

STUDY OF NATURAL QUALITY PARAMETERS OF GROUNDWATER IN DAMBOVITA COUNTY

Ivona David

Valahia University of Targoviste, 13, Sinaia Alley, Targoviste, Romania

E-mail: ivonadavid@yahoo.com, ivona.david@valahia.ro

Abstract

This paper aims to monitor some indicators of groundwater samples from different localities of Dambovita County (Dobra, Valeni-Dambovita, Selaru, Brezoaele), in different seasons (autumn, winter and spring) and compare them with maximum concentrations. (Maximum allowed concentration) provided for in the relevant regulations. The following indicators were monitored monthly for a period of seven months in the above-mentioned areas for groundwater samples: pH, water temperature, air temperature, total hardness (expressed in German degrees), nitrate content, amount of dissolved oxygen, biochemical oxygen consumption in 5 monitored days (BOD₅), aggressive carbon dioxide content and carbon dioxide content in the form of bicarbonates. The study identified exceedances of the limit values only for the nitrate content in some localities and in some of the studied months. The other parameters did not show any exceedances.

Keywords: groundwater, natural parameters, maximum allowed concentration

1. INTRODUCTION

The importance of water is increasing, especially as water has a significant impact on the development and diversification of human activity. Regardless of the form in which it is found, a brief assessment of existing water resources shows that society can only develop if this resource is rationally managed (Pleniceanu V. et al. [5], Ali J. et al. [1]).

The main current concern is to provide the population, industry and agriculture with adequate drinking water resources, both quantitatively and qualitatively. This concern was materialized in the provisions of Law no. 137/1995 regarding the protection of the environment, in the Water Law no. 107/1996 and in the Perspective Program for the arrangement of the hydrographic basins in our country (Pleniceanu V. et al. [5]).

The type of water source significantly influences the quality of the water, which, however, may change depending on the geological, meteorological and land use conditions. If groundwater is properly extracted, the risk of particulate matter is very low, unlike surface water or water extracted from springs which may contain many particles due to heavy rainfall. Groundwater or surface water can be characterized by a high content of calcium, magnesium and salts, depending on the geological conditions of the area where the water is extracted (Klimek F. et al. [4]).

2. MATERIALS AND METHODS

To carry out this study, the work stages were divided into three main categories:

- establishing the monitoring area;
- selection of the main water sources, not abandoned and from which the consumption is made daily;
- determining and locating the number of measurement points and the choice of equipment required (Racariu V. et al. [6]).

In this study, the following working points were chosen from four localities located in Dambovita County: Brezoaele, Dobra, Selaru and Valeni-Dambovita.

Brezoaele is a commune consisting of two villages, being located in the Titu Plain in Dambovita County, on the Dambovita River (Ghinea D. [3]).

Dobra is a commune consisting of two villages, located in the Cricov Plain in Dambovita County, located at the confluence of the Parscov River with the Ialomita River (Ghinea D. [3]).

Selaru is a commune made up of three villages, located in the Gavanu-Burdea Plain, on the Dambovita and Glavacioc rivers in Dambovita County (Ghinea D. [3]).

Valeni-Dambovita is a commune consisting of two villages, located in the northwest of the Ialomita Subcarpathians, at the southwestern foot of the Leaota Mountains in Dambovita County (Ghinea D. [3]).

A sampling interval of 30 days was established for a period of seven months.

Physical and chemical indicators were determined. Physico-chemical indicators consisted of the analysis of the following parameters: pH, total hardness (expressed in German degrees), nitrate content, air temperature, water temperature, dissolved oxygen content, biochemical oxygen content BOD₅, influence of forms of carbon dioxide (aggressive, bicarbonate).

The correlation coefficient, denoted R, shows both whether or not there is an association between the dependent variable and the independent variable, and the strength of the association (Anton C. [2]).

The coefficient of determination, denoted R², is the square of the multiple correlation coefficient and can take values between 0 and 1. If R² is zero or if its value is very small, in this case the chosen regression model does not explain the connection between the variables. Therefore, the relationship between the dependent variable and the independent variable does not coincide with the chosen model.

