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GROUNDWATER QUALITY MONITORING FROM THE JIUL VALLEY

Ciurcean Marius*, Stoicoiu Mălina*, Moiș Raul*, Gore Victoria*, Vrabie Andreea* Andronie Luisa*, Coroian Aurelia*

* University of Agriculture Sciences and Veterinary Medicine, Cluj-Napoca, Faculty of Animal Science and Biotechnology, Mănăştur Str 3-5, 400272, Cluj-Napoca, Romania, e-mail: marius.ciurcean@student.usamvcluj.ro; stoicoiumalina@yahoo.com, raul.mois@student.usamvcluj.ro, victoria.gore@student.usamvcluj.ro, andreeamaria.vrabie@student.usamvcluj.ro

*Corresponding author: luisa.andronie@usamvcluj.ro, aurelia.coroian@usamvcluj.ro

Abstract

Groundwater is formed as a result of precipitation that infiltrates the earth or from water infiltration from the riverbed of flowing or stagnant rivers. Groundwater protection refers to all the measures necessary to preserve the quality of water. The notion of groundwater quality means the totality of physical, chemical and microbiological properties, which must be maintained within the limits allowed to maintain the ecological balance. The turbidity indicator values for the four captures have the six-month average values, for the raw water in the range of 2.19-1.22 NTU, and for the network water in the range of 0.63-0.79 NTU. The pH indicator values for the four captures have the six-month average values, for the raw water in the range of 7.22-7.81 pH units and for the network water in the range of 7.18-7.7 pH units. The purpose of this study was the evaluation of quality parameters for underground water from Jiu Valley.

Keywords: groundwater, mains water, turbidity, permanganate index, Ca, Mg, nitrates, coliform bacteria

INTRODUCTION

The water sector comprises a number of directives, of which the Water Framework Directive is of particular importance (2000/60/EC). The Framework Directive not only provides a managerial framework for the whole water protection policy and legislation, but also replaces many 'first wave' laws after the various transitional periods: the Supteran Water Directive and two directives on measurement methods, the frequency of measurements and the directive on the discharge of hazardous substances. The Urban Waste Water Directive 91/271/EEC aims to protect the aquatic environment in the European Union (EU) from the adverse effects of urban waste water. It sets out EU-wide rules for the collection, treatment and disposal of waste water. The act also covers waste water generated by industries such as agri-food. Drinking water Directive 98/83/EEC: the objective of this Directive is to protect human health against the adverse effects of contamination of water intended for human consumption by

ensuring its wholesomeness and purity from micro-organisms, parasites and any other substances which, by their number or concentration, constitute a potential danger to human health. Nitrates Directive 91/676/EEC: the objective of this Directive is to reduce water pollution caused by or induced by nitrates from agricultural sources; prevent any new pollution of this type. Directive 80/68/EEC on groundwater – the objective of this directive is the protection of groundwater against pollution caused by certain dangerous substances – transposed into Romanian legislation by Government Decision no. 351/2005 on the approval of the Programme for the phasing out of discharges, emissions and losses of priority hazardous substances.

MATERIAL AND METHOD

We carried out a documentation and practical application to the four water intakes within S.C. Apa SERV Valea Jiului S.A. The main objectives were: knowledge of the protection areas of existing groundwater sources in the Jiu Valley; knowledge of how to capture, transport and treat water; knowledge of the operational monitoring plan of the quality of the raw water and of the one subject to treatment.Turbidity:the international reference standard is used - SR EN ISO 7027/2001, scope for surface water, groundwater and drinking water. Calibration of the TL 2310 turbidimeter is done with formazine Standard: 20 NTU, 100 NTU, 800 NTU. pH: for this parameter the reference standard - EN ISO 10523: 2012 - water quality is used. Amount of calcium and magnesium: determined according to the reference standard - SR ISO 6059/2008 - Water quality. Determination of the amount of calcium and magnesium. EDTA titrimetric method.

RESULTS AND DISCUSSIONS

Table 1

								2	The limit allowed
Period	Jieț	drains	Morișoara		Herta		Toplița		according to Law
		would	AB	would	AB	would	AB	would	458/2002
									republished in 2011
									and Law 311/2004
09.2019	1.29	0.72	2.45	0.84	1.65	0.54	1.89	0.52	
10.2019	1.05	0.58	2.69	0.91	1.58	0.80	2.12	0.69	
11.2019	1.34	0.83	1.98	0.88	2.15	0.91	2.06	0.92	1 NTU
12.2019	1.23	0.69	2.19	0.76	1.93	0.85	1.81	0.43	
01.2020	1.15	0.64	2.05	0.72	1.54	0.72	2.24	0.73]
02.2020	1.26	0.71	1.79	0.64	1.68	0.82	1.64	0.48]

Results obtained when determining the Turbidity indicator

Analyzing the values of the turbidity indicator we can see that all four catchments have average values over six months, for raw water in the range of 2.19-1.22 NTU and for mains water in the range of 0.63-0.79 NTU.

