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HEAVY METALS AND PHYSICO-CHEMICAL PARAMETERS ANALYSIS FROM THE WELLS IN THE BUHOCI AREA, BACAU

Alina COCHIORCA[1]*, Valentin NEDEFF[1], Adriano FIORUCCI[2], Mirela PANAINTE-LEHĂDUȘ[1], Narcis BÂRSAN[1], Oana IRIMIA[1]
[1]Department of Environmental Engineering and Mechanical Engineering,
„Vasile Alecsandri" University of Bacău
[2]DIATI, Politecnico di Torino, Italy
e-mail: cochiorca_alina@yahoo.co.uk

ABSTRACT

The study purpose is to analyze the heavy metals concentrations in the water from the Buhoci area wells and to evaluate the physico-chemical parameters of this water. Measurement of physico-chemical parameters were performed on site in five locality points using portable equipment. Heavy metals from these samples were analyzed in the laboratory of Hydrogeology, Politecnico di Torino, Italy. The analyzed water sources are used for domestic consumption. The results of the physico-chemical parameters comparative analysis fall within the limits admitted according to the requirements of Romanian Law no. 458 of July 8, 2002 with values in the range of: pH ≥ 6.5 - ≤ 9.5; turbidity (°C) ≤ 5; conductivity (µS/cm) ≤ 2,500.

KEYWORDS: heavy metals, physical-chemical analyzes, drinking water

1. Introduction

From the total quantity of water on the surface of the earth it results that 99% is not available to be used. And the percentage of 1% is stored in the earth. In most countries, groundwater and surface waters are the main sources of fresh water that can be used for domestic and irrigation purposes. A particular importance for citizens is the evaluation of drinking water quality to determine if it is adequate for consumption [1-7].

Natural waters, irrespective of their origin, contain many impurities, of a mineral and organic nature, dissolved or dispersed, in a higher or lower concentration, which they carry in the course of natural circulation [1-3, 8].

Water from natural sources presents various qualitative aspects. To determine the quality of the water, there can be examined the organoleptic, physical, chemical, biological and bacteriological properties on the basis of field, at the source site and laboratory analyzes [1-3, 8].

Groundwater is generally characterized by a high mineralization, the dissolved mineral salts content is more than 400 mg/L and particularly formed chlorides and sulfates of sodium, potassium, calcium and magnesium [8].

The concentration of hydrogen ions is around neutral, corresponding to a pH of 6.5 ÷ 7.0. From the dissolved gases predominate free carbon dioxide, the oxygen content being very low below 3 mg O_2/L [8, 9].

Depending on the mineralogical composition of the areas, some groundwater sources contain significant quantities of iron, manganese, hydrogen sulfide and sulphides, nitrogen compounds [8, 9].

Groundwater is formed up of a number of primary ions, which form compounds. These ions are sodium, potassium, magnesium, calcium, manganese and iron. Because of the cations, which are found in water combined with an anion, they can form salt compounds. The main anions are sulfate, chloride, acid carbonate and carbonate [10].

From an economic point of view, groundwater is much cheaper than surface water because there is no need to construct the reservoirs. Groundwater is usually of good quality, without solid suspensions (except for limited areas where pollution was affected) without bacteria and other pathogens [10].

Groundwaters are not just meant to be captured for supply. They have a significant contribution for supply by discharge into the river, either as a base flow or as a spring [10].

The level of water in fountains in particular areas is decreasing year after year. Due to water

supply with the both for drinking and for agriculture and industry, many streams dry out. The quality of drinking water that can come from groundwater sources is important for those who are supplying through drilling or wells [10].

In some regions, groundwater and surface water can be contaminated with heavy metals (lead, mercury and arsenic in large quantities) that can get into the body and can cause certain consequences. Just if it causes some consequences, these metals in small quantities are necessary in the body for human health. Besides the heavy metal pollution of water, it can also be polluted with nitrites and nitrates, microorganisms and organic pollutants [11-16].

The present study has been realized in the locality Buhoci in Bacau county, Romania. The study purpose is to analyze the heavy metals concentrations in the water from the Buhoci area wells and to evaluate the physico-chemical parameters of this water.

2. Study area, materials and methods

2.1. Study area

The Buhoci locality is situated 46º 57' N latitude and 27º 02' longitude E. It is located in the central - eastern area of Bacău County, with a distance of 15 km from the city of Bacau [17].

