THE IMPACT OF ANTHROPIC ACTIVITIES ON BEGA RIVER

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Abstract. *Water is one of the indispensable elements of life, ensuring the living conditions of people, plants and animals at the same time, intervening in the most varied production activities, either as a source of dynamics, raw materials, working gear or transport environment, etc. Water pollution modifies the physico-chemical and biological conditions of an aquatic ecosystem, a phenomenon that can occur naturally or as a result of human activity. A particular feature of water from the rivers is the self-purification capacity. In this paper attention is paid to flowing waters (rivers), namely, to Bega river. A current issue that attracts the attention of specialists in the field is linked to water pollution caused by agricultural or industrial activities. The present paper presents the quality of the Bega River, namely on the section next to the locality SânmihaiulRomân. Sampling was made 3 times a year, respectively, in January, June and September, in 3 consecutive years, namely, year 2016, year 2017 and year 2018. The analyses were carried out by the Quality Laboratory of the Banat Water Administration and the results obtained were interpreted and compared with the physico-chemical quality standards of the Order 161,from 2006, published in the Official Gazette of Romania which allows water to be framed in a quality class from I to IV. The water samples were taken in January, June, and September for the years 2016, 2017 respectively 2018. The main quality analyzed indicators in the study are: Total chromium, copper, zinc, arsenic, barrier, selenium, cobalt, cadmium, lead, mercury, nickel, total nitrogen, nitrites and nitrates As a result of the analyses it has been noticed that higher overdoses were recorded in nitrites which framed water in IIIrd class quality and cadmium only at the level of 2016. The rest of the indicators are in category I and second, still highlighting the impact of human activity on the quality of the Bega River. Measures should be taken to limit the excess use of fertilizers on farmland, with a view to reducing the amount of nitrites in the water.*

Keywords*: water quality, nitrogen regime, heavy metals, human impact*

INTRODUCTION

Water is an important factor in ecological balances, and its pollution is a current problem with more or less serious consequences for the population. By water pollution, it is altered the physical, chemical and biological characteristics of water, produced directly or indirectly by human activities and which causes the waters to become unfit for normal use for the purposes in which this use was possible before alteration occurred. Pollution effects of water resources are complex and varied, depending on the nature and concentration of the contaminating substances. Solving these problems raised by water pollution is carried out by treatment, ensuring the necessary conditions for consumption. Natural water pollution has a smaller expanse than the anthropic one. Natural pollution is due to the interaction of water with the atmosphere, when dissolution of the existing gases in it takes place, with the lithosphere, when the dissolution of soluble rocks and living organisms in the water occurs. Anthropic pollution has a higher scale and it is due to sources of wastewater of any kind, meteoric waters, sludge, residues, navigation, etc (ADAMOV ET ALL, 2016, CRISTA ET ALL 2013, 2014).

An important source of water contamination is the landfill of waste or of various solid residues, placed on the ground, under the open skies, in irrational placed and organized dumps (MARTONOS ET ALL, 2017, SALEEM, 2017). The impurities derived from these deposits may be produced by direct training of residues in the water by precipitation or by the waters flowing through the infiltration into the soil. Particularly serious can be the cases of contamination caused by waste dumps located in the major river bed of the watercourses and carried by their calves. The most widespread deposits of this kind are the city garbage and industrial solid wastes, especially the ashes of coal-burning thermo plants, various metallurgy slags, sterile from mining, sawdust and wood waste from sawmills, etc. It may also be classified in the same category of sources of contamination, sludge deposits from sugar factories, chlorine products or other chemical industries, as well as from sewage treatment plants. The excessive use of fertilizers in agriculture leads to groundwater pollution (RADULOV ET ALL, 2016, IMBREA ET ALL, 2017).

