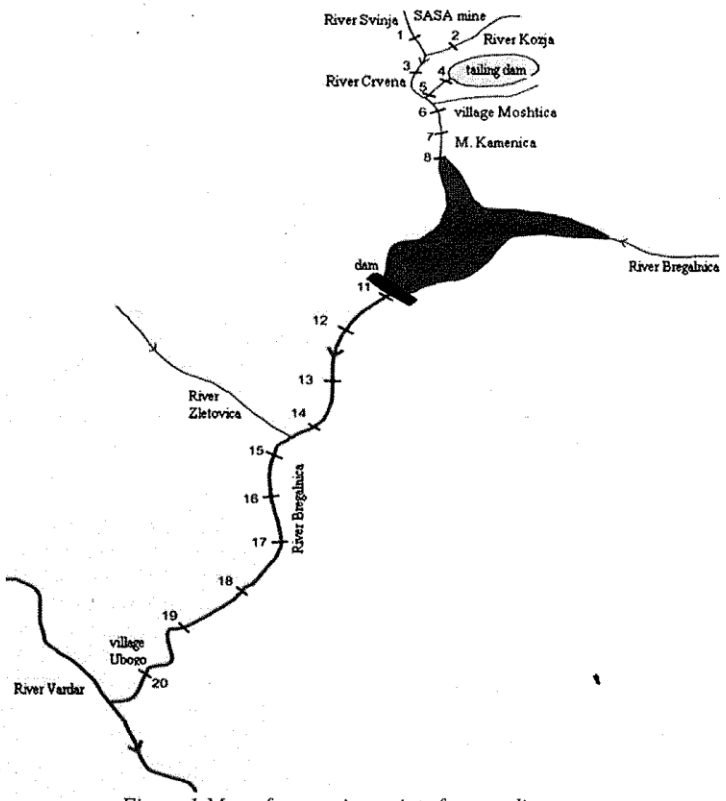


*Figure 1.Map of measuring points for sampling water*

*Table 1.Concentration of heavy metals in water sample*

| measuring points | 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | heavy metals, mg/l | | | | | | | | |
| | Mn | Zn | Cu | Pb | Cd | As | Fe | Cr | Co |
| 1 | 5 | 6,775 | 1,05 | 1,125 | 0,03 | 0,01 | 0,45 | 0,01 | 0,09 |
| 2 | 5,425 | 8,15 | 1,05 | 0,925 | 0,03 | 0,04 | 0,15 | 0,01 | 0,12 |
| 3 | 4 | 4,2 | 0,135 | 0,54 | 0,02 | 0,04 | 0,11 | 0,01 | 0,09 |
| 4 | 2,78 | 5,525 | 0,05 | 0,15 | 0,02 | 0,03 | 0,07 | 0,01 | 0,055 |
| 5 | 3,46 | 0,665 | 0,02 | 0,03 | 0,015 | 0,02 | 0,06 | 0,01 | 0,03 |
| 6 | 4,2 | 1,395 | 0,02 | 0,03 | 0,015 | 0,015 | 0,07 | 0,01 | 0,025 |
| 7 | 2,3 | 1,315 | 0,015 | 0,05 | 0,01 | 0,015 | 0,055 | 0,01 | 0,02 |
| 8 | 1,975 | 1,165 | 0,015 | 0,015 | 0,01 | 0,015 | 0,065 | 0,01 | 0,015 |
| 9 | 0,895 | 0,76 | 0,015 | 0,035 | 0,01 | 0,015 | 0,045 | 0,01 | 0,015 |
| 10 | 0,45 | 0,06 | 0,015 | 0,045 | 0,01 | 0,015 | 0,05 | 0,015 | 0,015 |
| 11 | 0,29 | 0,08 | 0,015 | 0,03 | 0,02 | 0,015 | 0,02 | 0,01 | 0,01 |
| 12 | 0,25 | 0,055 | 0,01 | 0,02 | 0,01 | 0,01 | 0,03 | 0,01 | 0,01 |
| 13 | 0,765 | 0,055 | 0,015 | 0,015 | 0,01 | 0,01 | 0,145 | 0,015 | 0,01 |
| 14 | 0,54 | 0,365 | 0,03 | 0,02 | 0,01 | 0,01 | 0,24 | 0,015 | 0,01 |
| 15 | 0,4 | 0,27 | 0,01 | 0,04 | 0,01 | 0,01 | 0,08 | 0,01 | 0,01 |
| 16 | 0,205 | 0,26 | 0,02 | 0,025 | 0,01 | 0,01 | 0,065 | 0,01 | 0,01 |
| 17 | 0,235 | 0,225 | 0,02 | 0,015 | 0,01 | 0,04 | 0,05 | 0,01 | 0,01 |
| 18 | 0,235 | 0,045 | 0,015 | 0,015 | 0,01 | 0,06 | 0,065 | 0,01 | 0,01 |
| 19 | 0,235 | 0,03 | 0,01 | 0,015 | 0,01 | 0,015 | 0,055 | 0,01 | 0,01 |
| 20 | 0,26 | 0,03 | 0,015 | 0,03 | 0,01 | 0,01 | 0,06 | 0,01 | 0,01 |

## 3. RESULTS

The results of water quality according measuring points (shown in Fig. 1)and the measurement data in 2004/2005 are shown in Tab. 1 and Fig. 2, 3, 4, 5 and 6.

