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The importance of monitoring the quality parameters of surface water and ground water in order to treat them for obtaining potable water

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Abstract. In the sustainable management of natural and artificial resources, the management of drinking water has a very important and direct impact on the population`s health. The analysis of the organoleptic characteristics, physical, chemical and bacteriological analysis in relation to the quality conditions as recorded in the specific rules is a way to prevent biological disasters that may produce the water in the field of infectious and non-infectious pathology. In this paper we present issues related to the monitoring of the main physical-chemical and bacteriological parameters of raw water used as source in water treatment plant from Bistrița City as well as undeline the need to improve methods for cleaning water destinated to human consumption, food industry and aquaculture.
Key words: drinking water, monitoring, water quality.

Zusammenfassung. Das Management des Trinkwassers spielt, im Rahmen des nachhaltigen Managementes der natürlichen und beünstlichen Vorräte, eine wichtige Rolle durch die unmittelbare und besondere Auswirkung auf die Gesundheit der Bevölkerung. Dea Analyse der organoleptischen, physikalichen, chemischen und bakteorologhischen Eingenschaften des Wassers ist im Verhaltnis mit den Qualitätsbedingungen, die in den Standarden und spezifischen Normen vorgesehen sind. Diese Versuchsmethoden benachrichtiden die biologischen Katastrophen, die das Wasser im Bereich der ausgedehnten stechenden und nichtstechenden Pathologie hergerufen kann. In dieser Arbeit stellen wir Aspekte vor, die in der Zusammenhang der Forsetzung der wichtigsten physikalisch-chemischen und bakteorologhischen Parametern des Rohwassers sind. Das rohe Wasser ist die Quelle der Wasserwerke aus der Stadt Bistrita. Auf weiter sind noch die Nötigkeiten der Verbesserung von methoden für die Trinkbarkeit des Wassers vorgestellt. Das Trinkwasser ist für das Trinken, in der Lebensmittelindustrie und Aquakultur verwendet.
Schlüsselwörter: Trinbarkeit, Fortsetzung, Wasserqualität.

Rezumat. În cadrul managementului durabil al resurselor naturale şi artificiale, managementul apei potabile ocupă un loc important prin impactul deosebit şi direct asupra sănătăţii populaţiei. Analiza caracteristicilor organoleptice, fizice, chimice şi bacteriologice în raport cu condiţiile de calitate înscrise în standardele şi normele specifice este un mijloc de prevenire a dezastrelor biologice pe care le poate produce apa în cadrul vastei patologii infecţioase şi neinfecţioase. În lucrarea de faţă prezentam aspecte legate de monitorizarera principalilor parametri fizico-chimici si bacteriologici ai apei brute, ca sursa de alimentare a statiei de tratare a orasului Bistrița, cât şi necesitatea îmbunătăţirii metodelor de potabilizare a apei, apă utilizată pentru consumul uman, în industria alimentară şi în acvacultură.
Cuvinte cheie: potabilizare, monitorizare, calitatea apei.

Introduction. An important role in the existence of any locality is the drinking water supply, with appropriate quality, in sufficient quantities that people need for drinking, in the food industry, or in aquaculture. In this paper we have taken into consideration the drinking water supply for the Bistriţa city.

The hydrographic network of Bistriţa-Năsăud County is made up of rivers, lakes, ponds and significant reserves of groundwater. All these waters which cross the county are tributary to Someşul Mare river with a total length in the county of 119 km and with total area of 5033 km^2 (Pop 2001). The still waters are available in the form of natural and artificial lakes (Mac 1978). The biggest artificial accumulation of water in that area is Lake Colibiţa (75 million m^3).

The lakes that have a high fisheries potential and which are benefiting from aquaculture facilities are: Manic Lake, Budurleni Lake (locality Teaca), Brăteni Lake (locality Sânmihaiu de Câmpie), Fiad Lake, Colibiţa Lake (locality Bistriţa Bârgăului) (Ujvari 1972).

The existing schemes of arrangement for drinking water supply to the Bistriţa city include the following works: Cuşma source consisting in underground water from springs and surface water from the Geamanu river and the Bistriţa source consisting of surface water from Bistriţa river. Cuşma water source meets all conditions for a good quality drinking water (see Table 1).

