CHEMICAL STATEMENT OF WATER FROM DEEP BOREHOLES FROM THE HYDROGRAPHIC BASIN BÂRLAD

SITUAȚIA CHIMICĂ A APEI DIN FORAJELE DE ADÂNCIME AFLATE ÎN BAZINUL HIDROGRAFIC BÂRLAD

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Abstract. *The paper presents a chemical characterization of the deep aquifer from hydrographic basin Barlad. It took into account a total of 25 wells with depth between 79 and 289 m from the ground surface. From these boreholes water samples were taken and it was determined a range of chemical indicators. There have been exceeded over the permissible concentration required by Law 458/2002 on Drinking water quality of indicator* Na^+ *for 6 wells (1.05 respectively 2.55 times) and of indicator* SO_4^{2-} *for 4 wells (1.04 respectively 2.30 times). For these boreholes it is necessary water treatment plants such that the water to be supplied to the population. Thus, from the total investigated depth boreholes, 16 wells have drinking water quality conditions imposed by legislation.*
Key words: *boreholes, quality, hydrology, indicator, chemical characterization.*

Rezumat. *Lucrarea prezintă o caracterizare din punct de vedere chimic a acviferului de adâncime din bazinul hidrografic Bârlad. S-au avut în vedere un număr de 25 foraje cu adâncimea cuprinsă între 79 și 289 m față de suprafața terenului. Din aceste foraje au fost prelevate probe de apă și determinați o serie de indicatori chimici. S-au înregistrat depășiri, peste concentrația admisibilă impusă prin Legea 458/2002 privind Calitatea apei potabile, ale indicatorului* Na^+ *la 6 foraje (de 1.05 respectiv, 2.55 ori) și ale indicatorului* SO_4^{2-} *la 4 foraje, (de 1.04 respectiv, 2.30 ori). Se impune pentru aceste foraje prevederea de stații de tratare a apei pentru ca apa să poată fi furnizată către populație. Astfel, din totalul forajelor de adâncime investigate, 16 foraje îndeplinesc condițiile de calitate a apei potabile impuse de legislația în vigoare.*
Cuvinte cheie: *foraje, calitate, hidrologie, indicator, caracterizare chimică.*

INTRODUCTION

Water is one of the most important resources available on planet especially because is the reason for nascent, development, continuity and quality of life.

The main advantages of using groundwater for drinking are: presence near or in the complex areas of consumption, a superior quality instead of the other sources, the need for physical, chemical and biological simple treatment and inexpensive, continuous regeneration (Cojocaru *et al.,* 2011).

On the other hand, underground water sources play an essential role in the hydrological cycle and they are vital for maintaining wetlands and rivers flow, acting

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as a buffer during dry periods.

Groundwater can be polluted by: landfill leachate percolation (Han D. et al., 2014), irrigation or wastewater discharges (Morrissey *et al.,* 2015), water leaching of agricultural land salty and of agricultural land that applies in unreasonable quantities, fertilizers and pesticides (Junior Valle *et al.,* 2014) coastal aquifers intrusion (Tomaszkiewicz *et al.,* 2014) etc.

In order to use groundwater for drinking it must be determined a number of chemical indicators to assess its pollution level. Gautam *et al.,* 2015 concluded that 74%, 95% and 21% of the analyzed water samples are seriously polluted and groundwater is suitable for use in irrigation purpose. Also, Devis et. al., in 2013 has determined 17 groundwater quality parameters taken from 66 different sites. Water quality was classified as class III and IV respectively are not suitable for human consumption. The toxicity of chloride in groundwater was determined by Roy *et al.,* 2015, using juvenile freshwater mussels. The survival rate of the mussels was 80% but, generally, there was poor correlation between survival and individual contaminants.

Groundwater quality can also be evaluated using a number of models. So, a feasible evaluation model and also easy to use is the one based on the radial basis function neural network (Yu *et al.,* 2015). An innovative procedure which allows the rapid processing of large data basis to asses multi-scale temporal trends towards the underground water quality was used by Srinivas *et al.,* 2015. 11 chemical parameters of the ground water taken from 15 wells located in the region of Rajasthan, India.

The paper aims to make a chemical characterization of the deep aquifer from Barlad hydrographic basin.

