GROUNDWATER QUALITY IN THE MIDDLE BASIN OF BEGA RIVER

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Abstract: *The quality of groundwater from medium depth fountains and drillings advances a particular importance for drinking water to inhabitants of rural areas in the middle basin of the Bega River, condidering that only some of the towns have centralized supply network, most of the localities being small. Even in localities with centralized supply, wells are still used in various domestic purposes. To characterize the groundwater quality in terms of quality were established 13 sampling points of water from wells (underground water) and medium depth drillings with an uniform distribution on the surface of the studied area, were taken into account 10 parameters to assess the state of water quality (pH, electro-conductibility, O_2, CCO_{Cr}, NO_3, NO_2, NH_4, PO_4, K and phenols). The determinations made into area and into laboratory highlight a clear distinction between the quality of water from wells and drillings. The values of pH, electrical conductivity and oxygen regime indicators for all collected samples (OD and CCO_{Cr}) are within the limits imposed by legislation (Law 458/2002 and Law 311/2004 amending and supplementing the drinking water quality). In the case of some fountains (especially those from Remetea Luncă, Nemeşeşti and Curtea), parameters such as nitrates, ammonium and phosphates, have values that exceed the LMA (maximal allowed limit). To the same samples were identified large amounts of potassium, an element that enters the water from washing soils that have applied large amounts of chemical fertilizer. The presence of these substances is due to agricultural activities (use of chemical fertilizers, livestock waste), household activities, etc. In the case of the medium depth drillings was not reported exceeding of LMA, the values of the analyzed indicator fall within normal limits. Water quality in drillings of medium depth is higher than in underground water, therefore, the quantities of pollutants in water decrease with depth increasing.*

Key words: ***ground-water, pollution, quality***

INTRODUCTION

Groundwater is *"that amount of water that lies below the surface of the earth in those areas where hydrostatic pressure is equal to or greater than atmospheric pressure"* [TEODORESCU N., 2007].

Groundwater had a special importance since far periods of history, evidence for this is first dug wells for drinking water in ancient Egypt and China.

Compared with the surface water, the underground water has some advantages: greater expansion in the area, therefore a better geographical distribution and a high quality, being under the protection of superjacent layers.

The middle basin of Bega overlaps an area predominantly rural, therefore the wells and drilling of medium depth represented the most important source of drinking water - the share of central delivery is reduced - in this context its quality is of paramount importance.

MATERIALS AND METHODS

For the study, in 2011, were set 13 points of water sampling from wells and drillings of medium depth evenly distributed throughout the surface of the middle basin of Bega, in the localities: Curtea, Nemeşeşti, Margina, Făget, Săceni, Dumbrava, Traian Vuia, Mănăştur, Ohaba Lungă, Remetea Luncă, Bethausen, Bodo and Păru. Were considered 10 parameters of

water quality assessment such as pH, electro-conductibility, O_2, CCO_{Cr}, NO_3, NO_2, NH_4, PO_4, K and phenols. The analyses were performed both in field and laboratory according to STAS in force. The values obtained were compared with the CMA under the Law 458/2002 and Law 311/2004 (Law 458/2002 amending and supplementing the drinking water quality).

RESULTS AND DISCUSSION

Following the performed determinations, there were obtained the following results (Tables 1 and 2), shown separately for underground water from wells (Table 1) and medium depth water from soil drillings (Table 2).

Table 1

Physical and chemical properties of groundwater water in the hydrographic basin Bega (the middle course)

Indicator	Sampling points from wells (villages)						Limit of variation	LMA (Law 458/2002)
	Remetea Luncă	Nemeşeşti	Făget	Traian Vuia	Curtea	Săceni		
pH	7,2	7,5	6,9	8,0	7,2	7,3	**6,9 – 8,0**	>= 6,5; <= 8,5
Electro-conductibility	1366	1117	852	981	1190	1435	**852 - 1435**	2500 µS cm-1
O_2	6,5	5,2	7,2	6,2	6,0	7,3	**5,2 – 7,3**	5,0 mgO_2/l
CCO_{Cr}	40,6	51,6	43,6	39,6	51,6	86,2	**39,6 – 86,2**	-
NO_3	86	52	47	31	39	62,2	**31 - 86**	50 mg/l
NO_2	0,21	0,27	0,05	0,09	0,25	0,05	**0,05 – 0,27**	0,50 mg/l
NH_4	0,86	0,75	0,46	0,75	1,06	0,25	**0,25 – 1,06**	0,50 mg/l
PO_4	0,96	0,75	0,52	0,61	0,66	0,36	**0,36 – 0,96**	0,5 mg/l
K	21	36	3	35	18	2	**2 - 36**	-
Phenols	-	-	-	-	-	-	**-**	0,02

