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Research concerning the content of cations and anions in the groundwater of the Timis river

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Abstract In this study the objectives is the monitorizing of the cations (iron and manganese) and anions (sulfates, phosphates, chlorides) content of groundwater in the five prelevation places situated on the Timis river way, during the 2004 year. The obtained results were compared to the limit values of the chemical indicators established in actual legislation. The obtained values showed exceeding of the maximum admitted limits at points located downstream from pollution sources.The poluted sources are caused by discharge wastewater stations appeared in the sewage channel of Lugoj city and also from Bega-Timis discharge channel.

Key words

anions, cations content, chemical parameters, pollution sources

The Timis river, the richest source of water from the Banat Hydrographic space, drains a basin surface of 5677 km^2. Its length summing 244 km. Timis river has its streams on the Eastern parts of the Semenic Mountains in the Caras-Severin county. It crosses the whole Timis county, then passes to Serbia where it flows into the Danube at Panciova. The Timis river supplies Caransebes and Lugoj counties with water through the Timis-Bega chanel (Costei Hydrotehnic Knot), extra-supplies the Bega river stock for assuaring the Timisoara city need of water. Territorial spread of groundwater is presented as a continuous horizon in the low substance plain up to depths of about 30-40 m as well on terrace areas of the Timis river.[1] The mineral content of natural waters is closely related to meteorological and climatic factors. During periods of rain or melting snow river waters reduce their mineralization due dilution with very low mineral content waters. During winter, when rivers are fed by groundwater sources, their mineralization is lower (200-250 mg/l). Groundwater, in particular those of deep layers, is characterized by a higher mineralization and also less variable.[2]

Sodium and potassium are cations which, after calcium and magnesium are most common in water; in general, natural waters contain 5-30 mg/l Na si K. There are sources that contain 40-60 mg/l namely the deep waters. The fact that for some water, temporal hardness is higher than total one, reveals appearance sodium and potassium bicarbonates in higher concentrations than those of calcium and magnesium. [3] In surface water, sodium and potassium can reach levels of10-15 mg/l excluding water from salt lakes and sea, where can reach gram per liter levels.[13]

Chloride ion is present in natural waters from soil, or after pollution. Cl^- is practically not toxic to humans, even in relatively high concentrations, being necessary in human and animal diet. Chlorides in surface waters are present in relatively low concentrations of 0-30 mg/l. In groundwater from the deep strata they are present in concentrations of 5-15 mg/l. The existence in large amounts of the Cl^- in water can be caused by water washing salty soil, NaCl rocks, and penetration into surface waters due to used wastewater. [5] In this case, once with the presence of chlorides there is signals at the presence of ammonia, nutrients, increasing the concentration of organic substances and other pollutants. Chloride content in groundwater can vary between 20-250 mg/l. Starting to 500-700 mg/l, the presence of chloride in the water can be felt by organoleptic way.[6]

Sulfate ion is found in natural waters in concentrations 30-120 mg/l and is due to dissolution of mineral salts as: $CaSO_4 \cdot 2H_2O$ (gypsum), $MgSO_4 \cdot 7H_2O$, $Na_2SO_4 \cdot 10H_2O$ etc. The content of sulfate ion in industrial water is higher and varies in a relatively wide range. Increasing the sulfate ion concentration in the underground water and industrial effluents is caused by oxidation of pyrite and hydrogen sulfurates and also by using H_2SO_4 in various industrial processes.[5] Sulfate ion is not toxic, but in quantities higher than 250 mg/l in drinking water has a purgative action. Also, for higher concentrations than 300 mg/l sulphates has aggressive action, and from 800 mg/l attack the concrete construction.

Materials and Method

In Romania territory, Timis River crosses the Caras-Severin county in the right localities: Teregova, Armeniş, Sadova Veche, Slatina-Timiş, Bucoşniţa, Petroşniţa, Valea Timişului, Prisian, Buchin, Caransebeş, Jupa, Zăgujeni, Prisaca, Cărăvan (Constantin Daicoviciu) (figure 1). The quality of the Timiş river water was noticed in the five control points on the main way of the river: Slatina-Timiş, Caransebeş, Găvojdia, Cebza, Grăniceri, points uniformly distributed between the streams and the river exit point from the county, namely the Serbian border.