The deterioration of water quality through pollution, associated with increasing consumption, has resulted in increasingly sustained concerns regarding the protection and conservation of water resources, a decisive factor in sustainable development. The interest of the countries of the world to prevent and combat water pollution and to ensure a healthy environment is reflected by multiple and varied actions by international organizations (governmental or non-governmental), as well as of specialized agencies of the U.N. among them, it is noted: U.N.E.S.C.O., BY THE F.A.O., W.H.O., C.E.E. between the concerns to which water protection issues are also found. " The Rio Statement" and "Agenda 21", two of the documents adopted by the United Nations Conference on Environment and Development (Rio de Janeiro, 3-14 June 1992), include, among other things, important references to the conservation and protection of continental and oceanic waters. The International Conference on Water and Sustainable Development (Paris, 19-21 March 1998) adopted a statement in which strands of action are drawn up for the judicious and efficient management of water resources, ensuring their sustainable development. During the Worldwide Reunion on Sustainable Development from Johannesburg (26 August – 4 September 2002), the common interest of all nations on environmental protection and conservation has been reaffirmed and new programs and directions of action have been established, some of which target water resources (ZHU ET ALL. 2011).

If at a national level, the overall situation of river water quality is quite good, at a regional level (hydrographic basins and rivers) there are situations of increased pollution. The main pollutant substances were represented by: chlorides, suspensions, organic elements, petroleum products, nitrogen, ammonia, hydrogen sulfide, detergents, pesticides, different metals. Surveillance of water quality in Romania is achieved through the National Water Quality Monitoring System including 5 subsystems (surface running waters, natural and artificial lakes, coastal marine waters, groundwater, wastewater). For flowing waters there is a surveillance network consisting of 320 order I sections, located on the main rivers of the country, where 25-30 of quality indicators are determined in monthly campaigns. In more than 60 sections, located on important rivers, daily determinations are carried out for approx. 12 quality indicators. The activity of protection and conservation of water quality is in complex forms and it is governed by a number of provisions contained in laws and normative acts. (VĂDEANU ET ALL, 2009)

MATHERIAL AND METHODS

In order to establish the water quality of the Bega River in Timiş County, water samples were taken from the area of Sînmihaiu Român (Figure 1). Sînmihaiu Român is a commune in Timiş County, Romania, which is located in the Timisoara Plain, on the Bega channel. The commune is located in the center of the county at a distance of 13.2 km from the city of Timisoara with an area of 88.5 sq. km (Figure 2). Comparing with the residence of the commune, there are the villages: Utvin, at 3.2 km and Sînmihaiu German, at 4,9km. Being placed in the west of the country, the climate has a temperate transition character, with warm summers, not too cold winters, quite early springs and sometimes very long autumns, receiving ocean climatic influences from the north-west and southern Mediterranean.

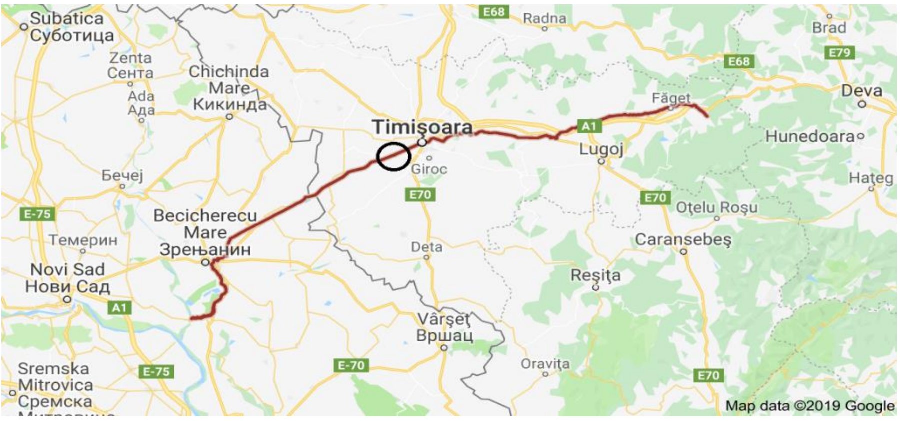

Fig. 1. The control section taken in the studio is an area marked on the the Bega River (in the local area of Sînmihaiu Roman)

Fig. 2. The section taken into account is an area marked on the Bega River (in the local area of Sînmihaiu Roman)

About the past of the commune we have little data available. The village of Sînmihaiu Roman appears in the first documentary, in 1327, and the villages of Sînmihaiu German and Utvin in 1333. The village of Sinmihaiu German, besides the German colonization that were made here in 1717 and 1808, hence the name, is famous by the natural water sources with thermal water.