MATERIAL AND METHOD

In order to achieve a chemical characterization of the deep aquifer from Barlad hydrographic basin it was identified a number of drilling conducted during:

- Hydrogeological network of investigation and prosecution belonging to the National Hydrogeological System (Water basin Administration Prut - Barlad) that comes under the groundwater body ROGWPR05 - 22 pcs.
- Hydrogeological network of investigation and prosecution belonging to the National Hydrogeological System (Water basin Administration Buzau - Ialomita) that comes under the groundwater body ROGWBI12 - 3 pcs.

In Fig. 1 it can be observed the site of the boreholes national network from Barlad hydrographic basin.

These boreholes have depths between 79 and 289 m from ground surface and the total optimum flow that can be pumped from these wells belonging to national hydrogeological network is 28979.423 m^3 / day.

From each borehole water samples were taken and it was determined the following chemical indicators: H, NH_4^+, Na^+, Mg^{2+}, Ca^{2+}, K^+, CBO_5, Cl^-, SO_4^{2-}, NO_2^-, NO_3^-, HCO_3^{2-}, total hardness and fixed residue. The test results were taken from definitive hydrogeological studies found in the archive of the Water Basin Administration Prut - Barlad. These were compared with the permissible concentration required for each indicator by Law 458/2002 on drinking water quality.

