GROUNDWATER POTABILITY IN DIFFERENT AREAS OF DOLJ COUNTY

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Abstract. The global assessment of groundwater quality was determined based on the hydrological units which generally correspond to geomorphologic units existing in Dolj County perimeter. There were studied several villages located on the Danube terraces and within the floodplains, in the Jiu area and in the Pliocene, Pleistocene, and Sarmatian deep formations. There was established the quality class of groundwater.

Keywords: groundwater, water quality, physicochemical indicators, phreatic water bodies, mineral waters.

Rezumat. Potabilitatea apelor subterane din diferite areale ale judeţului Dolj. Aprecierea globală a calităţii apelor subterane a fost determinată pe baza unităţilor hidrogeologice care în general corespund cu unităţile geomorfologice existente în perimetrul judeţului Dolj. S-au luat în studiu mai multe localităţi situate în zona teraselor şi luncilor Dunării, a Jiului, a formaţiunilor de adâncime pliocene, sarmaţiene şi pleistocene. S-a stabilit clasa de calitate a apelor subterane.

Cuvinte cheie: ape subterane, calitatea apei, indicatori fizico-chimici, corpuri de ape freatice, ape minerale.

INTRODUCTION

The groundwater, an invisible resource, was one of the themes of the UN General Assembly debate, which appointed on March 22 of each year "The World Water Day". The groundwater is estimated at 99% of all liquid drinking water resources on Earth, 1% constituting the water of lakes, reservoirs, and rivers (SAVIN, 2008). Most of these waters are highly mineralized and only 45% of the groundwater reserves correspond to drinking conditions. They have several advantages, among which: they represent stable water source supply, being less affected by drought; being stored in underground tanks they do not require the construction of reservoirs; in arid areas, the groundwater is the main or only power supply; where groundwater can be used locally, the costs for transmission are saved (GAVRILESCU, 2007).

The population growth requires increased efforts in the sustainable management of water resources (reserves assessment, rational use and conservation) and they are of paramount importance in the social and economic future development of any country, region or locality (CÂRŢÂNĂ, 2005).

MATERIAL AND METHODS

Between 2008 and 2009 we established the groundwater quality, based on hydrological units, which generally correspond to geomorphologic units of the perimeter of the Jiu Basin (Fig. 1).

Thus, samples from distinct bodies of groundwater were analyzed, as it follows:

- terraces and floodplains of the Danube and tributaries are the most important groundwater body in terms of spreading the phreatic deposits and water sources. There were taken samples from Bistret, Moţătei, Bailesti localities.
- terraces and floodplains of the Jiu and its tributaries. These waters are subject to geomorphologic division in which they are stationed, creating discontinuities in their regional development. However, in terms of spread, it is the most important unit, approximately 80 km long and 5 km wide; the deposit thickness varies between 3-8 m. The studied localities are: Zaval, Malu Mare, Ostroveni.
- deep groundwater from Pliocene formations, developed both in the Jiu hydrographic basin and the Danube basin, with a large expansion in area and depth. There were studied: Sadova and Amărăşti.
- deep groundwater body from the Sarmatian formations, encountered under the Pliocene deposits, forming a synclinal from the Sub-Carpathian Depression. They are at low depths, being in the middle and rising near the land surface, in the Danube area. The studied locality is Gighera.
- deep groundwater body from Pleistocene formations. They are stationed in several aquifer layers, have small thickness of 3-4 m, have a seasonal aquifer layer, with less water, but important for the area because most of the wells tap that aquifer layer. The studied localities are Piscu Sadovei and Dobresti (SAVIN, 2001).

These waters were characterized in terms of quality indicators, oxygen regime and indicators of mineralization.

RESULTS AND DISCUSSIONS

The groundwater quality depends on their hydrogeological, hydrochemical characteristics, as well as on the anthropogenic characteristics. Thus, the water samples collected from Bistret, Moţăţei, and Bailesti localities have an alkaline nature. The oxygen regime represented by the dissolved oxygen, the consumed oxygen expressed as potassium permanganate and the consumed oxygen expressed as potassium dichromate did not meet the standards for drinking.

The total salts, hardness, sulfates, calcium, magnesium, ammonium ion, orthophosphates, total phosphorus, iron, and manganese exceed the MPC. The studied waters are of sodium bicarbonate and calcium bicarbonate nature. Occasionally, there are also magnesium bicarbonate waters, being highly mineralized.