The study was conducted on fourteen physic chemical indicators. Water samples were taken over three months (January, June and September) for the years 2015, 2016, namely 2017. The main indicators taken into account were those of specific toxic pollutants of natural origin: Total chromium, zinc, copper content, arsenic, barium, selenium, cobalt , lead, cadmium, Mercury, nickel, total nitrate content, nitrate and nitrate content,

The analyses were carried out by the Banat's Water Quality Laboratory of the River Basin Administration and the results obtained were interpreted and compared with the physico-chemical quality standards of Order 161 from 2006, published in the Official Gazette of Romania which allows water to be framed in a quality class from I to V.

RESULTS AND DISCUSSIONS

According to the analysis of water samples was determined that in the **year 2016** the total chromium level of water was within normal limits according to the quality class I, the smallest value being recorded in June by 0.25 μg/dm^3, and the highest value being 0.27 μg/dm^3 in September.

A decrease in the value of copper is observed, allowing the water to be wrapped in a superior class of quality. The highest value is recorded in January of 2016 with 5.55 μg/dm^3, and this value is in a continuous decline in June and September.

Zinc levels had a significant and progressive decrease. In January we have a concentration of Zinc levels of 120 μg/dm3 which makes us fit water in quality class II. During the year during the measurements carried out, the Zinc level decreased from 120 μg/dm^3 to 5 μg/dm^3 in September. The smallest value of Zinc levels is recorded in the measurements carried out in June 2016.

With regard to the Arsen indicator, we found a concentration of 11 μg/dm^3 in the first measurements made in January 2016, following a half-life in June, i.e. 5 μg/dm3. In September, a concentration of 16 μg/dm^3 was found in the measurements. Given these values, we can fit the water in quality class II.

Barium content is far above the permissible limits of quality classes I, II and III, with values ranging from 1 to 30 μg/dm^3. The smallest value being identified in January of 2016, i.e. a concentration of 1 μg/dm3. The results of the samples showed a level of 1 μg/dm^3 which makes us fit the value of January in quality class IV, namely 30 and 20 for the months of June and September in quality class V.

The results of the samples indicated a low level of selenium namely 0.5 μg/dm^3 in January, a continuous decrease of 0.41 μg/dm^3 June and 0.2 μg/dm^3 in September was recorded. Given these values, we can fit water in quality class I in EEC regarding selenium concentration.

The values on the cobalt concentration identified in the measurements for the year 2016 were as follows: 9 μg/dm^3 in January 0.5 μg/dm^3 in June and 0.4 μg/dm^3 in September. Given these values we can fit the water in quality class I.

The lead content is reduced by values below the class I quality limit, the minimum of 1 μg/dm^3 in January, following the value of 1.1 μg/dm^3 and the maximum being 1.9 μg/dm^3 in September.

With regard to the heavy metals regime, it is noted that no overviews to the concentration of cadmium are reported, nickel and lead, the values being corresponding to class I of quality, except for the cadmium value recorded in September 2016, i.e. 20 μg/dm^3, this value by making us fit the level of cadmium in a V class of water quality.

The level of mercury identified in the analysis bulletins was 0.05 in January,,001 in June and 0.002 in September. Interpreting these measurements making us fit the water in quality class I in terms of mercury content.

According to the total nitrate level we can fit the water in quality class I, respecting the values up to 1.5 mg N/dm^3, being identified concentrations between 1 mg N/dm^3, 1.1 mg N/dm3 and 1.5 mg N/dm3. The highest value being identified in January of the year 2016

The nitrites content in the water is higher, in June (0.065 mg/l) water being classified into quality class IV, in the rest of the months taken for the study, the quality of water rising up to quality class III with values oscillating from 0.06 mg/l (January) to 0.011 mg/l for September 2016.