Table 1

The quality parameters of water from the source Cuşma

No	*Quality indicator*	*U/M*	*Value*
1	pH	-	6.8-7
2	Permanent hardness	ºd	2-3
3	CCO-Mn	mg/l	1.1-1.5
4	Dissolved oxygen	mg/l	13.0
5	Ammonium	mg/l	-
6	Turbidity	NTU	0

Water from river Bistriţa is used as drinking water after purification in the treatment plant since 1970 and following steps of treatment have been imposed: decantation, filtration and chlorination. The main purpose of this paper is to show the quality level of raw water used for obtaining drinking water, water for food industry and for aquaculture.

Material and Method. The study was conducted for the period 2004-2007 and endorsed the change in the parameters of drinking water during the months of spring, summer, autumn and winter. The main parameters of drinking water taken in the study were: turbidity, ammonium, nitrites, nitrates, sodium, germs, faecal coliforms, total coliforms, For each parameter there have been emphasized the average quarterly values corresponding to years from 2004 to 2007. The purpose of the tests is to determine the organoleptic characteristics, physical-chemical, biological and bacteriological analysis in relation to the quality standards contained in the specific rules.

The quality requirements for drinking water are regulated by Law 458/2002, with subsequent amendments. Bacteriological analysis is done under the norms STAS 3001/1991, under the permanent control and authority of public health in the surveillance program.

The microbiological quality of water is a major concern because of the risk of disease. However, in case of failure in the necessary conditions (laboratory and qualified staff) will be allowed to replace the bacteriological analysis with the free residual chlorine, this being stipulated by mutual agreement between Inspectorate of Public Health and the manufacturer of water.

The physical-chemical analysis are particularly important in the case of water sources exposed to pollution: industrial, agricultural and municipal discharge (Reid 2003). Chemical quality of water may also present a major risk for the health of the population (Bucur 1999). The recommended indicators differ depending on the source, station for treatment, storage tanks, and the distribution network (Roșu 2007). The determination of residual chlorine is made at the harvest under standardized methodology (STAS 6364). If the concentration is below the maximum allowed concentration (CMA) of 0,5 mg/l, it will be increased in order to reach this value at the end of the distribution network.

The indicators of drinking water that must be investigated are:

• microbiological: total coliforms, faecal coliforms, faecal streptococci,
• free residual chlorine and related,
• minimal physical-chemical indicators.

Results and Discussion. Water for human consumption must be free of any micro-organisms or substances which through the number or concentration can affect public health, that’s why the monitoring of physical-chemical and microbiological parameters of raw water, before purification has a particular importance.

The monitoring system of the technological flux was put into service in 2003, and it can provide: real-time monitoring of the configuration of the water treatment system, the verification system state at a time, tracing the damage, track maneuvers, the automatic local control or remote control of the process.

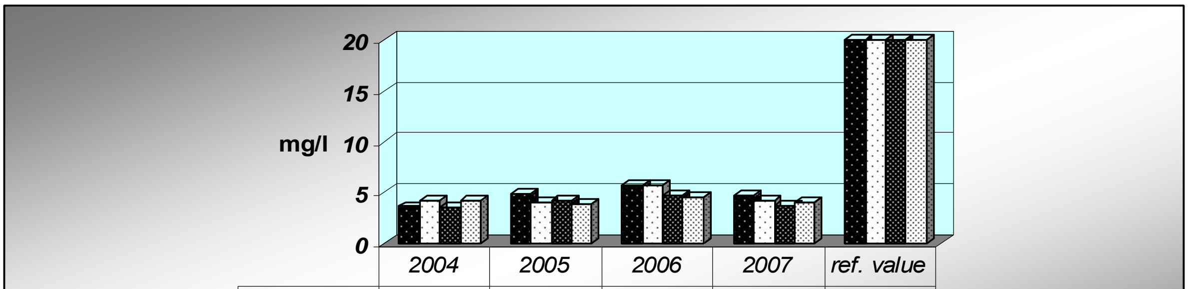
The treatment station`s laboratory has the purpose to supervise the water quality along the whole technological flux, the quality of chlorinated water pumped into the distribution network and also the microbiological and organoleptic quality of drinking water in different sectors of the distribution network.

As required by Law 458/2002 on the quality of drinking water, with subsequent amendments by Law 311/2004 and Decision 974/2004 - rule the surveillance, health inspection and quality monitoring of drinking water, the drinking water producers are required to prepare annual monitoring control programs for the treatment stations, tanks and supply areas.