Table 2

Physical and chemical properties of the medium depth groundwater in the hydrographic basin Bega (the middle course)

Indicator	Sampling points from artesian / drilling (villages)							Limit of variation	LMA (Law 458/2002)
	Ohaba Lungă	Margina	Dumbrava	Păru	Bodo	Bethausen	Mănăştur		
pH	7,6	7,9	7,7	9,0	8,6	8,0	8,3	**7,6 – 9,0**	>= 6,5; <= 8,5
Electro-conductibility	627	323	405	425	530	580	456	**323 – 627**	2500 µS cm-1
O_2	7,3	8,0	7,3	6,9	7,1	8,0	7,0	**6,9 – 8,0**	5,0 mgO_2/l
CCO_{Cr}	37,2	30,6	41,2	38,6	62,2	70,6	60,6	**30,6 – 70,6**	-
NO_3	61	36	2,0	1,5	1,3	2,2	2,4	**1,3 – 61**	50 mg/l
NO_2	0,07	0,08	0,07	0,06	0,05	0,08	0,07	**0,05 – 0,08**	0,50 mg/l
NH_4	0,22	0,28	0,18	0,22	0,36	0,42	0,31	**0,18 – 0,42**	0,50 mg/l
PO_4	0,31	0,23	0,18	0,21	0,15	0,16	0,19	**0,15 – 0,31**	0,5 mg/l
K	2	2	2	2	2	2	2	**2**	-
Phenols	-	-	-	-	-	-	-	**-**	0,02

Interpretation of the analytical results was made by comparing the values of indicators with corresponding values from Law 458/2002 to determine the potable water.

In terms of reaction the most natural waters have pH value ranging between 6 - 8.5, the deviation from these values indicates the pollution with different inorganic compounds.

In the case of the collected water samples, the pH values fall in LMA, the limit of variation, in the case of wells is between 6.9 and 8.0 and in the case of drillings the values are higher, being between 7.4 and 9.0 (figure.1).

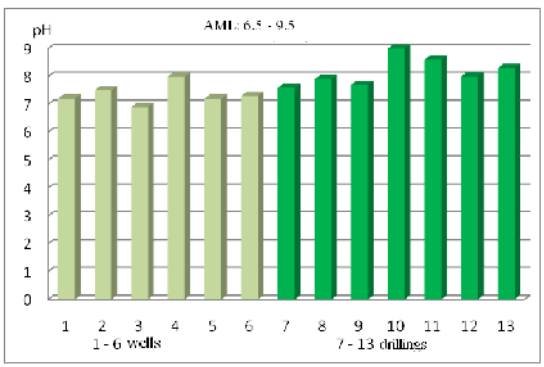

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Figure 1 – Variations of pH values

The electrical conductivity of water is one of the most commonly used indicators to assess the degree of mineralization of waters because shows us the total content of dissolved salts in water and differentiation between organic and inorganic salts. Pure water is weak electrically conductive compared to that with a high content of salts.

In the case of the analyzed water samples, the electrical conductivity has the highest values in wells, medium depth groundwater has much lower salt content, which indicates the quality status of it (figure 2). There was no determined exceeding of LMA.

