VARIATION IN TIME AND RELATIONSHIP BETWEEN TURBIDITY, NITRATES AND MICROBIOLOGIC PARAMETERS IN SOURCES OF DRINKING WATERS

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Abstract

The study broght in question three characteristic parameters of waters, respectively the turbidity, nitrates and microbiological particles (Microbian Colonies and Total Coli), determinated in main water sourses before treatment to convert them in drinking water. The measurments of parameters was effectuated for one year from three sourses (groundwaters and CRISul Repede river water) at the water factories from Oradea. The turbidity was found to be more different from each source of water to other and it was significanlty higher in Crisul Repede river. Nitrates concentration was very closely for all sourses in the same sampling time, easily higher in underground waters, and its variation in time was in the same manner for all, with higher concentration in spring and lower concentration in mounths of autumn. The number of Coli and microbian colonies was counted only in underground waters and was higher in summer and less in winter months. It found a clear relationship between turbidty and number of microbiologic particules for whole study period, but a clear involvment of turbidity in evolution of nitrate concentration was difficult to apreciated.

Key words: drinking water, nitrate, turbidity, monitoring, microbiological

INTRODUCTION

In this paper, we intend to follow the time variation of physical, chemical and microbiological parameters of the main water sources used for supply with drinking water in Oradea. The monitoring program of the water quality at the treatment stations was effectuated from main sources of each drinking water factory: SP1 with a total flow of 22593 m^3/day and SP4 with 17996 m^3/day. At SP1 85% comes from groundwater and 15% of Crișul Repede, while SP4 is supplied only with groundwater (Ionescu, 1996). Due to the involvement of water form Crișul Repede river to SP1, our interest was focused on the analysis of water samples from SP1, SP4 and CRIS (Edzwald., 20011). Monitoring of waters from SP1, SP4 and CRIS was effectuated since July 2013 to May 2014 and the variation of turbidity, nitrates and Microbial colonies and Total Coli were followed (Mănescu et al., 1994). How turbidity was involved in variation of other studied parameters was another aspect discussed in this paper (Trofin, 1983).

Turbidity is due to the presence in water of small particles in suspension which settles within very long time, or remain unsedimented. Particles in suspension can become support for microbial species (Mann et al., 2007). High values of turbidity in water may present epidemiological risk (Satterfield, 2006). Nitrates are oxidized produce of organic and inorganic nitrogen from inorganic, organic or biologic structures and their monitoring is necessary for preventing possible healthy problem (Thompson et al., 2007).

MATERIAL AND METHOD

Determination of microbiological and physicochemical parameters was performed in the Laboratory of Drinking Water from water Company with RENAR license because is applied a quality management in conformity with standard EN ISO 17025/2005 effect on general requirements for the competence of laboratories testing and calibration. Sampling, preservation and travel of water samples was done complying with internal procedures of the laboratory. Determination of turbidity was carried out with a turbidity meter type Hanna HI 88713. Determination of nitrate was performed always on the day of sampling with a double-beam UV-VIS spectrophotometer, type T 60 (Mănescu et al., 1982). The number of Microbial Colonies was determined after inoculation on culture medium for 48 hours, thermostated at 37°C (Dufour et al, 2003). Total Coli was counted because the most important source of bacterial pollution of water providing from the animal and human waste. Total Coli was determined by both presumptive and confirmation tests, based on the fermentation of lactose to lactic acid or CO_2, in 48 hours at 37°C (Figueras et al., 2010).

RESULTS AND DISCUSSION

In Fig. 1 registered average values of turbidity of water samples taken at studied points: SP1, SP4 and CRIS. The lost water turbidities were found to SP1, and the highest values were recorded for CRIS samples. For absolutely all samples, average values of turbidity were found under permissible limit (<5 NTU). However there, maximum values over the permissible limit were recorded only for CRIS water in January and February (Legea nr. 311/2004, Hotărârea 100/2002).