The Buhoci locality, from the point of view of geographic location, is situated in the temperate area with a strong continental influence. Along the wide corridor of Siret and Bistrita, the cold air enters from N and from the mountainous region [17].

The average annual temperature in the locality is 9.1 °C, which varies from year to year. Precipitation is influenced by temperature, humidity of the air and wind. The most abundant precipitation is in summer, followed by spring and autumn. Decrease in precipitation in winter is due to cold and dry continental air in winter and Asian anticyclone [17].

Figure 1 represents the location of the study area, exactly Buhoci locality [18].

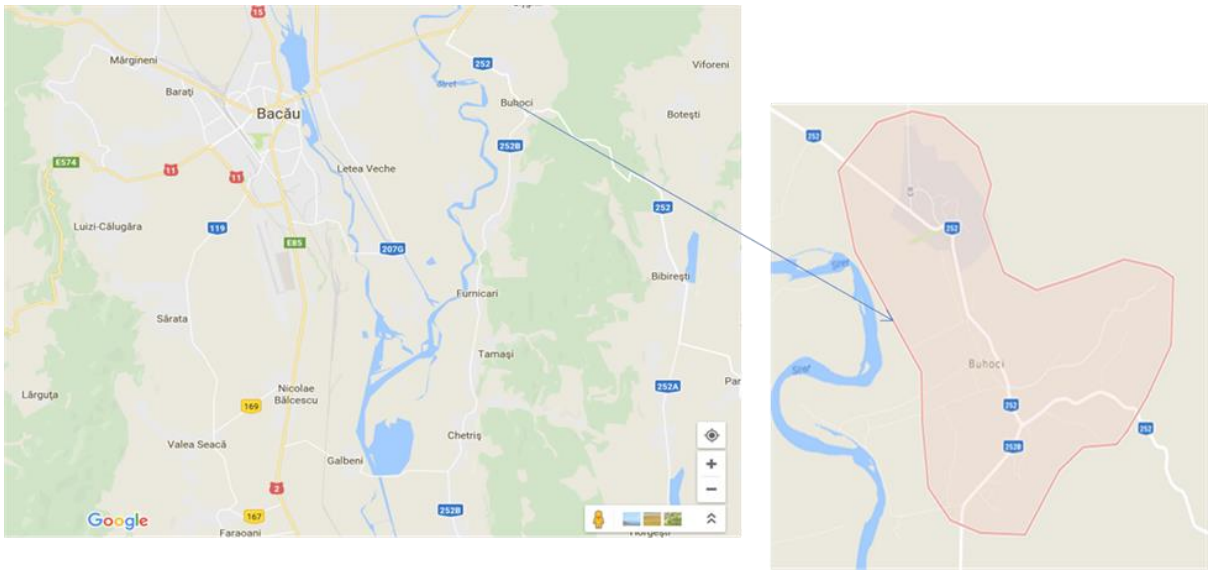


Fig. 1. *Location of the study area* [18]

2.2. Materials and methods

2.2.1. Sampling

For analysis of physico-chemical and heavy metals properties, 5 sampling points (Figure 2) were located using Global Positioning System (GPS), table 1. Water samples were collected in March using plastic containers. For every sampling point was collected every 500 mL of the sample.

2.2.2. Analysis of physico-chemical parameters and metals

Measurement of physico-chemical parameters were performed on site in five locality points using portable equipment. Heavy metals from these samples were analyzed in the laboratory of Hydrogeology, Politecnico di Torino, Italy.

The analysis of metals Na, K was realized using the AA-6800 Atomic Absorption Spectrophotometer. Ca, Mg and HCO_3 were determined by titration

method using the Metrohm 809 Titrando equipment, and the other metals were analyzed using Inductively Coupled Plasma Mass Spectrometry.