The phreatic layers of Malu Mare, Zăval, Ostroveni are intercepted at different depths depending on the terrace level. In the old, higher, and upper terraces areas, the aquifers are found commonly below the depth of 10-15 m. In the low terrace and floodplain areas, the phreatic layer was intercepted in most cases between 5-20 m depth. The permeable deposits thickness of the phreatic horizon varies between 3-8 m. The highest thickness was found in the areas of the lower basin of the Jiu River. In the terrace areas, the thicknesses are smaller, rarely exceeding 10 m. In the phreatic water quality assessment there was also taken into consideration a number of components, which by their high content, depreciates the water quality.

On the underground flow direction, the water is enriched in salts and the fixed residue increases. It is noted also that in areas with slower hydrodynamic regime (with small slope drainage), and together with the evaporation factor from the layer, when the hydrostatic level is near the surface (under 3 m), waters are more mineralized.

In Malu Mare, Zăval, Ostroveni localities, the water pH is neutral and slightly alkaline, the oxygen regime, sulfates, calcium, ammonium, orthophosphates, total phosphorus, and manganese exceed the limits for drinking (Table 1).

Table 1. The physicochemical characteristics of phreatic water from the Danube and the Jiu terraces and floodplains.
Tabel 1. Caracteristicile fizico-chimice ale apelor freatice din terasele şi luncile Dunării şi Jiului.

Indicator	U.M.	Water body 1			Water body 2			CMA
		Bistreț	Moțăței	Băilești	Malu Mare	Zăval	Ostroveni	
Water temperature	°C	18.8	18	19.7	19	14.1	17.7	-
pH	UpH	8	7.8	7.9	7.6	8	7.6	6.5-7.5
OD	mg O_2/l	8.7	9	8.2	7.9	9	1.5	7
CCO-Mn	mg O_2/l	8.8	4.7	6.8	10.6	5.4	5	5
CCO-Cr	mg O_2/l	17.5	10.1	15.2	19.8	12.8	11.3	10
Total salts	mg/l	499	595	588	297	335	488	500
Hardness	Mev/l	6.4	8.7	8.2	3.6	4.1	6.4	5
Chlorides	mg/l	39	21.3	39.1	21.3	28.4	30.2	50
Sulfates	mg/l	123	138	119	70.1	87.8	121	80
Calcium	mg/l	109	149	141	59.2	68.8	110	75
Magnesium	mg/l	31.6	43.8	38.9	21.9	21.9	31.6	25
Sodium	mg/l	23.5	13.1	23.7	13.1	17.3	18.6	25
Ammonium	mg/l	0.341	0.132	0.876	0.349	0.287	0.163	0.2
Nitrites	mg/l	0.0015	0.0039	0.033	0.039	0.021	0.009	0.1
Nitrates	mg/l	1.48	5.5	8.63	4.86	4.45	1.29	1
Orthophosphates	mg/l	0.08	0.08	0.08	0.14	0.07	0.05	0.05
Total phosphorus	mg/l	0.17	0.21	0.17	0.37	0.16	0.13	0.1
Iron	mg/l	0.26	0.16	0.22	0.66	0.28	0.17	0.2
Manganese	mg/l	0.07	0.06	0.08	0.13	0.06	0.04	0.05

In Table 2 there are shown the physicochemical analysis of Sadova, Amărăşti, Piscu Sadovei, and Dobresti localities. The waters are neutral and slightly alkaline. The oxygen regime is normal, in the case of OD and COC-Mn. The waters are mineralized. The water is hard. The sulfates, calcium, magnesium, ammonium ions, phosphorus, iron, and manganese exceed the maximum permissible concentration.

Table 2. The physicochemical characteristics of phreatic waters from Pliocene, Sarmatian and Pleistocene formations.
Tabel 2. Caracteristicile fizico-chimice ale apelor freatice din formațiunile pliocene, sarmațiene şi pleistocene.

Indicator	U.M.	Water body 3		Water body 4	Water body 5		CMA
		Sadova	Amărăşti	Gighera	Piscu Sadovei	Dobreşti	
Water temperature	°C	15.6	16.2	17.8	15.2	16.6	-
pH	upH	7.8	7.5	7.9	7.6	8.3	6.5-7.5
OD	mg O_2/l	4.3	4.8	2.3	4.2	5.2	7
CCO-Mn	mg O_2/l	5	5.7	5.4	4.8	5.4	5
CCO-Cr	mg O_2/l	11.8	12.1	12.6	10.9	11.7	10
Total salts	mg/l	450	445	583	452	421	500
Hardness	mev/l	6.1	5.2	5.4	6.3	6.1	5
Chlorides	mg/l	29.4	30.8	113.6	30.1	31.2	50
Sulfates	mg/l	120	110	18.31	122	120	80
Calcium	mg/l	98	80.9	113.6	105	121	75