The Nitrogen content has very good values, with water framing into quality class I. The highest value being 0.4 mg/l in June and the lowest value being 0.36 mg/l in September. In January, a value of 0.3 mg/l was recorded.

The water sample bulletins taken in the **year 2017** show that from the point of view of the concentration of total chromium, water registers within abnormal limits according to class I of quality, with values from 32 μg/dm^3 in January, following a value of 33.2 μg/dm^3 for June and 44 μg/dm^3 for September. We see a continuous increase in the concentration of the level of chromium toilet which makes us fit the water samples in quality class II.

From the point of view of the copper content it is indicated high quality water values being classified in grade A quality, retrieving values between 3 μg/dm^3 in January, 4 μg/dm^3 for June and 1.51 μg/dm^3 for September 2016

As regards the concentration of zinc level it is net lower than Class A quality parameters, following the analysis bulletins retrieving values between 9 μg/dm^3 and 28 μg/dm^3. We see an index of 19 μg/dm^3 in January, following an equivalent increase of 28 μg/dm^3 for June, following that in September we can find a more seated level even with value measured in January 9 μg/dm^3.

From the point of view of the arsenic content, the water fits into quality class III, the values being between 21 μg/dm^3 in January,28 μg/dm^3 in June following a decrease of 1 μg/dm^3 to the value recorded in June, namely 27 μg/dm^3 for September.

Barium content is far above quality class V values, identifying values in a continuous increase over the 3 months during which measurements were made: 1.81 μg/dm^3 in January, 2, 1 μg/dm^3 in June, the maximum measured being identified in the analysis bulletins of September 4.1 μg/dm^3

Selenium is recovered in a concentration of 3 μg/dm^3 in January, 0, 18 μg/dm^3 in June and 15 μg/dm^3 respectively in September. Given these values, from the perspective of the concentration level of selenium we can fit the water in quality class IV in January, in quality class I in June and in quality class V in September.

At the cobalt indicator the values recorded in the analysis bulletins fit the water in quality class I, with values ranging from 0.2 μg/dm^3, 4 μg/dm^3 and 0.15 μg/dm^3 for June 2016.

For the lead indicator, in all 3 months in which analyses of water samples have been carried out, the quality class I has not been exceeded. Values were recorded in a constant increase respectively 1 μg/dm^3 in January, 1, 1 μg/dm^3 in June and 1.9 μg/dm^3 in September.

At the cadmium indicator we retrieve a level of 0.2 μg/dm^3 in January and 0.3 μg/dm^3 for the September for quality class I. For June we retrieve a level of 0.6 μg/dm^3 for quality class II.

From the perspective of the concentration of mercury levels, the values recorded in all 3 months in which samples were taken, make us fit the water in quality class I, according to the quality standards stipulated in Order 161 from 2006.

In the analysis bulletins, for the nickel indicator, the values were below the maximum permissible level of the water quality class, retrieving the following values: 4 μg/dm^3 in January, 5.3 μg/dm^3 in June and 2 μg/dm^3 in September.

The total nitrogen concentration is the equivalence of the water quality class II. We retrieve concentrations ranging between 3 mg N/dm^3 and 5 mg N/dm^3. In January of 2016 the lowest value was recorded. For the month of June we identify almost a doubling of the concentration of nitrogen levels, and that for September we have a decrease from 5 mg N/dm^3 to 4 mg N/dm^3.

The following values were recorded for the nitrites indicator: 0,02 mg N/dm^3 in January, respectively 0.03 mg N/dm^3 in June and September, the water registers into quality class II.

The nitrogen content is equivalent to quality class II for the month of January 1.1. In June and September we see a significant decrease in nitrogen content 0,3 in June and 0,4 in September. The decrease in the concentration of nitrate levels makes us fit the values of June and September of 2016 in class I of water quality according to Order 161/2006.