As shown in Figures 1 - 4, in respect to raw water used for purification in the treatment station in terms of physical-chemical parameters, the average quarterly parameters fall below the maximum values allowed by NTPA 013 - quality standards that must be fulfilled by the surface water used for purification (approved by Government Decision 100/2002, updated by HG 662/2005 and HG 567/2006). Mainly, we have this situation because upstream the treatment station there is no agent with significant industrial activity which can be a major polluter of the river Bistriţa.

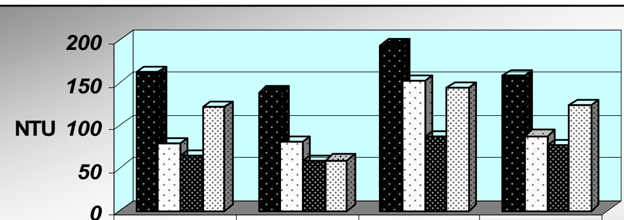
Regarding the bacteriological parameters, as seen in Figure 5-6, the quarterly average values for total coliforms and faecal coliforms exceeds in most cases the maximum permitted under the legislation (NTPA 013).

The situation of constant overruns of the values above the maximum bacteriological standards is due to the proximity of some villages to the Bistriţa Ardeleana river (source of water for purification). These villages do not have centralized sewage systems and purification stations, and much of the waste water discharge flows into river water.



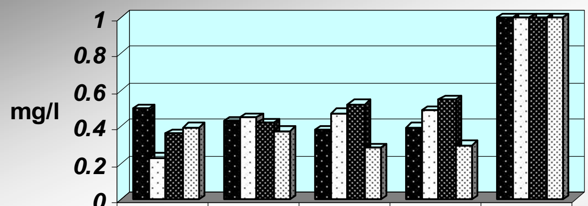
	2004	2005	2006	2007	ref. value
quarter I	3.59	4.81	5.63	4.63	20
quarter II	4.2	4.01	5.74	4.13	20
quarter III	3.45	4.15	4.66	3.66	20
quarter IV	4.14	3.82	4.5	4.02	20

Figure 1. Variation in average quarterly values of organic substances in raw water during 2004-2007.



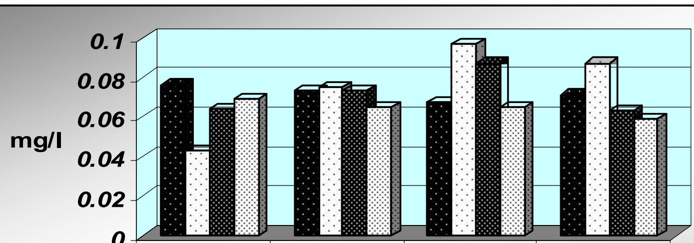
	2004	2005	2006	2007
quarter I	163	139	194	159
quarter II	79	81	152	88
quarter III	64	58	87	76
quarter IV	121	59	144	124

Figure 2. Variation in average quarterly values of the parameter turbidity in raw water during 2004-2007.



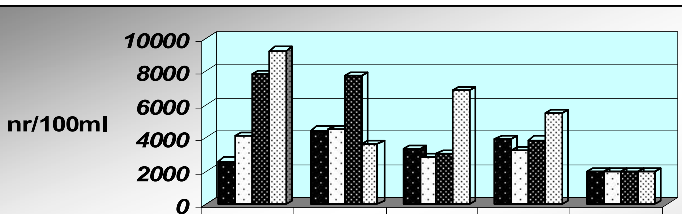
	2004	2005	2006	2007	ref. value
quarter I	0.501	0.431	0.382	0.396	1
quarter II	0.231	0.452	0.476	0.488	1
quarter III	0.365	0.423	0.523	0.549	1
quarter IV	0.396	0.378	0.285	0.299	1

Figure 3. Variation in average quarterly values of the parameter ammonium in row water during 2004-2007.



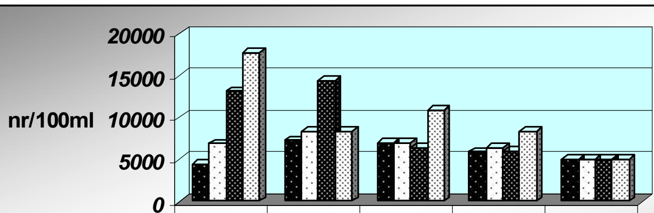
	2004	2005	2006	2007
quarter I	0.076	0.073	0.067	0.071
quarter II	0.043	0.075	0.097	0.087
quarter III	0.064	0.073	0.087	0.063
quarter IV	0.069	0.065	0.065	0.059

Figure 4. Variation in average quarterly values of the parameter nitrite in raw water during 2004-2007.