If R^2 is equal to 1, it means that all the observations agree are correlated to the regression line, so the regression model perfectly explains the connection between the variables (Anton C. [2]).

3. RESULTS AND DISCUSSIONS

Three categories of parameters are used to determine the quality and to assess the degree of pollution of water samples:

- basic parameters: temperature, pH, conductivity, turbidity, total dissolved solids, total suspended solids, dissolved oxygen, colibacillus;
- indicative parameters of persistent pollution: cadmium, mercury, organohalogen compounds and mineral oils;
- optional parameters: total organic carbon (TOC), biochemical oxygen consumption (BOD_5), heavy metals, arsenic, boron, sodium, cyanides, total oils, streptococcus (Rusanescu M. et al. [7]).

Analyzed physical indicators

Table 1 shows the physical indicators analyzed from the samples taken from the four localities of Dambovită County. The parameters were monitored for a period of seven months. From the analysis of the data in Table 1, it is observed that the air temperature varied between 6.5-19 °C, while the water temperature varied between 5-19 °C, between September 2020-March 2021.

At the same time, the pH water varied between 7.4 and 8.3 units, depending on the locality and period. The pH of the groundwater in Selaru, which has alkaline values (over 8 pH units).

Table 1. Analyzed physical indicators

Locality	Month	pH/temp. 20°C	Air temp. °C	Water temp. °C
Dobra	Sept. 2020	7,8	15	12
	Oct. 2020	7,7	14,5	10,5
	Nov. 2020	7,7	14	11
	Dec. 2020	7,9	8	5
	Jan. 2021	7,7	7	10,5
	Feb. 2021	7,9	6,5	11
	Mar. 2021	7,8	9	10
Valeni-DB	Sept. 2020	7,5	18	16,5
	Oct. 2020	7,6	18	17
	Nov. 2020	7,6	17,5	16,5
	Dec. 2020	7,5	10	9,5
	Jan. 2021	7,6	9,5	9
	Feb. 2021	7,5	12,5	10,5
	Mar. 2021	7,5	16,5	15
Selaru	Sept. 2020	8,3	17	15
	Oct. 2020	8,1	16	14
	Nov. 2020	8,2	14,5	17
	Dec. 2020	8,2	14	15
	Jan. 2021	8,1	13	16
	Feb. 2021	8,3	16	17
	Mar. 2021	8,1	18	19

Brezoale	Sept. 2020	7,4	19	18
	Oct. 2020	7,6	17	15,5
	Nov. 2020	7,6	13	14
	Dec. 2020	7,7	11,5	14
	Jan. 2021	7,5	14	16
	Feb. 2021	7,4	18	19
	Mar. 2021	7,5	19	16

Analyzed chemical indicators

The chemical indicators analyzed can be found in the following tables.

Table 2. Analyzed chemical indicators

Locality	Month	Dissolved oxygen, mg/l	BOD_5 , mg/l
Dobra	Sept. 2020	7,91	6,5
	Oct. 2020	7,29	4,7
	Nov. 2020	9,72	4,02
	Dec. 2020	10,9	3,89
	Jan. 2021	10,1	5,5
	Feb. 2021	10,2	4,7
	Mar. 2021	8,9	2,7
Valeni-DB	Sept. 2020	12,26	5,4
	Oct. 2020	10,92	4,88
	Nov. 2020	9,91	5,12
	Dec. 2020	11,56	3,45
	Jan. 2021	11,22	3,12
	Feb. 2021	9,57	4,2
	Mar. 2021	8,40	2,2
Selaru	Sept. 2020	13,3	2,1
	Oct. 2020	11,3	2,9
	Nov. 2020	10,5	2,7
	Dec. 2020	10,2	3,4
	Jan. 2021	9,8	3,9
	Feb. 2021	10,1	4,8
	Mar. 2021	9,4	2,5
Brezoale	Sept. 2020	11,1	4,5
	Oct. 2020	9,85	3,9
	Nov. 2020	10,4	3,6
	Dec. 2020	11,4	5,7
	Jan. 2021	10,5	5,1
	Feb. 2021	9,8	3,5
	Mar. 2021	8,7	2,6