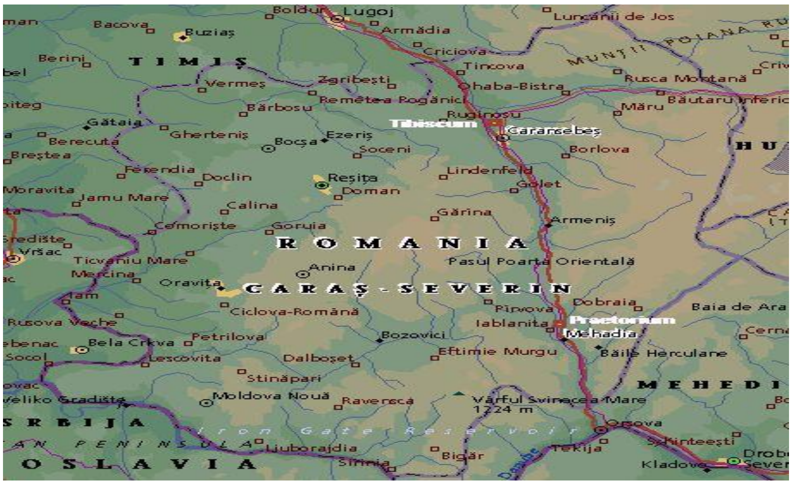

Figure1.Water prelevation points on the Timis river

The collection Slatina-Timiş point is placed on the superior water way of the Timiş river and can be considered as a reference point, being situated closer to possible sources of pollution, as the towns of Caransebeş, Lugoj or some factories and zootechnical complexes.

The collection Caransebeş point is situated near the capture plug of the water for drinking in the no.2 water works of the Caransebeş city. The Timiş river water is used for supplying the 5 infiltration basines (S=1800m²) which suplementing the underground volume of the15 drillings which assure 25 % of the necessary water of the Caransebeş city, the rest being assured by nr.1 factory which takes water from the Zerveşti accumulation.

The collection Găvojdia point is situated nearer to the river mouth of the confluence points of the Timiş with small rivers like Spaia and Nădrag and the Bistra river, possible branches of pollution of the Timiş, but before Lugoj city, an important posiblle source of pollution. At a small distance, aproximately 10-15 km in aval, there is nr. 2 drinkable water works of the Lugoj city.

The collection Cebza point is situated aval from the Timiş-Bega derivation, aval from the evacuation of the worn out waters comming from the Lugoj city sewerage, aval from the Bega-Timiş unloading channel and aval from the confluence with Şurgani (crosses Buziaş city) and Pogăniş, all posiblle source of pollution.

The collection Grăniceri point lies in the Serbian fronture, at aproximately 7 km aval from the confluence with Lanca-Birda which collects the worn out waters from the zoootechnical part of the Ciacova farm and also in aval from the pigs farm from Peciu-Nou which leaks dejections streight in the Timiş river.

The phosphates determination was done according to standard SR-EN1189-2000[11]. To obtain phosphate ion analysis from drinking waters it was used spectrophotochemical method with Vanado – Molibdat. Chloride determination was done according to standard method SR ISO 9297/01 [9]. Chloride determination was done by titration with silver nitrate using chromate as indicator (Mohr method).

Sulphate determination was done according to standard method USA 95[10]. Sulfate ion ($S0_4$) is precipitated in an acetic acid medium with barium chloride ($BaCl_2$) resulting barium sulfate ($BaS0_4$) crystals of uniform size. The $BaS0_4$ absorbance suspension is measured photometrically and sulfate ion concentration is determined by comparison with the blank. Determination of microelements Fe, Mn, of the water samples was performed in accordance with legal provisions regarding the measurement of water surface parameters by atomic absorption spectrometric method in air-acetylene flame [12]. The method is common for all analyzed elements and shall comply with standards.