Table 2

									The limit allowed
Period	Jieț	drains	Morișoara		Herta		Toplița		according to Law
	AB	would	AB	would	AB	would	AB	would	458/2002 republished
									in 2011 and Law
									311/2004
09.2019	7.22	7.18	7.71	7.69	7.66	7.61	7.64	7.61	
10.2019	7.31	7.28	7.63	7.60	7.81	7.70	7.75	7.61	
11.2019	7.22	7.19	7.81	7.79	7.72	7.69	7.53	7.48	6.5 - 9.5 pH units
12.2019	7.32	7.29	7.65	7.58	7.53	7.48	7.39	7.35	
01.2020	7.26	7.22	7.74	7.71	7.76	7.73	7.54	7.51	
02.2020	7.31	7.29	7.69	7.62	7.80	7.76	7.71	7.68	

Results obtained when determining the pH indicator

Analyzing the values of the pH indicator we can see that all four catchments have average values over six months, for raw water in the range of 7.22-7.81 pH units and for mains water in the range of 7.18-7.7 pH units 9.

Table 3

Period	Jieț drains		Morișoara		Herta		Toplița		The limit allowed according to Law 458/2002
	AB	would	AB	would	AB	would	AB	would	republished in 2011 and Law 311/2004
10.2019	0.88	0.64	0.48	0.32	0.40	0.3	0.88	0.64	
11.2019	0.72	0.56	0.40	0.28	0.32	0.24	0.96	0.72	$5 \text{ mgO}_2/l$
12.2019	0.88	0.72	0.56	0.40	0.56	0.40	0.8	0.64	- 8-2
01.2020	0.80	0.64	0.48	0.32	0.40	0.32	1.02	0.56	
02.2020	0.96	0.56	0.56	0.48	0.48	0.4	0.8	0.40	
03.2020	0.80	0.64	0.72	0.4	0.32	0.24	0.72	0.48	

Results obtained when determining the permanganate index indicator

Analyzing the values of the permanganate index indicator, we can see that all four catches have average values over six months, for raw water in the range of 1.02-0.32 mg O2 / L and for mains water in the range of 0.24-0.72 mg O2/L.

Table 4

Period	Jieț	drains	Mor	ișoara	Н	Herta		plița	The limit allowed according to Law 458/2002 republished in 2011 and Law
	AB	would	AB	would	AB	would	AB	would	311/2004
09.2019	2.54	2.40	3.44	3.25	7.12	6.98	4.22	4.12	
10.2019	2.69	2.63	3.59	3.36	6.40	6.30	4.72	4.54	min5 ⁰ dH
11.2019	2.96	2.64	3.70	3.53	6.68	6.52	5.26	5.03	
12.2019	2.66	2.61	3.59	3.30	6.78	6.63	4.52	4.46	
01.2020	2.43	2.54	3.59	3.25	7.12	6.69	4.66	4.54	
02.2020	2.57	2.69	3.82	3.71	6.36	6.30	4.35	4.20	

Results obtained when determining the indicator amount of calcium and magnesium

Analyzing the values of the indicator amount of calcium and magnesium we can see that all four catchments have average values over six months, for raw water in the range of 2.43-7.12 0 dH, and for mains water in the range of 2.40- 6.98 0 dH.

Table 5

Period	Jieț drains		Morișoara		Herta		Toplița		The limit allowed according to Law
	AB	would	AB	would	AB	would	AB	would	458/2002 republished in 2011 and Law 311/2004
09.2019	0	0.33	0	0.39	0	0.36	0	0.46	
10.2019	0	0.45	0	0.37	0	0.38	0	0.42	
11.2019	0	0.39	0	0.42	0	0.42	0	0.37	min. 0.1 - max.0.5
12.2019	0	0.42	0	0.46	0	0.35	0	0.43	mg / L
01.2020	0	0.39	0	0.39	0	0.33	0	0.33	(mains water)
02.2020	0	0.33	0	0.38	0	0.34	0	0.35	

Results obtained in the determination of the indicator free residual chlorine

Analyzing the values of the indicator free residual chlorine we can see that all four catches have average values over six months, for raw water is zero and for mains water in the range of 0.33-0.46 mg/L.

Table 6

Period	Jieț drains		Morișoara		Herta		Toplița		The limit allowed according to Law 458/2002 republished
	AB	would	AB	would	AB	would	AB	would	in 2011 and Law 311/2004
09.2019	15	0	9	0	11	0	24	0	011/2004
10.2019	18	0	14	0	8	0	19	0	0 ufc / 100mL
11.2019	12	0	7	0	14	0	29	0	(mains water)
12.2019	26	0	10	0	16	0	19	0	
01.2020	19	0	6	0	9	0	26	0	
02.2020	31	0	12	0	21	0	16	0	

Results obtained when determining the coliform bacteria indicator

Analyzing the values of the coliform bacterium indicator, we can observe that all four catches have the average values over six months, for the raw water between 6 - 31 cfu/100mL and for the mains water there was no coliform bacterium.