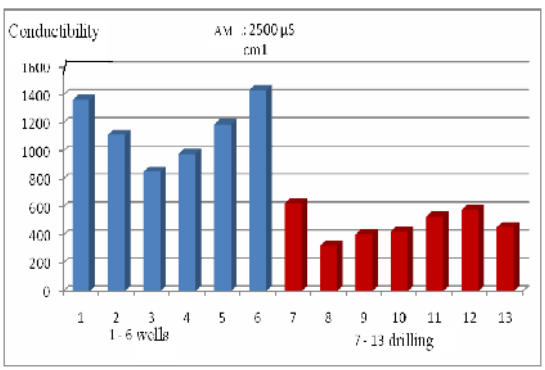

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Figure 2 – Electrical conductibility values of water from wells and drillings

Dissolved oxygen is one of the most important indicators used to assess water quality.

The low values of the amount of oxygen in the water indicate the loss of its freshness and reduce self-cleaning ability.

The analyzed water samples have values of oxygen between 5.2 - 7.3 mg/l for wells and higher values, respectively 6.9 - 8.0 mg/l for drillings, superiors to LMA by 5.0 mg/l referred to in Law 458/2002.

CCO_{Cr} has higher values in samples from wells (39.6 - 86.2) and lower values in samples from drillings (30.6 - 70.6), indicating a higher quality of water from drillings compared to water from fountains.

Nitrates are formed by complete oxidation of ammonia in the presence of nitrifying bacteria. Their presence in underground water is due largely to the contact with soil loaded with nitrates from different sources.

The nitrates concentration in the case of analyzed samples varies very widely (1.3 - 86 mg/l) depending on the water source (figure 3).

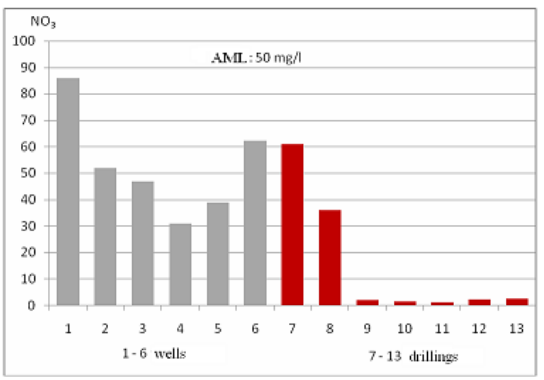

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Figure 3 - The concentration of NO_3 in wells and drillings

In the case of wells the nitrate concentration exceeds the LMA in 3 of samples (Remetea Luncă – 86 mg/l, Nemeşeşti - 52 , Săceni – 62.2), with high values in other cases. High concentrations of nitrates indicate their penetration in groundwater - the depth of these wells is approximately 10 m.

In the case of drillings the nitrate concentration is much lower, LMA is exceeded in a single location (Ohaba Lungă – 61 mg/l), which has a depth of about 30 m.

In Figure 3 results low levels of nitrates along with increasing depth from 86 mg/l for wells up to 1.3 mg/l for drillings of medium depth (50-100 m).

Nitrites come from incomplete oxidation of ammonia in the presence of nitrifying bacteria. Their presence in water is due to either bacterial oxidation of ammonia or nitrates reduction.

The nitrites concentration determined for the 13 water samples does not exceed the LMA of 0.50 mg/l (fig. 4). Similar to nitrates, higher values were recorded in wells, and in the case of drillings the nitrate content is reduced.

Ammonia appears from incomplete degradation of the organic substances containing nitrogen. Its presence in water is due to rainfall, nitrite reduction, by leaching of soils loaded with ammonia, as a result of agricultural and /or industrial activities.

NH_4 concentration in groundwater samples are above LMA in 4 of the 6 analyzed samples (figure 5), it recorded very high concentrations, by 1.06 at Curtea and 0.86 at Remetea Luncă.