Table 3. Analyzed chemical indicators

Locality	Month	Agressive CO_2 mg/l	CO_2 bicarbon ates mg/l
Dobra	Sept. 2020	4,1	390,4
	Oct. 2020	3,08	378,2
	Nov. 2020	4,7	329,7
	Dec. 2020	5,67	330,6
	Jan. 2021	5,89	345,0
	Feb. 2021	6,5	456,3
	Mar. 2021	9,87	567,5

Valeni-DB	Sept. 2020	5,6	234,8
	Oct. 2020	5,98	345,8
	Nov. 2020	6,12	433,1
	Dec. 2020	5,89	467,3
	Jan. 2021	4,23	240,5
	Feb. 2021	8,8	356,8
	Mar. 2021	8,7	339,5
Selaru	Sept. 2020	4,41	237,4
	Oct. 2020	5,3	345,3
	Nov. 2020	6,43	344,8
	Dec. 2020	4,81	463,2
	Jan. 2021	6,72	389,5
	Feb. 2021	7,88	401,2
Brezoaele	Sept. 2020	4,12	289,6
	Oct. 2020	5,18	356,6
	Nov. 2020	3,97	408,4
	Dec. 2020	6,11	432,5
	Jan. 2021	5,23	445,3
	Feb. 2021	4,18	564,6
	Mar. 2021	6,2	432,4

Brezoaele	Sept. 2020	34,24	21,78
	Oct. 2020	32,45	21,23
	Nov. 2020	31,86	22,21
	Dec. 2020	30,36	22,47
	Jan. 2021	29,73	21,29
	Feb. 2021	28,97	22,33
	Mar. 2021	31,16	22,12

Table 4 shows the chemical indicators (nitrates and hardness) for samples taken from the four localities of Dâmbovița County. The lowest nitrate content was found in the water samples collected from Selaru locality (between 0.038 and 0.131 mg / l), followed by Valeni-Dambovița locality (between 3.39 and 8.72 mg / l), and the highest values were observed in the locality of Brezoaele (between 28.97 and 34.24 mg / l) and Dobra (between 35.72 and 38.38 mg / l), during the period of seven months.

The highest values for the total hardness were noticed in Brezoaele locality, and the lowest in Valeni-Dambovița and Selaru localities. These water samples are characterized by a moderate to high hardness.

Tables 2 and 3 show the values of the water oxygen regime and the forms of carbon dioxide.

The dissolved oxygen content ranged from 7.3 to 13.3 mg/l, the BOD₅ content ranged from 2.1 to 6.5 mg/l, and the aggressive CO₂ concentration ranged from 3.1 to 9.9 mg/l.

The largest variation was observed in the case of the concentration of CO₂ in the form of bicarbonates, which varied between 234.8 and 567.5 mg/l, noting, in general, a gradual increase in values from autumn season to spring.

Table 4. Analyzed chemical indicators

Locality	Month	Nitrates (NO ₃), mg/l	Total hardness (°dH)
Dobra	Sept. 2020	37,58	15,65
	Oct. 2020	36,35	15,70
	Nov. 2020	38,38	15,71
	Dec. 2020	37,84	15,39
	Jan. 2021	36,12	15,11
	Feb. 2021	35,72	14,81
	Mar. 2021	36,29	15,24
Valeni-DB	Sept. 2020	4,28	9,13
	Oct. 2020	5,16	9,56
	Nov. 2020	3,39	8,98
	Dec. 2020	5,98	8,74
	Jan. 2021	6,40	10,23
	Feb. 2021	8,72	10,55
	Mar. 2021	7,67	9,89
Selaru	Sept. 2020	0,112	10,85
	Oct. 2020	0,093	11,26
	Nov. 2020	0,131	10,38
	Dec. 2020	0,087	9,48
	Jan. 2021	0,056	10,11
	Feb. 2021	0,038	9,24
	Mar. 2021	0,064	9,93