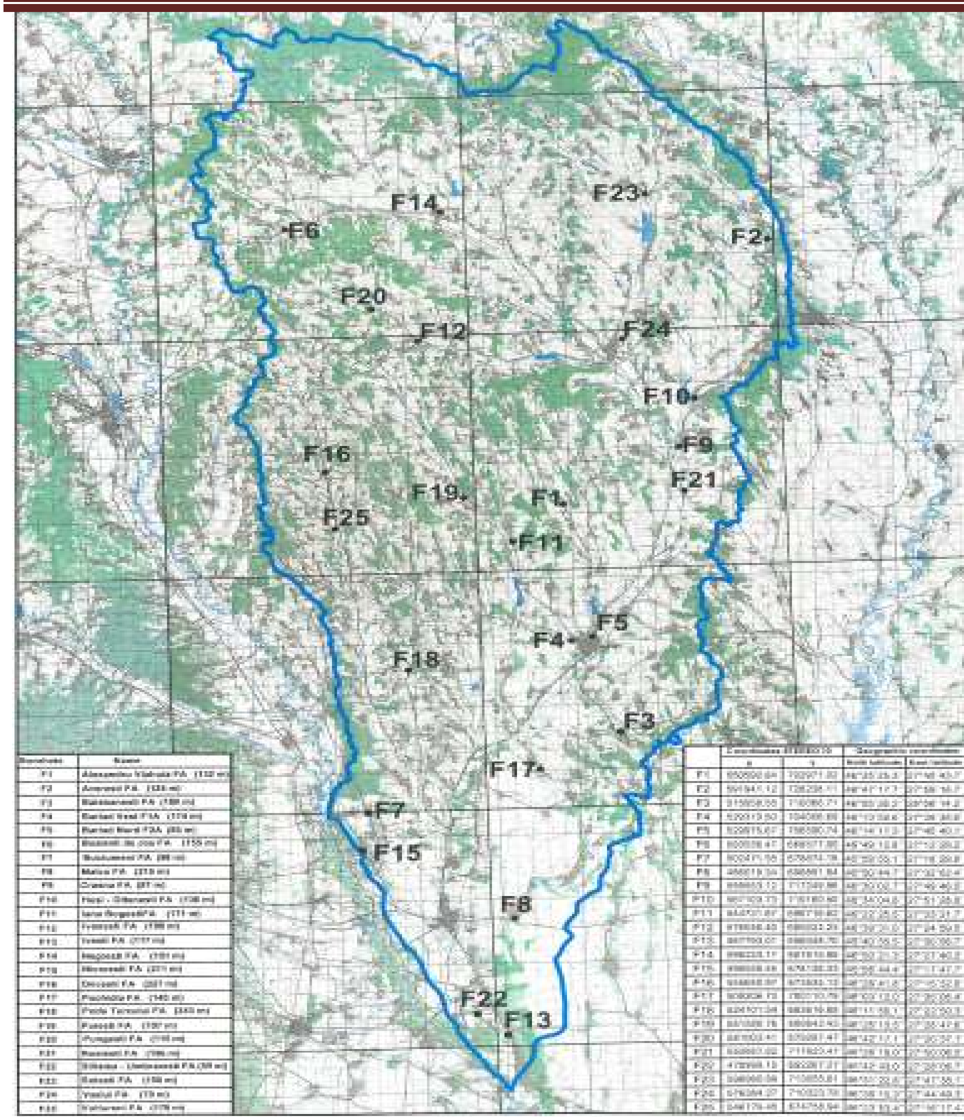

Fig.1 - Site of the analyzed 25 boreholes

RESULTS AND DISCUSSIONS

In EU there is a continuing concern to ensure a unified policy towards the issues related to water ("Framework Directive 60/2000 / EC"), whose purpose is to put into practice integrated management plans in water basins with measures allowing, especially in the case of groundwater bodies, identification, delimitation and characterization of the water bodies based on geological criteria (age of

Table 1

The results of the chemical analyzes of water samples taken from deep wells

Bore hole	Measured parameter													
	pH	NH_4^+ (mg/l)	Na^+ (mg/l)	Mg^{2+} (mg/l)	Ca^{2+} (mg/l)	K^+ (mg/l)	Total hardness	Fixed residue (mg/l)	CBO_5 (mg/l)	Cl^- (mg/l)	SO_4^{2-} (mg/l)	NO_2^- (mg/l)	NO_3^- (mg/l)	HCO_3^{2-} (mg/l)
F1	7	0.50	170.00	5.00	28.00	*	2.80	590.00	2.50	26.00	250.00	0.10	4.00	195.00
F2	7.50	0.13	*	*	*	*	45.00	*	14.07	-	*	0.11	38.00	*
F3	8.40	0.00	117.53	0.00	5.60	*	0.80	440.00	*	8.00	69.93	0.00	0.00	213.50
F4	7.00	0.71	82.00	19.00	124.00	9.00	21.80	684.00	*	48.00	226.00	0.48	16.00	*
F5	7.00	0.25	158.00	12.00	16.00	2.00	5.10	548.00	*	36.00	201.00	0.025	3.00	213.00
F6	7.50	0.13	*	*	*	*	4.50	*	*	210.00	*	0.37	0.00	957.70
F7	7.00	2.00	112.00	31.20	60.00	*	15.60	645.00	*	62.00	230.00	0.80	8.00	256.00
F8	7.50	*	80.00	101.00	160.00	6.00	45.90	1178.00	3.60	52.00	576.00	0.00	7.50	403.00
F9	7.50	0.25	210.00	5.00	8.00	2.00	2.24	*	*	46.00	32.00	0.10	2.00	488.00
F10	7.00	4.50	230.00	26.00	56.00	4.00	14.00	860.00	5.30	30.00	200.00	0.20	6.00	610.00
F11	7.50	0.08	196.00	7.20	8.00	5.00	2.80	585.00	*	16.00	183.00	0.62	0.00	329.00
F12	7.00	6.50	198.00	7.00	68.00	10.00	11.20	775.00	12.00	28.00	240.00	0.00	1.00	439.00
F13	*	*	395.00	5.60	26.00	*	*	*	*	187.00	300.00	*	0.20	810.00
F14	7.50	*	80.00	101.00	160.00	6.00	45.90	1178.00	3.60	52.00	576.00	0.00	7.50	403.00
F15	7.50	0.00	45.54	27.16	80.08	45.54	45.90	1178.00	*	20.00	41.14	0.0004	0.00	475.80
F16	7.50	0.50	100.00	16.00	24.00	2.00	7.28	370.00	*	30.00	5.00	0.10	4.00	366.00
F17	7.50	0.00	69.00	50.40	60.00	12.00	20.10	527.00	1.80	36.00	207.10	0.00	0.30	390.40
F18	7.00	*	125.00	2.00	36.00	12.00	5.60	430.00	*	26.00	63.00	*	4.00	329.00
F19	7.50	0.00	210.00	7.00	12.00	0.00	3.36	640.00	*	16.00	145.00	0.20	4.00	415.00
F20	7.50	2.00	300.00	2.00	16.00	4.00	2.80	860.00	*	20.00	246.00	0.00	4.00	512.00
F21	7.50	*	180.00	17.00	36.00	*	*	*	*	16.00	78.00	*	8.00	*
F22	7.00	1.45	237.00	22.00	52.00	19.00	12.32	913.00	6.20	25.60	211.00	0.00	0.00	220.00
F23	7.00	4.00	510.00	2.40	16.00	5.00	2.80	1400.00	*	230.00	260.00	0.20	2.00	707.00
F24	7.00	0.35	68.00	41.00	92.00	14.00	22.40	667.00	3.20	56.00	182.00	0.022	12.50	329.00
F25	7.00	0.48	159.00	38.40	8.00	18.00	10.08	640.00	1.90	16.00	192.00	0.04	1.00	402.00