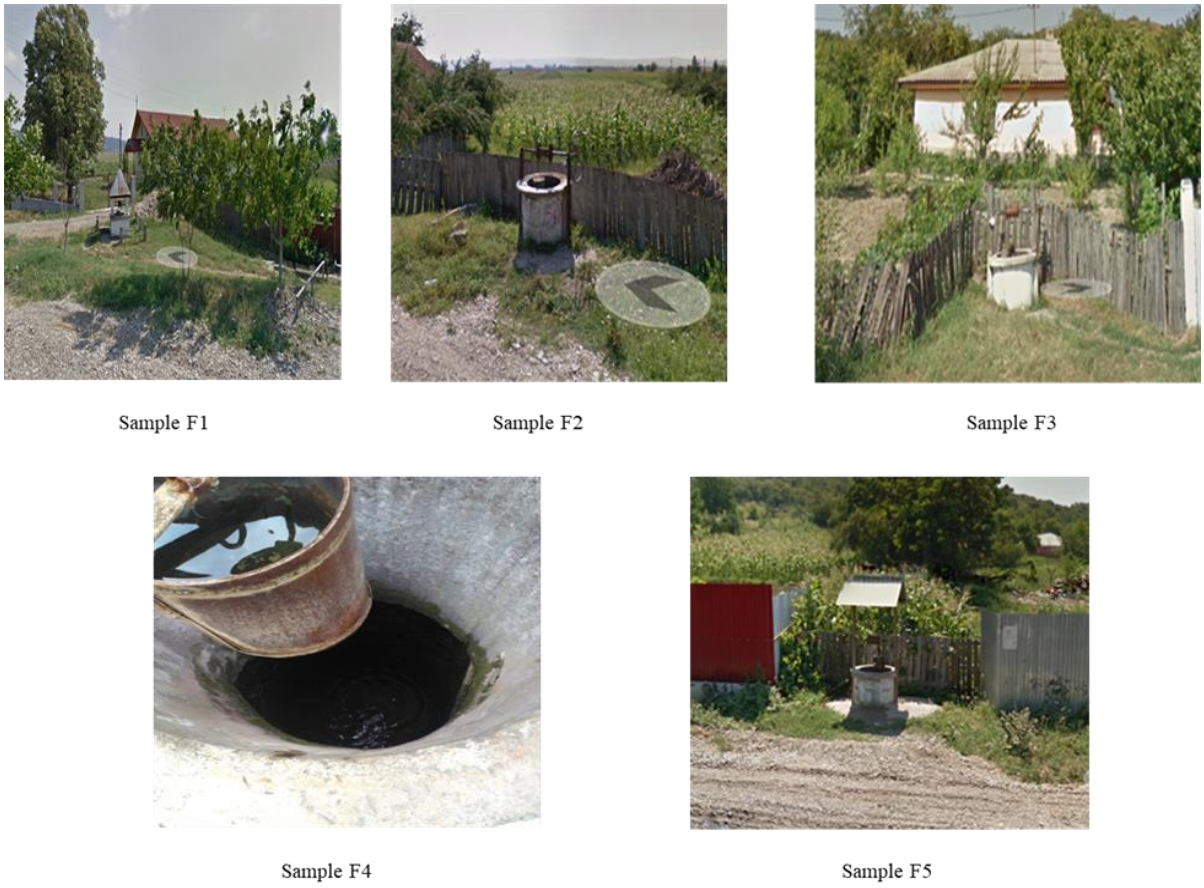


Fig. 2. *Sampling points for analysis* [19]

3. Results and discussion

3.1. Physico-chemical parameters

Physical and chemical parameters analyzed from water samples collected from the wells in March were conductivity, temperature, pH, turbidity, salinity and dissolved oxygen (Table 2).

The admissible limit values of physico-chemical parameters in drinking water according to Law no. 458 of July 8, 2002 updated in 2017 are presented in Table 1.

Table 1. *Limit values permitted for physico-chemical parameters in drinking water* [20]

Nr. crt.	Measured parameters	Maximum Admissible Concentration
1	pH	≥ 6.5; ≤ 9.5
2	Turbidity (NTU)	≤ 5
3	Conductivity (µS/cm)	≤ 2.500
4	Nitrites (mg/L)	0.50
5	Nitrates (mg/L)	50
6	Dissolved oxygen (mg/L)	5

Physico-chemical parameters differ significantly from the sampling samples so that the pH values of the five samples analyzed are easy alkaline (Figure 3) with a pH major than 7, with exception of sample number 1 (F1).