	2004	2005	2006	2007	ref. value
quarter I	2612	4474	3363	3940	2000
quarter II	4117	4498	2819	3267	2000
quarter III	7820	7772	3029	3877	2000
quarter IV	9243	3628	6840	5460	2000

Figure 5. Variation in average quarterly values of faecal coliforms in raw water during 2004-2007.



	2004	2005	2006	2007	ref.value
quarter I	4440	7274	6916	5876	5000
quarter II	6893	8296	6967	6383	5000
quarter III	13131	14363	6365	6011	5000
quarter IV	17696	8279	10887	8276	5000

Figure 6. Variation in average quarterly values of total coliforms in raw water during 2004-2007.

However, the significance of this discharge may be more serious; important biological parameters such as: *Giardia*, *Cryptosporidium* and *Salmonella*, are not examined at this time and likelihood of their existence in raw water is high enough.

While in terms of total coliforms and faecal coliforms, effectiveness of disinfection with chlorine is demonstrated by tests on drinking water that leaves the treatment station (ST) or tests on network drinking water (R), not the same thing can be said about other pathogens whose structure is more complex than a simple bacteria (where the disinfectant works only on a single cell and not over a body). For example, *Giardia lamblia* is a flagellate Protozoa, and their resistance to the chlorine disinfection is wellknown.

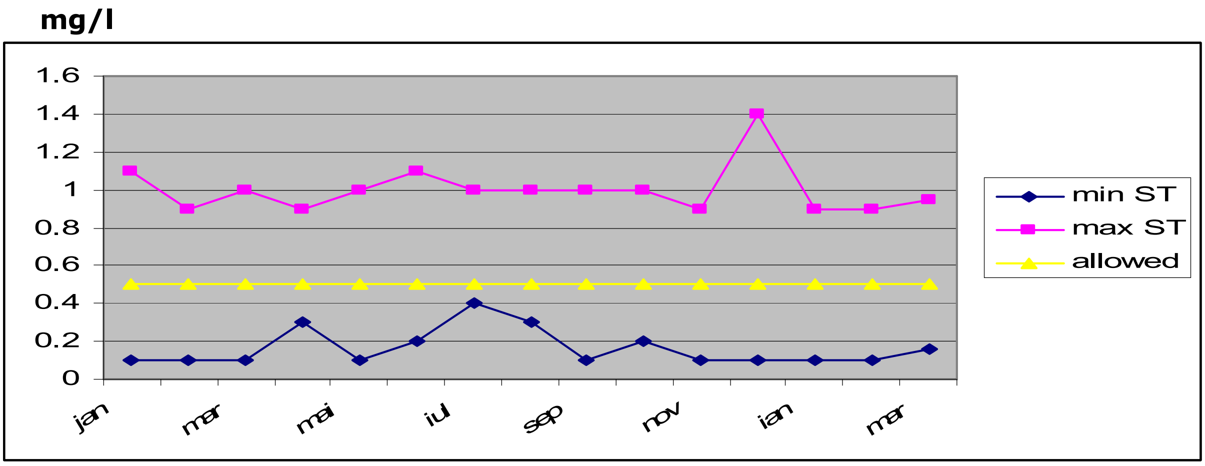


Figure 7. Variation of free chlorine at the exit point of the station during treatment: January 2006 - March 2007.