Recorded values of turbidity were included from 0.42 (May) to 0.58 (September) for SP1, from 0.64 (August) to 1.18 (May) for SP4 and between 1.74 (September) – 2.58 (August), NTU unities.

In Fig. 1 it can see that the average values of turbidity remained almost constant in water samples from SP1, and the higher turbidity was recorded in September. For samples from SP4, turbidity was slightly higher than SP1, with a slight increase in November and December, respectively in spring. Values significantly higher of turbidity were observed in samples from CRIS. The maximum turbidity was reached in July. The turbidity decreased slightly from August, increased to February and decreased again for spring months. The variation of turbidity in time had different evolution for sampling points SP1, SP2 and CRIS (Fig. 1) because the involvement of the external factors was not felt in the same mode.

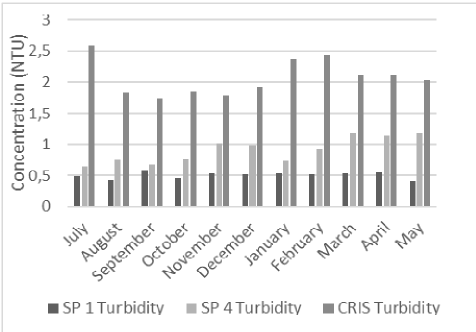

Fig. 1. Variation in time of avarage values of turbidity sampling from SP1, SP4 and CRIS

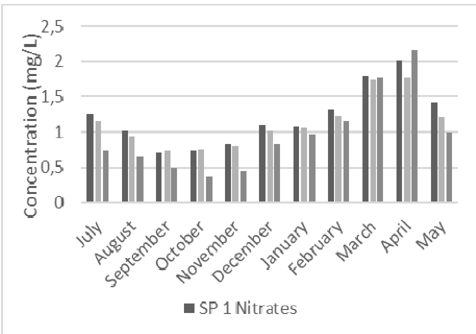

Fig. 2. Variation in time of avarage values of nitrates sampling from SP1, SP4 and CRIS

In Fig. 2 can be seen a good similitude between nitrate concentrations of all three water sources and the results from all samples were less than the recommended limit of nitrates in drinking water (<50 mg/L) (Legea nr. 311/2004, Hotărârea 100/2002). Nitrate concentrations decreased slightly from July to November, after which it begins to rise, reached to a maximum in April and in March returned to levels comparable with those of July. Basically, the lowest nitrate concentrations were recorded in the autumn, and the highest in spring. Almost all the time studied nitrate concentration was higher for both SP1 and SP4 than for CRIS samples, except in the spring, in April and May. The values of nitrates concentration for those sampling points were recoded in the next ranges: 0.72 (September) – 2.01 (April) for SP1; 0.75 (September) – 1.76 (March) for SP4; 0.37 (October) – 1.76 (March) for CRIS, mg/L units.

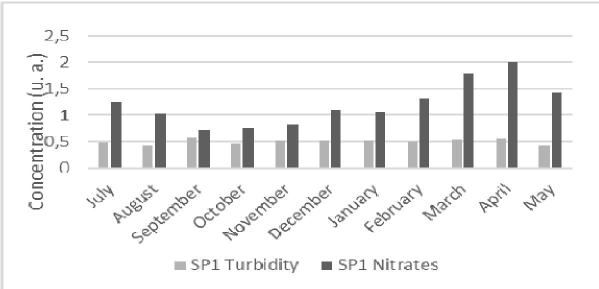

Fig. 3. Comparative variation in time of both turbidity and nitrates from SP1

In the case of the comparative study between the turbidity and the nitrates concentration for all sampling points, SP1, SP4 and CRIS, it was not found a linear variation of these two parameters. It was difficult to found a correlation between turbidity and nitrates in this situation (Fig. 3-5). For SP1 samples (Fig. 3), nitrates concentration recorded values in a large field, in spite that turbidity had a small variation in time.

