BioFlux ProEnvironmen Original Article
ProEnvironment 15/52 (2022) 487 - 490

Estimating Mine Water Quality. A Case Study: Borșa – Toroioaga Mine

SAFIRESCU Ovidiu Călin*, Diana Mădălina DOMȘA

Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Calea Manastur, 400372, Cluj-Napoca, Romania
* Corresponding author e-mail: calin.safirescu@usamvcluj.ro

Received 9 November 2022; received and revised form 6 November 2022; accepted 21 November 2022; Available online 30 December 2022

Abstract

The entire mining activity produces, due to its specificity, multiple and varied negative effects on the environment, exemplified by the impurity of surface and groundwater flowing waters, but also by the hydrodynamic imbalance of groundwater. This work is conducted in the Borsa Basin, from Maramureş Mountains, and includes areas located in the integral protection area, located in direct impact with the Ciusla River. Through the studies and research carried out in this paper, it was aimed to highlight the risk of pollution caused by mine water leaks, though quantification of pH, conductivity, and turbidity of mine waters from 6 collecting points. Following the surveys, the affected environmental factors, the condition and the decrease of the performance of the pollution installations were highlighted, which led to the depreciation of the way of operation and their performance.

Keywords: environment, pollution, exploitation, sampling.

1.Introduction

Ore processing, including iron ore smelting and coal coking, is a potential source of atmospheric emissions that, locally, can be very significant. Emissions can include dust particles, sulfur oxides, nitrogen oxides, hydrogen sulfide and a number of organic compounds. Similar emissions can be caused by the uncontrolled burning of residues on mining sites.

The sources are represented by the process itself or the place of combustion, and the way of propagation – a chimney or occasional leaks. Although the immediate receptor is the atmosphere, this, in turn, can be an intermediary for the local residents of the area who will thus be exposed to an increased level of pollution. Most of the atmospheric pollutants, other than dust particles, related to the mining industry, are associated with the valorization processes or smelting, refining or actual use.

Many of the emissions into the atmosphere from mining sites are under legislative control, in particular under the EU Directive 96/61/EC on the prevention and control of pollution [1].

Techniques that may be considered for inclusion in the emissions management plan. Runoff from the base of tailings dumps and processed mineral stacks can be acidic, with high concentrations of polluting substances, especially heavy process metals, because managing the environmental risk associated with the storage of mineral residues is a particularly delicate and important issue [3, 6].I

n surface mines and quarries, although groundwater may be of good quality and a useful resource, it may become contaminated (eg with suspended solids) during pumping to the surface. In some mines, chemicals in water tables can make these aquifers a serious source of pollution once they reach the surface. Produced water in operating mines must normally be controlled to prevent flooding of galleries and for its parameters to comply with legislation on the quality of discharges into surface and underground water sources [3, 6].

The present work aims to identify the physico-chemical quality indicators of mine waters from five sampling points, Toroioaga Mine, Borșa, Maramureș County, by taking samples from different points considered relevant.

2.Material and Method

The analysis of water samples, taken from the Borșa, Maramureș area in the six sampling points, were carried out within the Engineering and Environmental Protection Laboratory, within the Faculty of Agriculture of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, during November 2021, February-April 2022. The sampling points are: upstream of the Tomoiaga mine, water outlet from the Borșa-Tomoiaga mine, decanter, sludge filtration, pumps to the emissary and downstream of the Tomoiaga mine [4]. The pH of the mine waters, their conductivity and turbidity were measured at each sampling point monthly during the experimental period. pH was measured potentiometrically [8], conductivity electrochemically [7]and turbidity nephelometrically [6].