Note: The values of permitted concentrations according to Law 458/2002 on drinking water quality, are: Na^+ = 200 mg/l; Cr^- = 250 mg/l; SO_4^{2-} = 250 mg/l; NO_3^{2-} = 50 mg/l; NO_2^- = 0.50 mg/l; pH = 6.5-9.5.

*Analysis were not made

water-bearing deposits, petrographic features, structural characteristics, capacity of water storage, etc.) hydrodynamic characteristics (expansion of water bodies), the quantitative status (H-level piezometric Q-flow) and quality (G-generals: conductivity, TDS, pH, alkalinity, SO - organic substances: oxygen dissolved CCO-Mn, N-nutrient nitrogen, nitrates, ammonium SP-MG - heavy metals: the list of priority hazardous substances; SP-O- organic micropollutants; CT- total coliforms, faecal coliforms Type CF, SF, etc faecal streptococci, etc.).

For these reasons now all water basin administrations in our country are concerned with the practical implementation of the framework directive and of Directive 2006/118 / EC on the protection of groundwater against pollution and deterioration. In the coming years it is expected coming over some key stages, the most important being the development of the first management plans for the river basin (surface and underground water body) and also laying down the main practical measures still required to achieve the objective "chemical status good groundwater "(within 2015).

Within Barlad basin there are 44 sources of pollution, of which 39 are wastewater treatment plants. From these the most pollutants are Negreşti waste water treatment plant, Vaslui waste water treatment plant, SC Bearings S.A. Barlad; R.A.G.C.L. Barlad; S.C. Alcohol S.A. Ghidigeni; Tecumseh City; S.C. Sugar S.A. Lieşti etc. (Panaitescu, 2008).

In Tab.1 it is presented the results of chemical analyzes on water samples collected from 25 analyzed deep boreholes. It is noted that in general, the analyzed chemical indicators are within the limits imposed by legislation. Breaches of these limits were recorded for the indicator Na^+ at 6 wells: F9, F10, F13, F19, F20 and F23, of 1.05 respectively 2.55 times and for the indicator SO_4^{2-} at 4 wells: F8, F13, F14 and F23, of 1.04 respectively 2.30 times. It is necessary for these boreholes providing water treatment plants for water to be used for drinking and supplied to the population.

The groundwater stock can be an important source of drinking water because there is a shortage of phreatic and surface water in Barlad basin and also the chemical water indicators in most of the boreholes the conditions required by Law 458/2002 on drinking water quality.

CONCLUSIONS

Following chemical analysis of the deep groundwater situation in Barlad basin, we have reached the following conclusions:

1. Deep groundwater can be an important source of water used for drinking.

2. From the 25 boreholes, 17 have permitted chemical indicators by the limits set out in Law 458/2002 on drinking water quality.

3. Of the nine inappropriate wells 2 wells (F13 and F23) do not achieve the chemical quality requirements on indicators of Na^+ and SO_4^{2-} 4 wells (F9, F10, F19 and F20) do not achieve the chemical quality requirements on indicator Na^+

and 2 drilling (F8 and F14) do not achieve the chemical quality requirements on indicator SO_4^{2}.

4. The boreholes that don't achieve the chemical quality requirements on indicator Na + (F9, F10, F13, F19, F20 and F23) requires a more advanced treatment plant and so that the cost of making the water potable are high.

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