In the first measurement performed in the **year 2018** of January, the total chromium concentration was 13 μg/dm^3, making us framing the total chromium level for the period mentioned in quality class I. In June and September we notice a triple of the total chromium concentration in the samples taken. We retrieve a concentration of 45 μg/dm^3 in June and 44 μg/dm3 in September. Taking into account these values, identified in the measurements of the second half of the year, we can fit the water quality from the perspective of the total chromium concentration in quality class II.

The copper content is low. We retrieve a progressive decrease in the level of copper with values ranging from 4 μg/dm^3 in January, 3 μg/dm^3 in June and respeective 1 μg/dm^3 in September.

In the first half of 2018 we retrieve a high level of zinc concentration, 189 μg/dm^3 in January and 120 μg/dm^3 in June, which makes us fit the water samples taken for the months mentioned in quality class II a. As far as the second half of 2018 we see it entering into normality. We retrieve a value close to the maximum permissible level 99 μg/dm^3 for class I quality.

The arsenic we find it in concentrations quite high so we can fit the water in quality class III. We retrieve a value of 31 μg/dm^3 in January,45 μg/dm^3 in June, namely 48 μg/dm^3 in September. We can see a steady increase in the content of arsenic over the three months during which samples have been taken.

Barium content is constant and high, 1 μg/dm^3 in all three months of sampling. This high amount of barium level makes us fit the water in the quality class IV.

The heavy metals in the selenium category, cobalt and lead do not show high values, which allows us to fit the water in quality class I. From these values we recall the following levels: Selenium with a value of 0,005 μg/dm^3 in January 0,007 μg/dm^3 in June and 0,001 μg/dm^3 in September. For cobalt we have two identical values in the months of January and September 0,4 μg/dm^3 while in June we retrieve a value of just 0.1 μg/dm^3. The lead level was decreasing 3 μg/dm^3 in January, 2 μg/dm^3 in June and a slight increase of 2.52 μg/dm3 in September.

In January and June cadmium we retrieve it in normal values of 0.1 μg/dm^3 and 0.4 μg/dm3 which makes us fit the water in quality class I. We see a significant change in the concentration in September 0.19 μg/dm^3 which makes us fit the quality of water in the second class.

The presence of mercury and nickel are found in normal values below the maximum permissible of quality class I. For the mercury indicator we have a value of 0.011 in January, 0, 1 µg/dm3 in June and 0.009 µg/dm^3 in September. For the nickel indicator we have the minimum value identified in January of 2.4 µg/dm^3, following a slight increase of 4 µg/dm^3 and a value of 6 µg/dm^3 in September.

For the total nitrate indicator we retrieve a constant value of 3 mg N/dm^3 during the three months during which samples were taken, January, June and September.

The nitrites indicator overpassing is recorded, starting with June 2018. We identify values of 0.3 mg N/dm3 in June and 0.4 mg N/dm^3 in September. These values make us fit the water in quality class II for June, namely quality class III for September.

The nitrogen content is in a continuous decline, the water frames in quality class I, retrieving values of 1 mg N/dm^3 in January, 0, 3 mg N/dm^3 in June and 0.4 mg N/dm^3 for September.

Comparative analysis of specific indicators of toxic pollutants of natural origin between the years 2016, 2017, 2018

From the comparative analysis of the three years taken into account in which the total chromium level was followed, an overpassing of quality class I it is noticed for January and September in 2016. For the years 2017 and 2018 we retrieve values between 32 and 45 µg/dm3, which makes us fit water in quality class II (Figure 3).

The copper content is low in all the months of study, so that the values frame within the limit of quality class I of the water (Figure 4).