Analyzing the values of the nitrate indicator we can see that all four catches have average values over six months, for raw water in the range of 0.99 - 5.21 mg/L and for mains water in the range of 0.93 - 5.16 mg/L.

Table 7

Results obtained in the determination of the indicator nitrates (nitrates)

Table 8

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Period	Jieț drains		Jieț drains Morișoara		Herta		Toplița		The limit allowed according to Law 458/2002 republished in
	AB	would	AB	would	AB	would	AB	would	2011 and Law 311/2004
09.2019	10	0	12	0	11	0	12	0	
10.2019	12	0	16	0	8	0	16	0	0 ufc / 100mL
11.2019	8	0	9	0	13	0	7	0	(mains water)
12.2019	5	0	14	0	9	0	10	0	
01.2020	9	0	11	0	7	0	9	0	
02.2020	10	0	18	0	11	0	5	0	

Results of Escherichia coli (E-coli) indicator

Analyzing the values of the e-coli indicator, we can see that all four catchments have the average values over six months, for the raw water between 5 - 18 cfu / 100 mL and for the mains water there are no E-coli.

Table 9

	ieces)													
Period	Jieț drains		Morișoara			Herta		oplița	The limit allowed according to Law 458/2002 republished in					
	AB	would	AB	would	AB	would	AB	would	2011 and Law 311/2004					
09.2019	12	0	10	0	8	0	13	0						
10.2019	6	0	8	0	11	0	16	0	0 ufc / 100mI					
11.2019	5	0	9	0	15	0	14	0	(mains water)					
12.2019	9	0	5	0	9	0	8	0						
01.2020	11	0	3	0	14	0	15	0						
02.2020	9	0	5	0	8	0	12	0						

Results obtained when determining the indicator Enterococci (Streptococcus-

Analyzing the values of the enterococcal indicator we can see that all four catches have average values over six months, for raw water between 3 - 16 cfu / 100 mL and for mains water there were no enterococci (streptococci-feces).

CONCLUSIONS

Groundwater is formed by precipitation that seeps into the ground or from water infiltration from the bed of flowing or stagnant rivers.

Groundwater protection refers to the set of measures necessary to maintain water quality. The notion of groundwater quality means all the physical, chemical and microbiological properties, they must be kept within the limits allowed to maintain the ecological balance.

Following the analyzes of the studied indicators, we can conclude the following:

The values of the turbidity indicator for the four catchments have the average values over six months, for raw water in the range of 2.19-1.22 NTU and for mains water in the range of 0.63-0.79 NTU, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being 5 NTU; The pH indicator values for the four catchments have the average values over six months, for raw water in the range of 7.22-7.81 pH units and for mains water in the range of 7.18-7.7 pH units, the limit admitted according to Law 458/2002 republished in 2011 and Law 311/2004 being 5

311/2004 being 6.5-9.5 pH units; The values of the permanganate index indicator for the four catches have the average values over six months, for the raw water in the range of $1.02-0.32 \text{ mgO}_2/1$ and for the mains water in the range of $0.24-0.72 \text{ mgO}_2/1$, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being 5.0 mgO₂/L;

The values of the calcium and magnesium sum indicator for the four catchments have the average values over six months, for the raw water in the range of 2.43-7.12 0 dH and for the mains water in the range of 2.40-6.98 0 dH, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being at least 5.0 0 dH;

The values of the free residual chlorine indicator for the four catchments have the average values over six months, for raw water it is zero and for mains water in the range of 0.33-0.46 mg/l, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being at least 0.5 mg/L; The values of the coliform bacterium indicator for the four catches have the average values over six months, for raw water between 6 - 31 cfu/100 mL and for mains water there was no coliform bacteria, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being 0 cfu/100m; The values of the nitrate indicator for the four catchments have the average values over six months, for the raw water in the range 0.99 - 5.21 mg/L and for the mains water in the range.0.93 - 5.16 mg/L, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being at least 50 mg/L; The values of the e-coli indicator for the four catchments have the average

values over six months, for raw water between 5 - 18 cfu/100ml and for mains water there are no E-coli, the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being 0 cfu/100mL;

The values of the enterococcal indicator for the four catches have the average values over six months, for raw water between 3 and 16 cfu/100 mL and for mains water there were no enterococci (streptococci-feces), the limit allowed according to Law 458/2002 republished in 2011 and Law 311/2004 being 0 cfu/ 100 mL.

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