Table 2. *Physico-chemical parameters of water in the locality Buhoci*

No.	Sampling points	Date	pH	O_2 (mg/L)	Temp °C	Turbidity (NTU)	Salinity °C	Conductivity (µS/cm)	Nitrites (mg/L)	Nitrates (mg/L)	Geographical coordinates
1	F_1	March 30, 2017	7	4.7	10.7	4.21	0.6	1647	0.000	110.26	N 46°34'44,7276'', E 27°0'27,828''
2	F_2	March 30, 2017	7.4	5.8	10.5	3.65	0.8	1608	-	-	N 46°34'45''/ E 27°0'28''
3	F_3	March 30, 2017	7.4	3.5	11.5	0.71	0.7	1522	-	-	N 46°34'13''/ E 27°0'56''
4	F_4	March 30, 2017	7.5	4.5	9.2	1.64	0.6	1290	-	-	N 46°33'59''/ E 27°1'9''
5	F_5	March 30, 2017	7.28	3.9	9.8	1.11	0.5	1228	0.000	62.77	N 46°34'7''/ E 26°59'55''

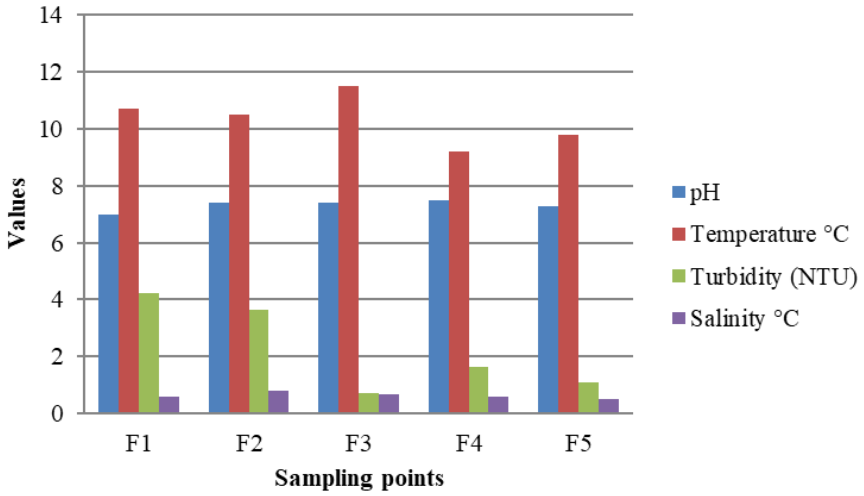


Fig. 3. *Parameter values in water samples*

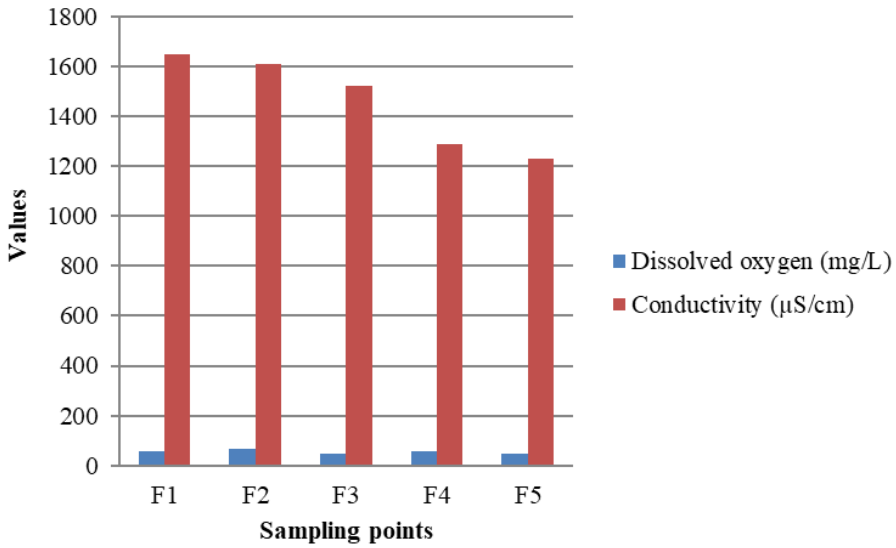


Fig. 4. *Parameter values in water samples*

The turbidity values (Figure 3) of the 5 samples collected from the wells in Buhoci varies between 0.71-4.21 NTU. The highest value is recorded in the sample number 1 (F1) due to disturbance of the soil during the withdrawal of water.

The quantity of dissolved oxygen (Figure 4) is higher in sample 2 (F2) than the other sampling points (Figure 4), because it depends on pressure, alkalinity and temperature (Figure 3).

The results of water conductivity analyses indicate that this parameter falls within the limits allowed by law for all collected samples. Conductivity values varies between 1228 - 1647 µS/cm.

3.2. Concentration of metals in drinking water

The maximum permissible limits of heavy metals in drinking water on the Law no. 458 of July 8, 2002 updated in 2017 are presented in Table 3.