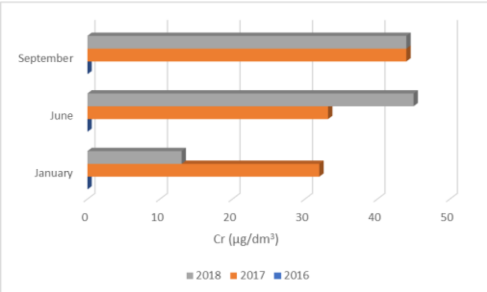

Fig. 3. Level of Chromium

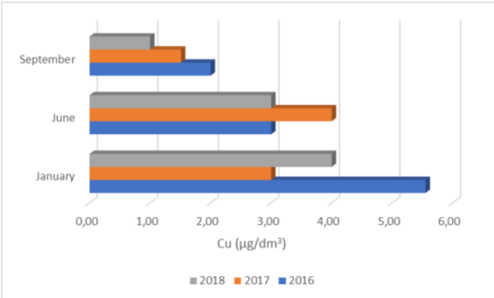

Fig. 4. Evolution of Copper

The concentration of zinc is variable. However, the limits of the water quality class II (Figure 5) were not exceeded in the study months.

With regard to the arsenic regime, a maximum permissible concentration is recorded for all three years of study, for which we can fit water in quality class II (Figure 6).

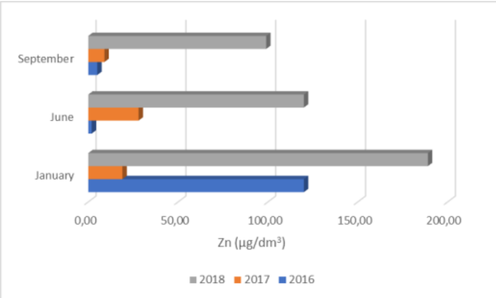

Fig 5. Concentration of zinc

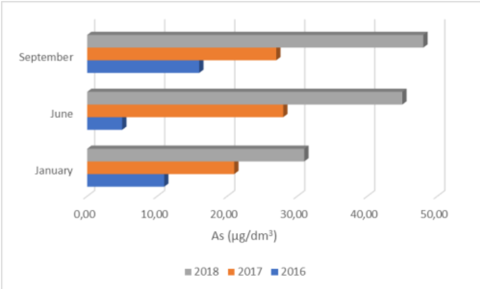

Fig. 6. Evolution of Arsenic

The nitrites content (Figure 7) shows values ranging from 0.01 mg/l to 0.4 mg/l. In all three years of study, the recorded values make us fit the quality of water in class III.

As regards to the nitrogen content (Figure 8), during the three years in which samples were taken, there was only one overrun of the quality class in January 2017, this month the level of nitrate being 1.1 mg/l, in the rest of the years in which samples were taken, the maximum concentration of nitrate did not exceed the threshold of the water quality class.

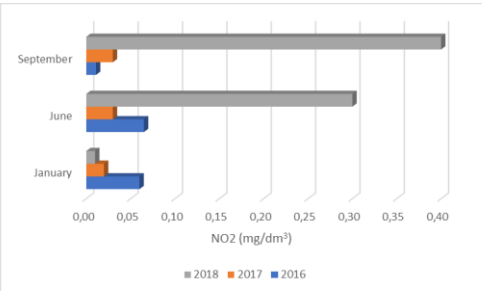

Fig. 7. Nitrites content

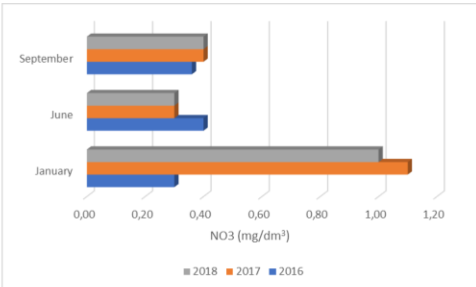

Fig 8. Nitrogen content

From the point of view of the barrium, this compound is found in very high concentrations. In all 12 months of study during the 3 years, barium concentration is much above the average level, water is in category V of water quality (Fig. 9).

In 2016, the concentration of selenium is under quality class I. We see in Figure 10 a significant increase in selenium levels in January 2017, 3 µg/l which makes us register the evidences in September of 2017 in III class water quality.