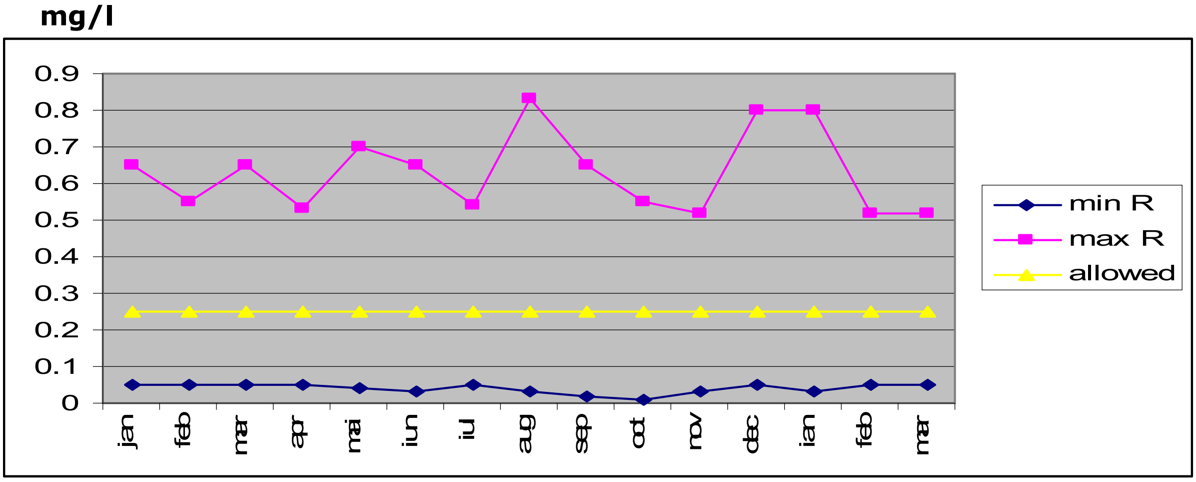


Figure 8. Variation of free chlorine in the network during treatment: January 2006 - March 2007.

Chlorination of water for disinfection was carried out using chlorine gas (average dose used was 1.5 mg/l), the dose being established in order to ensure a quantity of 0,25 mg/l, residual chlorine into the network. Determination of residual chlorine was made at harvesting place under standardized methodology. The results of the monitoring regarding residual chlorine are shown in Figures 7 - 8.

The monitoring of drinking water was carried out daily with a greater frequency than that imposed by Law 458/2002 - on the quality of drinking water, supplemented and amended by Law 311/2004, to have a permanent control over the quality of water distributed to the population. Drinking water was monitored at the exit of treatment station and then in several points on the distribution network, including the exit of the storage tanks.

The results of the drinking water monitoring reflects the fact that most of the physico-chemical and (after treatment) bacteriological parameters are below the maximum values accepted by the legislation, except the turbidity parameter. This happens because, in some parts of the network when there is low consumption there is possible to appear suspension deposits which can be taken by the water when there is high consumption.

Conclusion. The quality of raw water which comes from sources of ground water and surface water is subjected to treatment process and further analyses in order to be used for consumption, food industry or aquaculture. Monitoring system can be improved by identifying the phyto and zooplankton organisms. In terms of raw water quality there are problems related to floods (when water turbidity and bacteriological loading increases in the river), or related to upstream areas where there are no sewage systems and waste water treatment plants. These last aspects can be solved carrying out investments included in the ISPA Program. There is a system of quality control in general in the unit and the control unit provide water quality certification. The reports are done daily, monthly (these ones are submitted to the Directorate of Public Health district) and annual with the exceeded parameters.

References

Bucur A., 1999 [Elements of Water Chemistry]. Editura H. G. A., Bucharest. [In Romanian]

Mac I., 1978 [Morphohydrodynamic relations in Transylvanian Depression]. Studia Universitatis "Babes-Bolyai", Geol-Geogr 23(2), Cluj-Napoca. [In Romanian]

Pop P. G. R., 2001 [Transylvanian Depression]. Editura Presa Universitara Clujana. Cluj-Napoca. [In Romanian]

Reid P. E., 2003 Water Quality Systems Guide For Facility Managers. Second Edition. Routledge, USA.
Roșu C., 2007 [The Bases of Environmental Chemistry]. Editura Casa Cărții de Știință, Cluj-Napoca. [In Romanian]
Ujvari J., 1972 [Geography of Romanian Waters]. Editura Științifică, Bucharest. [In Romanian]
Government Decision 100/2002, to approve the quality standards for surface water used in order to treat them for obtaining potable water. [In Romanian]
Government Decision 974/2004, to approve the supervision norms, health inspection and quality monitoring of drinking water. [In Romanian]
Government Decision 662/2005 regarding quality standards that must be fulfilled by the surface water used for purification. [In Romanian]
Government Decision 567/2006 regarding quality standards that must be fulfilled by the surface water used for purification (includes NTPA 013 and NTPA 014). [In Romanian]
Law 458/2002 on the quality of drinking water. [In Romanian]
Law 311/2004 on the quality of drinking water. [In Romanian]
*** STAS-6364/1978 Residual and free chlorine - analysis methods.
*** STAS 3001/1991 Bacteriological methods.

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