Quality Assessment of the Danube’s Waters in Braila

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This study compares the results of the physico-chemical analyses of metallic ions (Fe and Cr) and the biological assessment of the Danube’s waters upstream and downstream Braila. The Belgian Biotic Index (BBI) was calculated by making use of the existence of the macro invertebrates into the Danube’s waters. The Danube’s pollution by Braila town is minor, the waters being of medium quality.

Key words: Fe, Cr, Belgian Biotic Index (BBI)

Despite the features of some areas, Romania is not considered rich in terms of water resources, taking the 21st place in this respect, under existing conditions of 1700m³ of water per year per inhabitant (comparatively to 4000m³ in France and more than 3500m³ in most western states) [1].

Besides the lack of an adequate volume and irregular distribution, the quality of surface and underground waters from some hydrographic basins has been seriously affected by pollution and climatic changes.

For Braila county, the Danube River represents the biggest water resource, being used for irrigation engineering, pisciculture, and industry and water delivery for population.

The present study emphasises the results of the Danube quality assessment, during 2003 – 2005, by means of physico-chemical and biological analyses, within samples taken from the Danube, upstream (before Chiscani thermopant) and downstream Braila (on the Lipovean beach) (fig. 1).

The most important quantities of polluting substances evacuated into the environment result from the production process (SC Brailact SA, SC Soroli Cola SA), alimentary industry (butcheries) (Vegetal Trading SRL, SC Cruciani Impex SRL), animal husbandry (SC Complexul de Porci SA), pulp and paper industry (SC Celhart Donaris SA), municipal waste-waters (R.A. Apa Brăila).

Experimental Part

The sampling sites had such locations as to allow the assessment of the influence of the pollution sources with metallic ions (Fe and Cr) in Braila. The distance between the two points is of approximately 24 km, and all along this distance the Danube is an effluent for all the waste waters of the town and the industrial areas. The sites were kept as much possible on the left bank of the river, in the middle and on the right bank.

These sites had as a goal to establish the influence of the diffusion of pollutants evacuated on the left bank and of the water quality in the middle of the river and on the right bank.

The sampling frequency was once a month during a period of three consecutive years 2003 – 2005, except winter months.

The physico-chemical analyses were done for the metal ions of chrome and iron using the Spekol spectrometer in line with the standards in use [2, 3].

For the conservation of the hard metals ions, the water samples were soured at pH 3.5 to avoid precipitation and hold these ions on the walls of the sampling container. The chrome gets into the water by the industrial waste-waters pollution and it exists under both trivalent and hexavalent forms. The hexavalent chrome is more toxic than the trivalent one [4].

The hexavalent chrome determination was realized by 1,5-difenilcarbazide in line with SR ISO 11083/98 [2].

In order to determine the iron content into the water, the spectrometric method with 1.10-fenantroline is used, in line with SR ISO 6332/96 [3].

Iron is found into the water under ferrous form, resoluble as acid carbonate and less as sulphates, phosphates or silicates. Iron is also found as resoluble ferrous salts and as insoluble ferrous salts (ferrous hydroxide), as well under colloidal form composite with organic substances. The iron from water allows the development of ferrous bacteria which block the pipes. If in excess, the iron makes water taste like metal, colours it red, deposits on pipes, on dishes etc., [5].

The aquatic macro-invertebrate samples were taken up the Danube River and downstream Braila at the same time and from the same sites where the water samples were taken for the physico-chemical analyses.

The following rules were taken into account for collecting the samples:

- the samples were taken from different places, because the animal distribution is not uniform;
- in collecting the samples the nictemeral rhythm was taken into account (the experience proves that the most samples can be collected immediately after the sunset);
- the repetition of collecting samples from diverse sites is necessary in order to get high fidelity;
- the samples collected from areas with faster flow are more conclusive because the water inhabitants most sensitive to pollution live there.

There is a wide variety of collecting sample equipment, the simplest of them being the hand net and the colonisation sampler.

A method of taking samples from the deep parts of a river is the one with the standard artificial substratum, also named an instrument for the colonisation samples. There are different types, but all of them are based on the same principle, i.e. it is introduced into the water an object with many holes, crevasses and niches where the macro-invertebrates can colonize in order to be qualitatively or quantitatively evaluated.