3. Results and Discussions

During experimental period, in 7 cases are reported pH values that are over limits established by standard. In this case, the reference value of 6.60 units of pH is stated by the GD 352/2002 NTPA003. Thus, in November 2021, two locations are characterized by pH values over the mentioned limit, meaning water exit from Tomoioaga mine (pH = 7.08), and mud filtration, but in this case, only a sligh exceeding of the limit is reported (pH = 6.55). In February 2022 a single eceeding of limit is reported at the location represented by water exit from Tomoioaga mine (pH = 7.16), while at mud filtration location the pH is equal with standardized limit (pH = 6.50). In March 2022 water exit from Tomoioaga mine (pH = 7.08), and mud filtration, but in this case, only a slight exceeding of the limit is reported (pH = 6.55). In March 2022, exceedings of pH limt value mentioned by Romanian regulatory organism (GD 352/2002 NTPA003) is reported at water exit from Tomoioaga mine (pH = 7.18), and mud filtration, but in this case, only a sligh exceeding of the limit is reported (pH = 6.53).

Similarly with situations reported in November 2021, and March 2022, exceedings of pH limt value mentioned by standard is reported at water exit from Tomoioaga mine (pH = 7.25), and mud filtration, but in this case, only a sligh exceeding of the limit is reported (pH = 6.60), while concerning water collected from pumps towards emissary the pH is equal with standardized limit (pH = 6.50). Our results show that the highest pH value is pH = 7.25 recorded at water exit from Tomoioaga mine, where the highest values of all time period are reported, while the lowest pH = 4.21 in water collected from decantor, where the lowest values of all time period are reported (Table 1).

Table 1. The pH of mine water samples

Prelevation points		Conductivity (µS/cm)				Reference value
Sample code	Location	XI 2021	II 2022	III 2022	IV 2022	GD 352/2002 NTPA003 [2]
B1	Upstream Borșa-Tomoiaga mine	5.08	5.07	5.06	5.09	6.50
B3	Water exit from T Borșa-Tomoiaga mine	7.08	7.16	7.18	7.25	
B5	Decantor	4.32	4.23	4.21	4.30	
N1	Mud filtration	6.5	6.50	6.53	6.60	
B4	Pumps towards emissary	6.38	6.40	6.38	6.50	
B2	Downstream Borșa-Tomoiaga mine	6.20	6.25	6.22	6.35	

XI – November; II – February; III – March; IV – April.

No exceedings of the Romanian standards (2500 µS/cm) are reported for conducty values measured in water collected from the six points of the experimental field. In November 2021, the highest conductivity values (806 µS/cm and 800 µS/cm) are reported at location of pumps towards emissary and upstream Tomoioaga mine, respectively, while the lowest (695 µS/cm) at downstream Tomoioaga mine location. In February 2022, the highest conductivity values (819 µS/cm and 807 µS/cm) are reported at location of upstream Tomoioaga mine and pumps towards emissary, respectively, while the lowest (691 µS/cm) at downstream Tomoioaga mine location. In March 2022, the highest conductivity values (820 µS/cm and 803 µS/cm) are reported at location of upstream Tomoioaga mine and pumps towards emissary, respectively, while the lowest (685 µS/cm) at downstream Tomoioaga mine location. In April 2022, the highest conductivity values (825 µS/cm, 821 µS/cm, and 820 µS/cm) are reported at location of pumps towards emissary, upstream Tomoioaga mine and water exit from Tomoioaga mine, respectively, while the lowest (705 µS/cm) at downstream Tomoioaga mine location.

Our results show that the highest conductivity value is 825 µS/cm recorded at location of pumps towards emissary, where the highest values of all time period are reported, while the lowest 691 µS/cm at location corresponding to downstream Tomoioaga mine location, where the lowest values of all time period are reported (Table 1).

Table 2. The conductivity (µS/cm) of mine water samples

Prelevation points		Conductivity (µS/cm)				Reference value
Sample code	Location	XI 2021	II 2022	III 2022	IV 2022	Law no. 458 from 8 July 2003 [5]
B1	Upstream Borșa-Tomoiaga mine	800	819	820	821	2500
B3	Water exit from T Borșa-Tomoiaga mine	738	741	736	820	
B5	Decantor	716	729	726	730	
N1	Mud filtration	754	756	760	765	
B4	Pumps towards emissary	806	807	803	825	
B2	Downstream Borșa-Tomoiaga mine	695	691	685	705	

XI – November; II – February; III – March; IV – April.