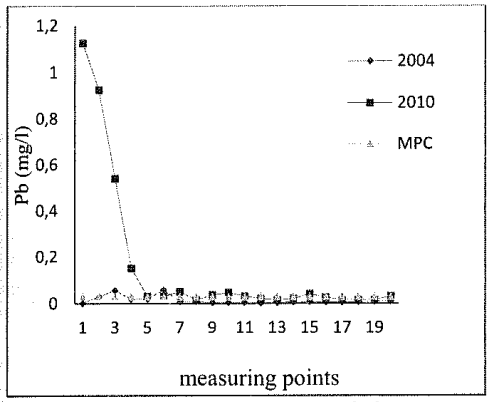


*Figure 2.Concentration of Pb*

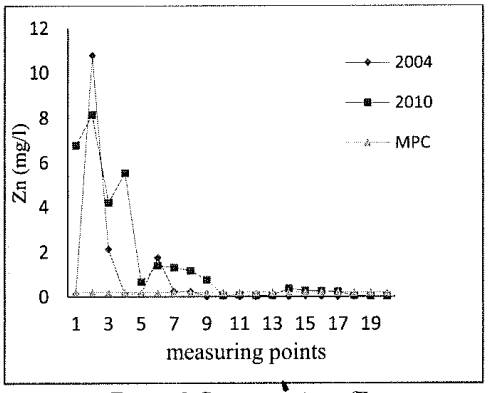


*Figure 3.Concentration ofZn*

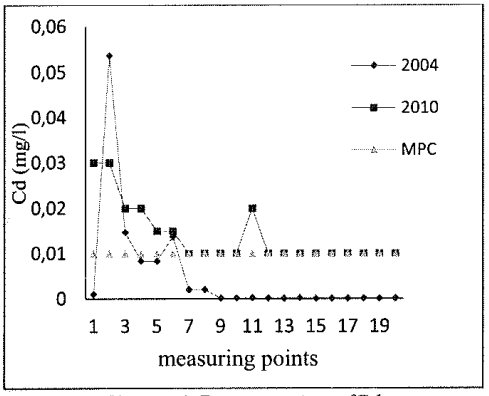


*Figure 4.Concentration ofCd*

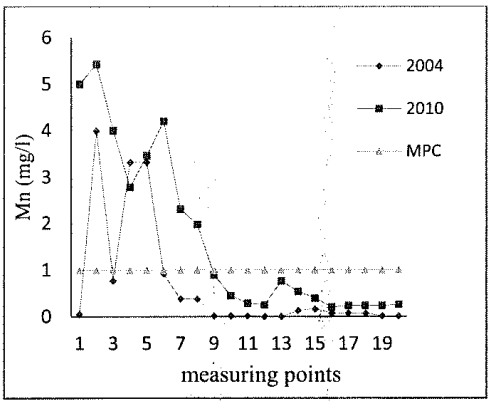


*Figure 5.Concentration ofMn*

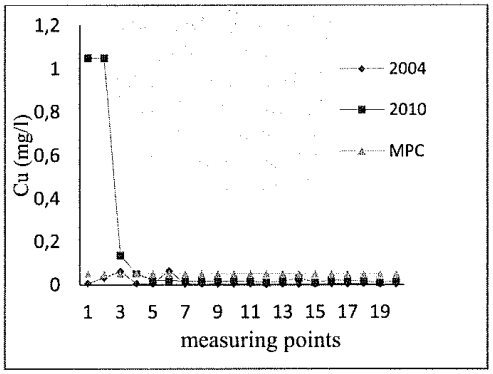


*Figure 6.Concentration of Cu*

The measured values for the content of Fe, Cr, Co and As were below the maximum concentration and aren't shown graphically.

## 4. CONCLUSION

According to the results for the concentration of arsenic, manganese, iron, chromium, zinc, copper, lead and cadmium in tested water samples it can be concluded that the waters that pass or derived from the vicinity of the mine Sasa have high concentrations of certain heavy metals that are represented in the ore and flotation slag.

This primarily refers to the concentration of manganese, zinc, lead, cadmium and copper. These metals are mostly present in the water near tailing dam to village Moshtica. In this area the concentration of cadmium ranged from 0,02 mg/l to 0,03 mg/l, the permissible maximum value is 0,01 mg/l.The maximum permissible valuefor lead is 0,03 mg/l, while in this area it ranges from 0,05 mg/l to 1,15 mg/l. The value for zinc is also larger and ranges from 2,6 mg/l to 8,45 mg/l, the MPC is 0,2 mg/l. The same happens with manganese, which ranges from 3 mg/l to 5,9 mg/l, a MPC is 1 mg/l. Copper ranged from 0,05 mg/l to 1,05 mg/l, and the MPC is 0,05 mg/l. Toward the inflow into the lake Kalimanci concentration of these metals

are reduced, and the outflow from the lake it is almost clean water.

Along the river Bregalnica to the village Ubogo (inflow in the river Vardar), water can be classified even in class II. The exception is in the vicinity of Shtip, fromvillage Chiflik, to village Dobroshani, where increased concentration of zincappears again.It is periodically because the higher concentration of zinc in this area appeared only during the first sampling, while the second time has been reported fairly clean waterin this area.

The fact that water is very polluted to the inflow into the lake Kalimanci, and further along the river Bregalnica continues as cleaner water indicates that as a result of the water staying, heavy metals are deposited.

Comparing the obtained results and the concentrations measured in 2004/2005 (the period whenSasa mine was not working), a difference in the concentration of heavy metalscan be seen.

In Sasa mine already introduced some ISO standards, including Standard for environmental management - ISO 14001. With this standard, care to the environmentwill be performed.To date, problems are solved in a good direction, although there are still risks and possible unexpected cases that may make unnecessary problems to the environment.

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