Table 3. *Limits admitted in drinking water of heavy metals* [20]

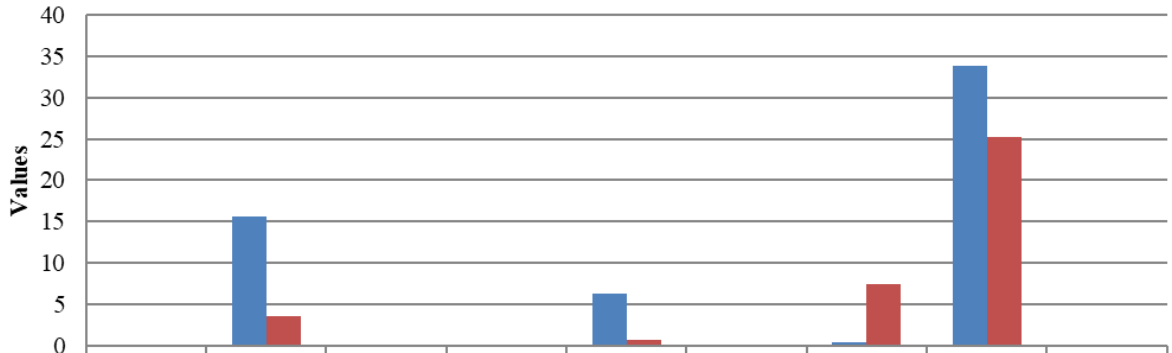
Metals in water	**Limits admitted in drinking water of metals**	
	Values accepted	**Analysis method**
Cu mg/L	0.1	STAS 3224/69
Pb µg/L	10	STAS 6362/85
Fe g/L	200	STAS 3086/68 SR 13315/96 SR ISO 6332/96
Zn g/L	5000	STAS 6327/81
Mn µg/L	50	STAS 3264/81 SR 8661-1,2/96 SR ISO 6333/96
Al g/L	200	STAS 6326/90
As µg/L	10	STAS 7885/67
Se µg/L	10	STAS 12663/88
Cd µg/L	5	STAS 11184/78

The analysis of the heavy metals in the water from the wells in Buhoci was done for sample 1 (F1) and sample number 5 (F5), because these water sources are much more usable. In Table 4 are shown the analysis of metals in water samples analyzed in the hydrogeological laboratory of the Politecnico di Torino.

Table 4. *Heavy metals concentration in water samples*

Sample	**Heavy metals concentration**								
	Cu mg/L	**Pb** µg/L	**Fe** g/L	**Zn** g/L	**Mn** µg/L	**Al** g/L	**As** µg/L	**Se** µg/L	**Cd** µg/L
F1	0.00347	15.62	0.0000275	0.001455	6.311	0.003421	0.488	33.84	0.08
F5	0.00980	3.621	0.00001434	0.001761	0.782	0.001857	7.518	25.23	0.028

The concentration of Pb in sample number 1 (F1) exceeds the maximum permissible limit of metals in drinking water (Figure 5) according to Law no. 458 of July 8, 2002. The quantity of Selenium (Se) for the two samples of water exceeds the legal limit in drinking water of 10 µg/L, the value being 33.84 µg/L (Table 4). The rest of the metals in the analyzed samples (Cu, Fe, Zn, Mn, Al, As and Cd) do not exceed the limits, falling below the maximum allowed by the law.



	Cu mg/L	Pb µg/L	Fe g/L	Zn g/L	Mn µg/L	Al g/L	As µg/L	Se µg/L	Cd µg/L
F1	0.00347	15.62	0.0000275	0.001455	6.31	0.003421	0.49	33.84	0.08
F5	0.00980	3.62	0.0000143	0.001761	0.78	0.001857	7.52	25.23	0.028

Fig. 5. *Values of metal concentrations in water samples*

4. Conclusions

This study was accomplished to evaluate physico-chemical parameters of water and to estimate the concentrations of metals in the water from the wells in the Buhoci area. From the analysis made it is to be seen that, the physical and chemical quality of water in the analyzed samples is good. The nitrite values in the analyzed water are zero, instead, the quantity of nitrates in the analyzed samples exceeds with much the maximum allowed by law. The concentration of nitrates in the wells can be due to the failure to comply and composition of the soil.

About the metals analyzed from drinking water coming from Buhoci locality, it results that they are below the limits allowed by law except for Pb, which is much over the limits admissible and Se.

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