Similarly to the situation reported for turbidity, concerning turbidity, no exceedings of the Romanian standards (30 NUT) are reported for turbidity values measured in water collected from the six points of the experimental field. In November 2021, the highest turbidity values (3.31 NUT and 3.13 NUT) are reported at location of upstream Tomoioaga mine and water exit from Tomoioaga mine, respectively, while the lowest (1.00 NUT) at location of pumps towards emissary. In February 2022, the highest turbidity values (3.35 NUT and 3.00 NUT) are reported at location of upstream Tomoioaga mine and water exit from Tomoioaga mine, respectively, while the lowest (1.45 NUT) at location of pumps towards emissary. In March 2022, the highest turbidity values (4.00 NUT and 3.50 NUT) are reported at location of upstream Tomoioaga mine and water exit from Tomoioaga mine, respectively, while the lowest (2.50 NUT) at location of pumps towards emissary. In April 2022, the highest turbidity values (4.60 NUT and 3.99 NUT) are reported at location of upstream Tomoioaga mine and water exit from Tomoioaga mine, respectively, while the lowest (2.36 NUT) at location of pumps towards emissary. Our results show that the highest turbidity value is 4.60 NUT recorded at location of upstream Tomoioaga mine, where the highest values of all time period are reported, while the lowest 1.00 NUT at location of pumps towards emissary, where the lowest values of all time period are reported (Table 3).

Table 3. The turbidity (NUT) of mine water samples

Prelevation points		Turbidity (NUT)				Reference value
Sample code	Location	XI 2021	II 2022	III 2022	IV 2022	Law no. 458 from 8 July 2003 [5]
B1	Upstream Borșa-Tomoiaga mine	3.31	3.35	4.00	4.60	30
B3	Water exit from Borșa-Tomoiaga a mine	3.13	3.00	3.50	3.99	
B5	Decantor	1.94	2.00	2.76	3.20	
B4	Pumps towards emissary	1.00	1.45	2.50	2.36	
B2	Downstream Borșa-Tomoiaga mine	2.43	2.50	2.65	2.71	

XI – November; II – February; III – March; IV – April.

4. Conclusions

Activitatea minieră din perimetrul de exploatare mina Borșa-Tomoiaga modifică sensibil calitatea apei de suprafaţă, de multe ori debitul apelor de mină fiind mai mare decât capacitatea proiectată a stației de epurare acestea sunt evacuate direct în cursul de apă prin conducta de by-pass. Același lucru se întâmplă când apar defecțiuni sau avarii pe sistemul de conductă sau echipamente aferente stației. Valorile relative ridicate ale conductivităţii măsurate în probele de apă prelevate din evacuările de ape acide pot reflecta o încărcare în diverşi ioni datorată atât timpului mai mare de staționare cât şi a proceselor oxidative. Toate apele care tranzitează prin construcții din beton armat ale galeriilor au concentrații ale ionilor metalelor grele mai mari în punctele de ieșire din acestea.

References

[1] Directiva UE privind prevenirea şi controlul poluării (96/61/EC), https://eur-lex.europa.eu/legal-content/RO/ALL/?uri=CELEX:31996L0061.

[2] HG 352/2005 NTPA003, https://legislatie. just. Ro /Public/ Detalii Docu ment /61585.

[3] http://romania-durabila.gov.ro/2021/02/16/calitatea- apei-din-romania-si-serviciile-de-salubrizare-perceptia-cetatenilor/.

[4] https://ro.wikipedia.org/wiki/Borșa Localizare

[5] Law no. 458 from 8 July 2003, https://legislatie.just.ro/Public/DetaliiDocument/37723 [In Romanian]

[6] Safirescu C., P. Burduhos, 2016, Ingineria apelor subterane. Ed. Bioflux, Cluj-Napoca.

[7] SR EN 27888:1997, https://e-standard.eu/en/standard/22665.

[8] SR ISO 10523/2012, https://www.iso.org/standard/51994.html.