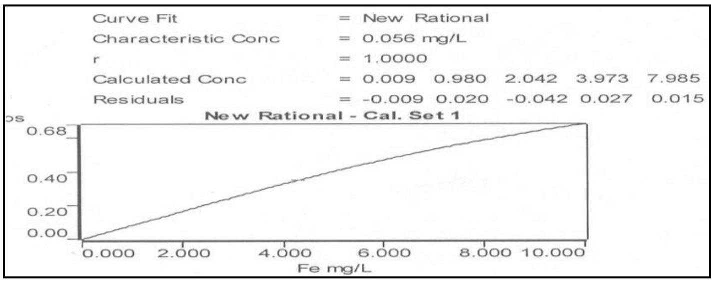

Figure 2. Etalon curve for Fe determination

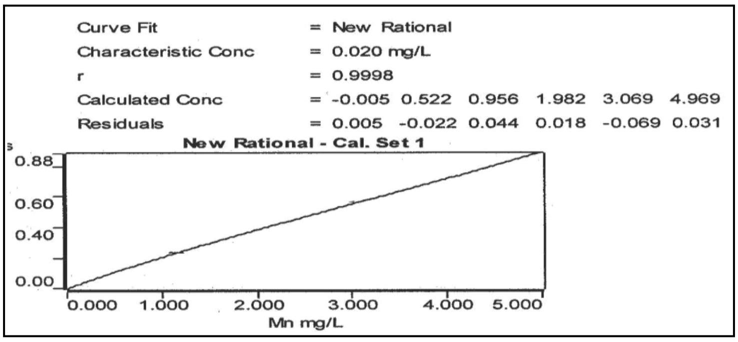

Figure 3.Etalon curve for Mn determination

Results and Discussions

The experimental results are presented in to the following tables and figures:

Table 1

Manganese content (mg/l) in water samples collected from drillings along the river Timis in 2004

Location	Ian	Apr	Iul	Oct	Media
Slatina-Timis	0.065	0.032	0.021	0.045	0.041
Caransebes	0.025	0.034	0.085	0.016	0.04
Gavojdia	0.025	0.042	0.076	0.546	0.172
Cebza	0.18	0.247	0.152	0.092	0.168
Graniceri	0.045	2.310	0.134	0.270	0.69

The content of manganese in drinking water is provided according to Law 458/2002 [4] from 50 µg/l - 0,05 mg/l. The maximum admitted value was exceeded in 2003 in Cebza and Graniceri drillings, with annual average of 0,536 mg/l in Cebza drilling and 0,126 mg/l in Graniceri. In 2004 it was maintained the increasing trend of manganese content in the two sampling points mentioned above, registering at the same time values exceeding, in July and October at the sampling point Gavojdia. The two villages (Cebza,Graniceri) are located downstream of wastewater discharge resulted from municipal sewage Lugoj, also downstream of Bega-Timis discharge channel all possible sources of pollution.[8].

Table 2

Iron content (mg/l) in water samples collected from drillings along the river Timis in 2004

Location	Ian	Apr	Iul	Oct	Media
Slatina-Timis	0.05	0.12	0.18	0.07	0.17
Caransebes	0.04	0.4	0.14	0.18	0.19
Gavojdia	3.54	0.45	1.16	0.85	1.5
Cebza	0.21	0.08	0	0.31	0.15
Graniceri	0.03	0.12	0.20	0.09	0.11

Iron content in drinking water is standardized according to Law 458/2002[4], provided at 0,2 mg/l. Gavojdia sampling point recorded maximum value for iron content, in 2004 with an annual average 1,5 mg/l. In 2003 were recorded exceeding in Gavojdia, Cebza and Graniceri prelevated points, with maximum values in Cebza point (annual average11,62 mg/l, maximum value 25,4 mg/l in April 2003).

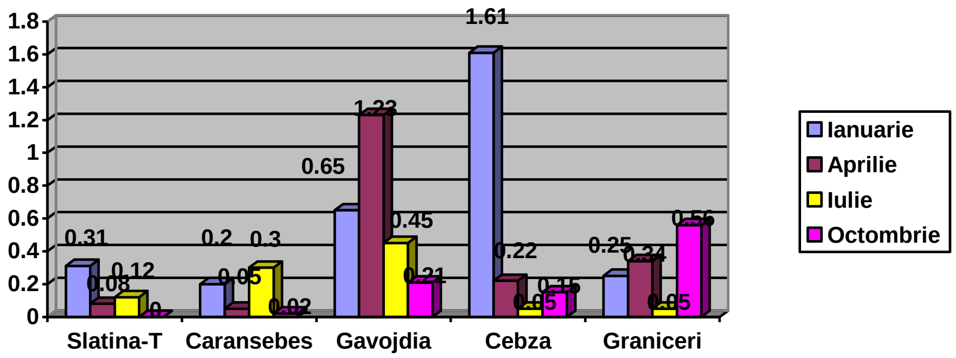

Figure 4. Phosphates content (mg/l) in water samples collected from drillings along the river Timis in 2004

Phosphate content is in surplus exceeding the maximum admited limit of 0,5 mg/l in 2004 in Cebza prelevated point (1,61 mg/l) and Gavojdia (1,23 mg/l in April and 0,65 mg/l in January).
In 2003 there were recorded exceeded of annual average values in three of the five sampling points(Gavojdia, Cebza, Graniceri) the maximum value being recorded at Cebza in January 2003 (3,75 mg/l). Increasing of the phosphate contents is attributed to decomposition of organic substances after contamination with agricultural products, detergents or other garbages. Higher levels of phosphate in ground or surface water may constitute an indication for the animal origin pollution, especially if are correlated with the development of microbial flora.[7,13]