For the water quality assessment, the colonisation instruments should be held in position for 4 weeks and there are required three reproductions in each collecting site, reproductions which lead to an adequate number of taxa extracted for data analysis and interpretation. After the sample taking, the next steps to follow focus on selection and sift. It was a solution of calcium chloride in order to separate the invertebrates from the substratum. And for an easier sorting from debris, the organisms are coloured with Bengal pink (200 mg/L) in formalin or ethanol, which also conserves them for laboratory determinations. In the case of coloured oligochets, their identification requires cleaning.

Macro invertebrate’s determinations were undertaken in site, when they were still alive, because their behaviour and the environmental characteristics help to do this, but for certain cases their conservation was required to be studied under microscope.

For the assessment of the Danube’s water in Braila, by means of the Belgian Biotic Index which uses the aquatic macro-invertebrates, there were taken samples of macro invertebrates monthly during a period of three years, 2003 – 2005, from March to November. To identify the macro invertebrates there were used determiners as well Internet sites with macro invertebrate photographs [6-8].

The Danube has a wide, muddy river bed, sandy or rocky on the edges. The water is deep, slow on the banks and faster towards the middle of the river. Moreover, the water is rarely clear, the pollutants dilution is realized fast enough and thus, the auto purification process is done.

The biological method used for the Danube’s waters quality assessment in Braila is emphasised by the Belgian Biotic Index (BBI). To calculate the BBI, it is required the standard table 1.

Results and discussions

Comparing the variation of the hexavalent chrome ion concentration during the three year period of study, no general tendency was noticed, each year having its characteristics. Notwithstanding this, the monthly chrome concentration is maintained under the admissible maximum value.

In 2003 Braila city contributed to the increase of the chrome concentration during the summer months, but there appeared downstream a tendency of the hexavalent chrome concentration diminution, mainly by the increase of the dilution produced by the 2005 autumn rains.
Regarding the concentration of the iron ions, there was noticed a 10-time overrun of the admissible maximum value in 2003; as opposed to that, only a 2-time overrun occurred in 2005. All the determinations lead to the conclusion of an auto purification of the Danube’s waters between the sampling places, with some exceptions. In 2005 the spring floods and the autumn rains led to a significant decrease of the concentration of the iron ion as compared to 2003.

If we compare the medium values of the two chemical indices which characterize the Danube pollution in Braila between 2003 – 2005, there can be noticed a decrease of the medium value of the chrome downstream Braila, as compared to the medium value of the same index obtained upstream, except the year 2003, when Braila little contributed with composites of chrome to the Danube pollution.

In the case of the iron ions, there can be noticed a 7 to 11 overrun of the maximum admissible concentration, except the year 2005, when as a result of the heavy rains,
there occurred a decrease of the iron ion by dilution, but it does not go under the maximum admissible value.

Conclusions

From the physico-chemical analyses undertaken for the Danube’s waters upstream and downstream Braila, during 2003 – 2005, for the chrome and iron ions, there can be noticed that the medium values of the iron ions overrun the admissible maximum limits, and this places the Danube within the third or fourth quality category (according to the Decree 161/2006) [11].

The evolution of the river waters quality in 2005 as compared to the previous years is not different and places the Danube within the second quality category, where it belongs. As a result of the heavy rains in 2005, which probably carried alluvia with high content of iron, as well of the antropic actions upstream Braila, from the figure no. 4 there can be noticed an overrun of the admissible maximum concentration, but not as high as in the previous years because of the dilution.

From the figure no.5 comprising the medium values of the Belgian Biotic Index for the years 2003 – 2005, there can also be noticed that the Danube is placed within the category of little or medium polluted waters. The values of the two indices decrease as a sign that the pollution is more pronounced only during the summer months when the evaporation is high, the dilution is little, and Braila town over-flows into the Danube a higher quantity of waste waters.

The results of the biological evaluations were compared with the ones from the physico-chemical analyses. The result was the same: a medium pollution, Braila town having no significant contribution to the pollution of the river waters.

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