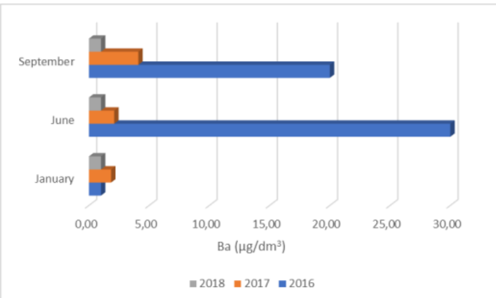

Fig 9. Barium concentration

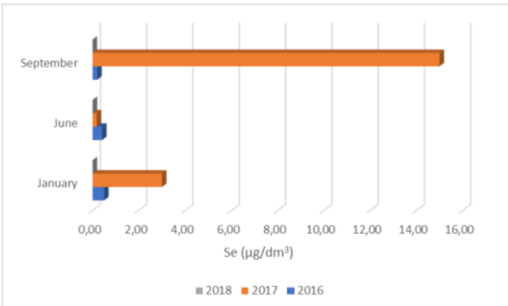

Fig. 10. Selenium levels

In January 2016, we retrieve a very high level of cobalt with a value of 9 µg/l, close to the upper limit of class I quality. In the rest of the months in which samples have been taken, the level of cobalt remain steady just below the value of 1 µg/l (Figure 11).

According to the analyzed samples, we notice that the half limit of the water quality class I (Figure 12) in terms of lead content has not exceeded.

The value of the cadmium indicator in September 2016 is very high compared to the other values interpreted according to the analysis bulletins, which makes us fit the cadmium in the III class of water quality for the month of September, 2016. In the other interpretations, we can conclude that the concentration of cadmium is most of the time above the upper limit specific to the water quality class I.

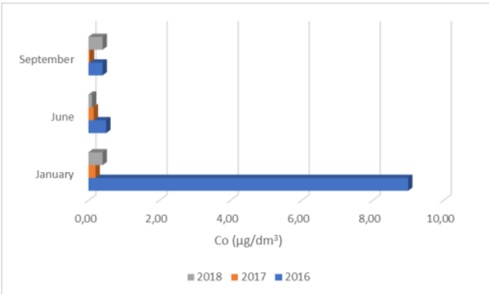

Fig. 11 Level of Cobalt

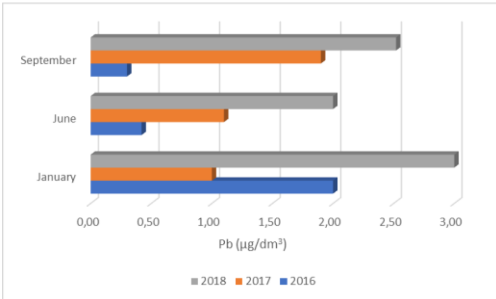

Fig 12. Concentration of Lead

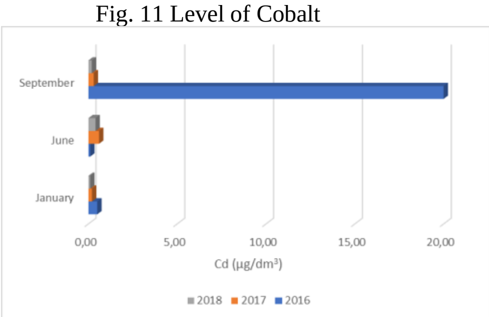

Fig. 13. Concentration of cadmium

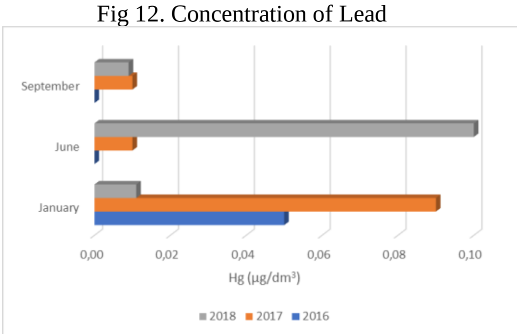

Fig. 14. Level of Mercury

In the 3 years of study, the compounds Mercury (Fig 14), Nickel (fig. 15) have been found below the upper limit of the water quality class I. Given the interpretation of the bulletins analysis, we can fit the water in quality class I, from the perspective of the nickel compound. The maximum value identified is 6 µg/l in September 2018.