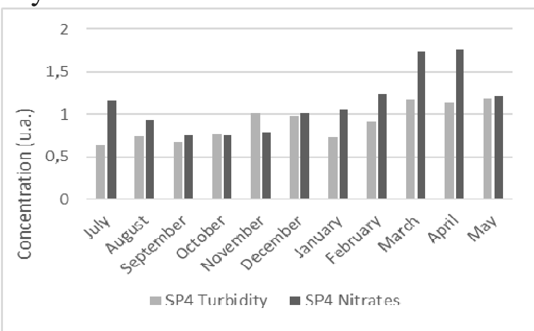

Fig. 4. Comparative variation in time of both turbidity and nitrates from SP4

Instead, in Fig. 4 it was observed a single range in which the increase of both nitrate concentrations and turbidity took place after a rule, from January to April. For water sampling from CRIS, the variation of nitrates concentration and turbidity took place in a similar mode, but not in the same time and it was saw a gap between these two parameters.

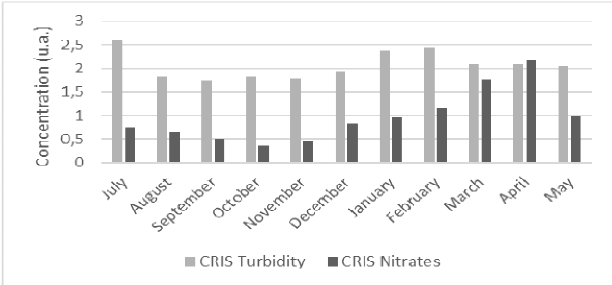

Fig. 5. Comparative variation in time of both turbidity and nitrates from CRIS

After microbiological analyzing, the concentration of *Microbial Colonies* and *Total Coli* was determined from S1 and SP4 (Fig. 6). Under the legislation *Coli* is not allowed to be present in drinking water, and the maximum number of *Microbial Colonies* accepted in water for consumption is 100 (at 27 °C) or 10 (at 37 °C) (Legea nr. 311/2004, Hotărârea 100/2002).

The number of *Microbial Colonies* found in waters sampling was ranged from SP1 from 1.13 (February) to 5.0 (September), while in sampling from SP4 were counted between 3.0 (February) and 20.25 (September). The number of *Total Coli* was varied in SP1 samples from 0 (January - March) to 1125 (September) and from 0 (January and February) to 3375 (September) in SP4 samples.

As can be seen in Fig. 6 the highest concentrations of *Microbial Colonies*, including *Total Coli* were recorded in water samples from SP4, especially in September. Both SP1 and SP4, a greater number of *Total Coli* was counted in the summer months, when owing to increase the biological and biochemical activity, the proliferation of microbiological colonies was stimulated even in the groundwater (Figueras et al., 2010). Unfortunately, the number of *Total Coli* was positive in almost months except February and March. So *Microbial Colonies* and *Total Coli* were greater numbers in sampling waters from SP4 than SP1 (Fig. 6) (McFeters, 1990).

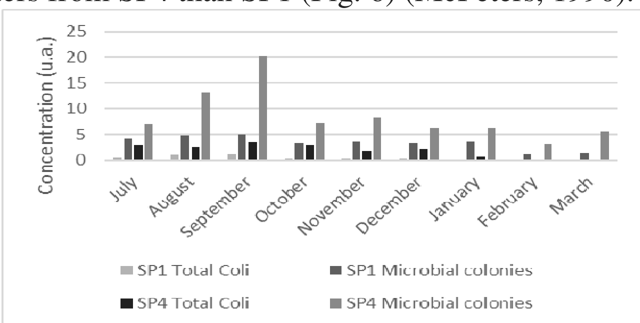

Fig. 6. Variation in time of avarage number of *Microbial coloniess* and *Total Coli* in sampling waters from SP1 and SP4

From graphic recorded in Fig. 7 it was possible to observe a comparative evolution in time between turbidity and microbiologic parameters in sampling waters from SP1 for the whole study period. There had to see an ascendent evolution of the number of *Microbial colonies* and *Total Coli* in summer months, from Julie to September in accord with the turbidity behaviour.