Indicator	U.M.	Water body 3		Water body 4	Water body 5		CMA
		Sadova	Amărăşti	Gighera	Piscu Sadovei	Dobreşti	
Magnesium	mg/l	30.4	28.6	62.09	30.8	31.1	25
Sodium	mg/l	17.9	15.9	1696	18.1	17.4	25
Ammonium	mg/l	0.231	0.253	0.312	0.233	0.246	0.2
Nitrites	mg/l	0.01	0.03	0.032	0.01	0.02	0.1
Nitrates	mg/l	2.16	2.81	3.95	2.19	2.91	1
Orthophosphates	mg/l	0.06	0.07	0.05	0.06	0.07	0.05
Total phosphorus	mg/l	0.14	0.16	0.18	0.16	0.18	0.1
Iron	mg/l	0.2	0.24	0.25	0.18	0.21	0.2
Manganese	mg/l	0.05	0.07	0.09	0.05	0.06	0.05

In the case of the Sarmatian formations, respectively Gighera locality, they present a higher content of total salts. Thus the sodium content (1696 mg/l), ammonium, calcium, magnesium, iron, manganese, determine the classification of these waters in the chlorosodic, iodine and bromine water class, the sulphhydric acid content being of 130 mg/l. The springs' nature can be made on account of the contact between two different geological fractions or the existence of a fault in this area, but it is not excluded any possibility of a linear output of geological units that were born at the limit of some dejection cones. The results of the tests conducted on the waters from Gighera have been represented in a Scholler diagram (Fig. 2).

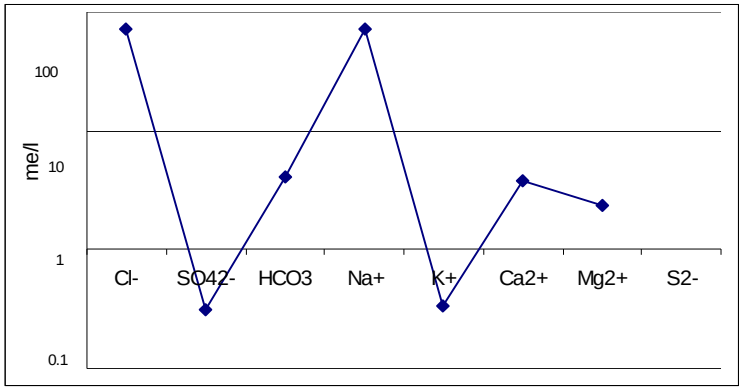

Figure 2. The Scholler diagram for major ions in the waters from Gighera – Dolj.
Figura 2. Diagrama Scholler pentru ionii majoritari din apele de la Gighera – Dolj.

Through their qualities, these waters have a pronounced mineralization and can be included on the list of mineral water resources of the country, fitting in the category of cold mineral springs of chlorosodic bicarbonate type with traces of hydrogen sulfide, waters which are suitable for therapeutic use, with therapeutic properties (spa waters and / or as mineral waters).

It would justify such financial efforts necessary for their capitalization, on one hand, and would bring to the specialists' attention these mineral waters, located in an area without tradition, but that might get the enviable valences in the resort sector, which the area in the immediate vicinity of the Danube Floodplain could acquire, with its sedative climate and through the cross border opportunities that it might offer in the future.

The high amount of ammonium ion, nitrates, orthophosphates, and total phosphorus is due to the application of nitrogen and phosphorus fertilizers (complex fertilizer). The other highlighted features depend on the formations that the waters cross.

CONCLUSIONS

The phreatic water from the terraces and floodplains of the Oltenia Plain has a total mineralization between 290-600 mg/l, depending on the lithological constitution of the aquifer horizon and store rock granulometry. It appears that where there are sands, the mineralization is higher than in the gravel area.

The most common waters are of calcic bicarbonate and sodic bicarbonate type. Gradually from north to south, there is an increase in iron content, nitrates, ammonium ion, and total hardness.

The high concentrations of ammonium ion, nitrogen, phosphorus, and pH in the Malu Mare area, is due largely to the weatherproofing of ammoniacal phosphorus water pit, in the Craiova area, infiltrated into the phreatic layer.

Only some of these waters meet the drinking characteristics, following the tapping of water deep enough so that water to be drinkable.

The waters from Gighera are suitable for curative purposes, with therapeutic properties (spa waters and / or as mineral waters).

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