For values from year 2016, the total nitrate level shall be up to the maximum permissible limits according to class I of water quality. In the years 2017 and 2018 there were significant overheads of the total nitrate level, which makes us fit the water in quality class II (Fig. 16).

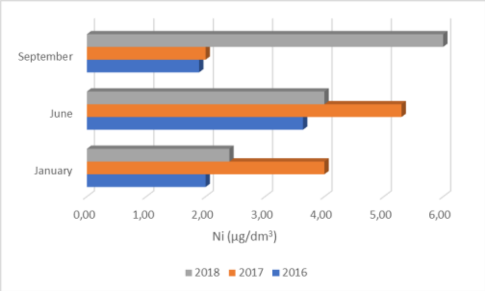

Fig 15. Concentration of Nickel

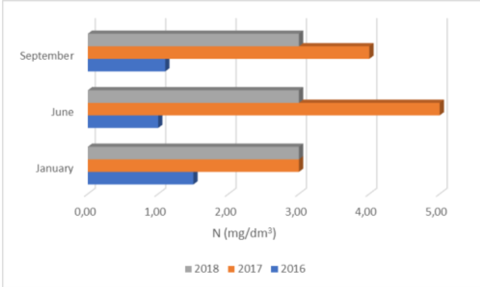

Fig. 16. Total nitrate level

CONCLUSIONS

From the comparative analysis of the three years taken into account in which the total chromium level was followed, one may notice that the quality class was exceeded for January and September in 2016. For the years 2017 and 2018 we retrieve values between 32 and 45 µg/dm3, which makes us fit water in quality class II.

The copper content is low in all the months of study, so that the values fall within the class I of water quality.

The concentration of zinc is variable. However, in the months of study, the limits of the water quality class II were not exceeded.

With regard to the arsenic regime, a maximum permissible concentration is exceeded for all three years of study, for which we can fit the water in quality class II.

The nitrites content shows values ranging from 0.01 mg/l to 0.4 mg/l. In all three years of study, the recorded values make us fit the quality of water in the IIIrd class.

As regards the nitrogen content, during the three years during which samples were taken, there was only one exceeding the quality class in January 2017, this month the level of nitrates being 1.1 mg/l, in the rest of the years in which samples have been taken, the maximum concentration of nitrate did not exceed the threshold of the water quality class.

From the point of view of the barrier, this compound is found in very high concentrations. In all 12 months of study during the 3 years, the barium concentration is much above the average level, water is in category V of water quality.

In 2016, the concentration of selenium is below the coefficient of class I quality. We see a significant increase in selenium levels in January 2017, 3 µg/l which makes us fit the evidence in September of 2017 in the IIIrd class of quality.

In January 2016, we retrieve a very high level of cobalt with a value of 9 µg/l, close to the upper limit of class I quality. In the remainder of the months in which samples were taken, the level of cobalt remained constant even below the value of 1 µg/l.

According to analyzed the samples we note that the upper limit of the water quality class in terms of lead content has not been exceeded.

The value of the cadmium indicator in September 2016 is very high compared to the other values interpreted according to the analysis bulletins, which makes us fit the cadmium in the IIIrd water quality class for the month of September 2016. In the years 2017respectively 2018 we can conclude that the concentration of cadmium is most of the time above the upper limit specific to class I of water quality.

In all three years of study, the level of mercury is classified below the water quality class I limit, the only exception being identified in June 2018.

In the 3 years of study, the nickel compound was found below the upper limit of the water quality class I. Given the interpretation of the analysis bulletins, we can fit the water in quality class I from the perspective of the nickel compound. The maximum value identified was 6 μg/l in September 2018.

For values from year 2016, the total nitrate level shall be up to the maximum permissible limits according to class I of water quality. In the years 2017 and 2018 there were significant overheads of the total nitrate level, which makes us fit the water in quality class II.

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