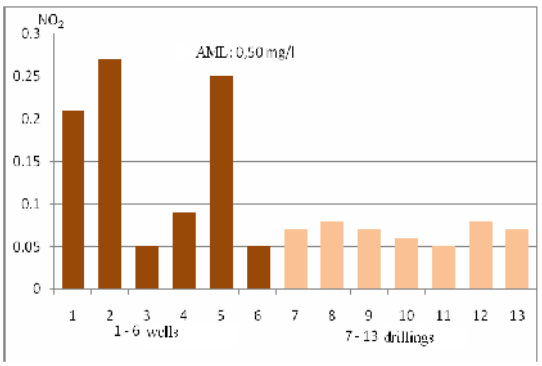

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Figure 4 – Changes in concentrations of nitrite in wells and drillings

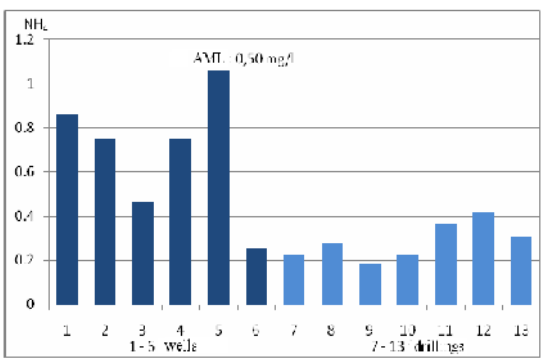

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Figure 5 – The concentration of NH_4 in wells and drillings

Water samples from drillings have values of NH_4 concentration below 0.50 mg/l as is referred in LMA (Law 458/2002), the values recorded being less than 0.40 mg/l.

In this case is highlighted the reducing of NH_4 amount with increasing aquifer layer depth (figure 5).

Phosphates present in quantities greater than 0.50 mg/l indicate water pollution with fertilizers based on phosphorus and nitrogen, with animal waste, pesticides, detergents, etc.

In 5 of the 6 water samples collected from wells was found a quantity of phosphates higher than LMA, the highest values occurring at Remetea Luncă – 0.96 mg/l, Nemeşeşti – 0.75 mg/l and Curtea – 0.66 mg/l (figure 6).

In the case of medium depth drillings were not found averages over the LMA for phosphorus, the water quality being higher than in groundwater, where pollutants can infiltrate in much larger quantities.

Water pollution due to administration of chemical fertilizers and livestock waste is emphasized by the content of K. The highest values were in the fountains from Nemeşeşti, Traian Vuia and Remetea Luncă (21 – 36 mg/l) and the lowest amount was recorded in drillings (2 mg/l).

In the 13 collected water samples there was made analyses to determine the concentration of phenols, but the acquired results are negative.

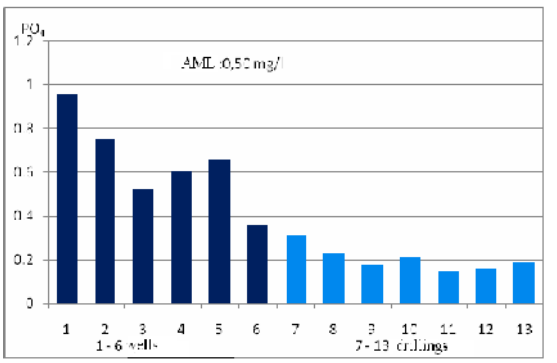

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Figure 6 – Changes in concentrations of PO_4 from wells and drillings

CONCLUSIONS

In the hydrographic basin Bega (the upper course) the water quality from wells and drillings was assessed in terms of 10 physical and chemical parameters listed in Law 458/2002.

In terms of the reaction, water samples taken from wells have pH values lower than those from drillings.

Electrical conductivity is higher in groundwater indicating a higher salt content than in drillings, where this indicator has low values, but the recorded values don't exceed the LMA.

Oxygen regime indicators (OD and CCO_{Cr}) have normal values.

Determination of nitrate, ammonium and phosphate highlights the over exceeding of LMA in the case of samples taken from wells, which indicates the infiltration of pollutants in groundwater, mainly from agricultural activities (fertilizers, livestock waste, household activities, etc.); in the case of medium depth drillings were not recorded exceeding of LMA, the values of the above mentioned indicators being within normal limits.

The values of the assessment parameters of water quality are reduced along with depth increasing (with the exception of pH, which has higher values) while water quality from medium depth drillings is higher than in groundwater, where pollutants can easily penetrate.

Overall, the water from the analyzed fountains and drillings meets the drinking water quality for human and animal consumption (excepting samples from Nemeşeşti, Ohaba Lungă and Curtea).

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