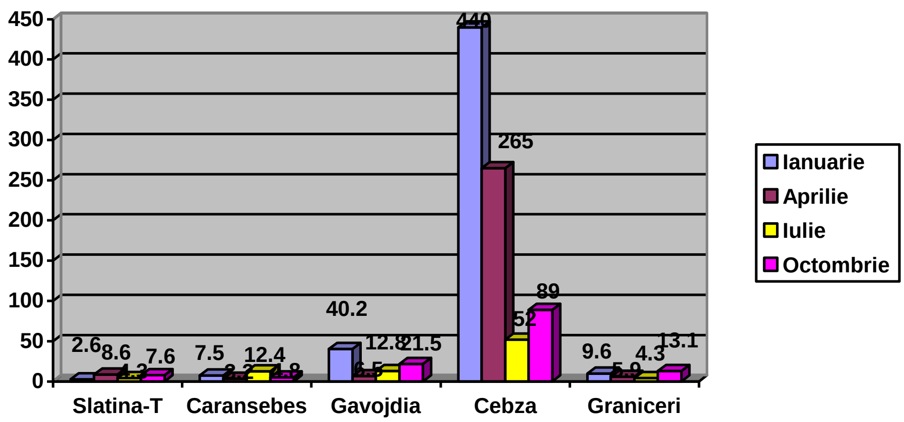

Figure 5. Chloride content (mg/l) in water samples collected from drillings along the river Timis in 2004

The maximum permissible chloride level of 250 mg/l was exceeded in the Cebza area in January 2004 when it was registered a value of 440 mg/l and 265 mg/l in April. Chloride concentrations were usually under 10 mg /l in not dried regions. At concentrations above100 mg /l the water have salty taste. Water with excess chloride is not adequate for human consumption, can have harmful effects on health. Increasing of the chloride content is due to industrial pollution or sewage. [5, 6] Chloride ion Cl^-, is present in natural waters, resulting from soil, or from pollution.

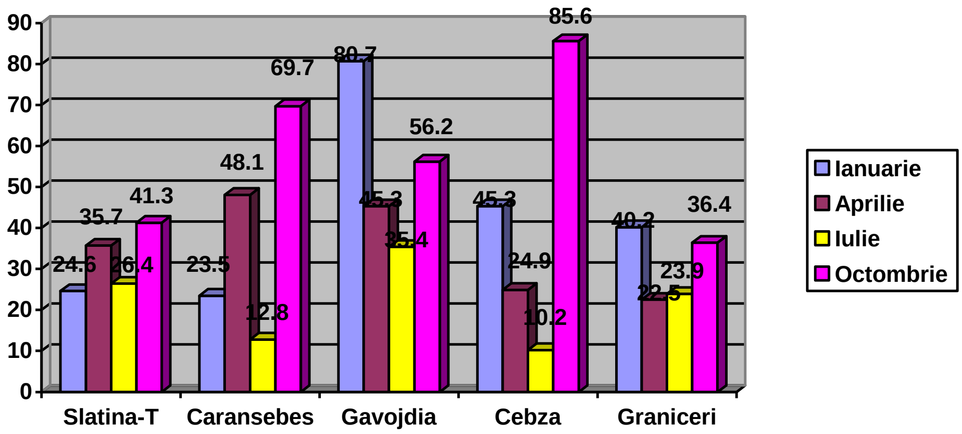

Figure 6. Sulfate content (mg/l) in water samples collected from drillings along the river Timis in 2004

The content of anions (sulfates and chlorides) in drinking water is limited to the amount of 250 mg / l, according to Law 458/2002 [4]. Sulfates content did not exceed the maximum admitted limit in any of the water samples analyzed in 2003-2004. The content of anions (chlorides, sulfates and phosphates) is exceeded in the sampling points located downstream from pollution sources.

Conclusions

The content of anions (chlorides, sulfates and phosphates) and cations (manganese and iron) indicators of groundwater pollution, presents values that exceed the maximum admitted limits in the sampling points of settlements Cebza and Graniceri. The two villages (Cebza,Graniceri) are located downstream of wastewater discharge resulted from municipal sewage Lugoj, also downstream of Bega-Timis discharge channel, all possible sources of pollution.

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