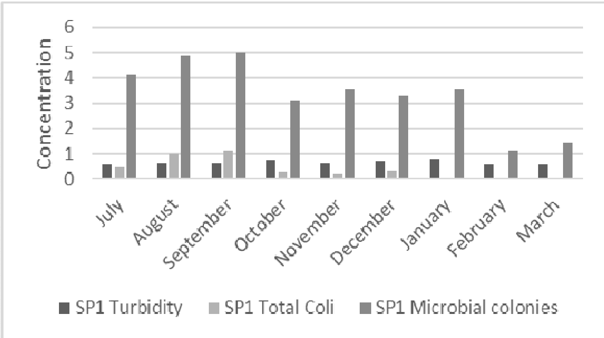

Fig. 7. Comparative variation in time of turbidity, *Microbial colonies* and *Total Coli* for water samples from SP1

In Fig. 8 was taken in discussion the similar variation between turbidity and the concentration of coliform in samples from SP4. The highest number of *Microbial Colonies* and *Total Coli* were recorded in the summer months, when turbidity was higher, and the lowest number was found in the winter.

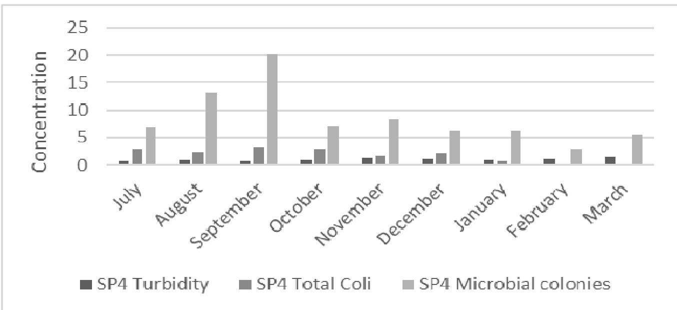

Fig. 8. Comparative variation in time of turbidity, *Microbial colonies* and *Total Coli* for water samples from SP4

CONCLUSIONS

The turbidity of water is within normal limits for all three sources of the analyzed water. It was found to be lower for groundwater from SP1 and SP4 than from the surface water, CRIS. The large differences between studied sources for turbidities values and its variation in time proved that influencing factors acted differently. Furthermore, the turbidity of Crisul Repede river (CRIS) was higher throughout time and more varied because it was stronger affected by external environmental factors (rainfall, the ground, pollutants) (Satterfield, 2006). Nitrate concentration had the same trend for all three sources, it was minimal in the autumn and maximum in the spring months. The increase in nitrate concentration can be associated with an increase of oxidative activity in spring and the consumption of nitrates as a source of oxygen in autumn. Very small differences between the concentration of nitrate from SP1, SP4 and CRIS must show that they depend largely on the specific area and soil composition (Bartram et al., 2011). The largest variation of nitrates concentration in sampling waters was obtained from CRIS. This is not surprising because the surface waters are in direct contact with possible sources of nitrogen, biological decompositions or for transformations due to the presence of pollutants, such as chemical fertilizers (Thompson et al, 2007). For groundwater SP1 and SP4, nitrogen sources were limited and the interchange with the external environment was carried out in a lesser extent. Unfortunately, a connection between turbidity and nitrate concentration was impossible to developed in the terms of this study. Although the increase in the turbidity engaging the train of particles had to be a source of nitrogen, they might be converted into nitrates after oxidation. And the oxidative destruction of organic materials resulted in a longer time, such that a gap between the time the turbidity is high and increases the concentration of nitrates (Edzwald, 2011).

The presence of *Microbial Colonies* and *Total Coli* was found to be in small number, solvable by conventional treatment of drinking water used in water stations from Oradea (Dufour et al., 2001). Increasing of the turbidity, especially in summer months, accompanied by higher temperatures, characteristic for this period of the year, were contributing factors to a greater number of *Microbial Colonies* and *Total Coli.*

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