Comments on the classification of the parameters studied in the maximum allowed concentration (MAC) norms and the classification of water in quality classes

The studied parameters that stay within the MAC norms (maximum allowed concentrations) are the following:

- pH values are in the range of 6.5 - 8.5, according to STAS 4706/88;
- the lowest nitrates content was observed in Selaru locality (between 0.038 and 0.131 mg / l), followed by Valeni-Dambovița locality (between 3.39 and 8.72 mg/l), these groundwater being included in category I (according to STAS 4706/88), which are waters that can be used for centralized supply of drinking water and livestock units, food industry, certain irrigation, fish farming, swimming pools, etc. In contrast, the highest values of nitrates content were observed in Brezoaele (between 28.97 and 34.24 mg/l) and Dobra (between 35.72 and 38.38 mg/l), which situate in category III (according to STAS 4706/88) and represents waters that can be used for irrigation, for the supply of hydropower plants, for the cooling of aggregates, for the supply of washing stations, etc. ;
- biochemical oxygen content at 5 days (BOD₅) – BOD₅ was between 5 and 7 mg/l (according to STAS 4706/88, groundwater falls into category II) in: Dobra locality, in September 2020 and January 2021, Valeni-Dambovița locality in September and November 2020 and Brezoaele locality in December 2020 and January 2021; in Selaru locality and in the months not mentioned for the other localities, the groundwater falls into category I (less than 5 mg/l);
- the dissolved oxygen content varied between 7.3 and 13.3 mg/l. The highest values were recorded in the localities of Valeni-Dambovița and Selaru in September, while in the rest of the months and localities, the dissolved oxygen content was lower than 12 mg/l. In general, the dissolved oxygen content can vary between 0-14 mg/l,

depending on the season and the day-night alternation, with minimum recommended values of 4 mg/l, because too little dissolved oxygen leads to a decrease in the capacity of water self-purification;

- the aggressive carbon dioxide content varied between 3.1 and 9.9 mg/l, in all localities and throughout the studied period;
- the carbon dioxide content in the form of bicarbonates varied between 234.8 and 567.5 mg/l, noting, in general, to gradual increase in values from the autumn to the spring season;
- the water hardness varied between 8.74 and 10.55 German degrees (°dH) for water samples taken during the seven months of study in Valeni-Dambovită, respectively between 9.24 and 11.26 °dH in the Selaru locality. The hardness was considered medium. The water is considered slightly hard in Dobra, where the recorded values were between 14.81 and 15.71 °dH. On the other hand, in Brezoele locality these values ranged between 21.23 and 22.47 °dH, the hardness being considered high.

4. CONCLUSIONS

The pH values fall within the MAC norms for water samples taken from the four localities, for the entire studied period; pH had a low influence on nitrate content, total water hardness and forms of carbon dioxide; The dissolved oxygen values were in line with the MAC norms for water samples taken from the four localities, for the entire period studied; the influence of dissolved oxygen on water temperature is stronger in the autumn season, but weaker in the winter and spring seasons; BOD₅ values were in line with the MAC norms for samples taken from the four localities, for the entire studied period; in the autumn and spring seasons, the water temperature influences the BOD₅ content more strongly, while in the winter season the BOD₅ content influences the water temperature more strongly; The highest value for water hardness was recorded in Brezoele locality (high hardness water), and the lowest value was identified in Valeni-Dâmbovița locality (moderate hardness water) for water samples taken from the four localities, throughout the studied period; The nitrates content stays within the MAC norms in Selaru and Valeni-Dambovită localities, and the nitrate content in Brezoele locality is within the MAC norms only in January and February, in the rest of the studied period not complying with the MAC norms; on the other hand, the nitrate content in the locality of Dobra is not fall within the MAC norms, being above the allowed limit; The two forms of carbon dioxide, aggressive carbon dioxide and carbon dioxide in the form of bicarbonate, showed that there is a moderate to strong influence on the pH, in all three seasons studied and in the four localities from where water samples were taken for analysis.

5. REFERENCES

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