Assessment of Drinking Water Quality of Targu Jiu City by Analyzing Physical and Chemical Quality Parameters

DANIELA CIRTINA, CAMELIA CAPATINA*
Constantin Brancusi University of Targu Jiu, Faculty of Engineering, 30 Eroilor Str., 210216, Targu Jiu, Romania

Monitoring and control of water quality for human consumption aims to verify if the water available to consumers meets the requirements of relevant legislation and in particular the values of parameters established. The paper presents a study on the assessment of the quality of drinking water distributed in the city of Targu-Jiu by analyzing the following physico-chemical quality parameters: pH, conductivity, turbidity, ammonia, nitrites, nitrates, chlorides, residual chlorine, hardness and aluminum ions content. From the results, it has been found that during 2013-2015, there were exceedings of the maximum permitted levels for residual chlorine and ammonium ion in drinking water samples.

Keywords: drinking water quality indicators, water physico-chemical quality parameters

Physico-chemical analysis of drinking water is particularly important when water sources are exposed to pollution (spills of industrial, agricultural, municipal waste and wastewater) [1]. Impurities in drinking water should not exceed certain limits concentrations indicated in the drinking water legislation. The water sources can contain impurities in concentrations exceeding ten times, sometimes hundreds of times drinking water limits [2]. Thus, it is crucial that the concentrations of the impurities and contaminants are to be kept as low as possible in a water supply so as to protect humans from their harmful impacts [3]. The task of removing these contaminats goes to the treatment plant, which, through combinations with various equipment and installations will perform a chain of processes, a continuous flow technology, by which ultimately the water distributed to the consumer will correspond to potability standards. Statistics show a strong correlation between the water supply and sanitation systems and population health in human settlements. A number of diseases, such as fever, typhoid, cholera and some stomach diseases have been propagate through the water, and, therefore, they are called waterborne diseases. Some of them produce a high level of mortality. Significant decrease of overall mortality can be achieved by ensuring hygienic living conditions in the polluted centers, especially through the distribution of drinking water for the whole population [4].

In general, water treatment plants used in a combination or another, the following treatment processes: screening – to retain the solid bodies entrained in the floating material and water; pre-settling - the unsettled suspensions are retained in vials by a simply stationary water retention; clarification - retaining the vast majority (90-95%) of suspensions of water by the same procedure of relative stationary, but after the coagulation-flocculation stage; filtering – for clarification finishing; fine particles, flocs and microorganisms will be removed; disinfection - destruction of all microorganisms; aeration - the water enrichment with oxygen, for the stimulation of the oxidation reaction; absorption - retaining the taste and odor of the water through contact with adsorbent materials; chemical precipitation - removing of dissolved substances as: iron, manganese; water hardness decrease; ion exchange - removing the elements of water to obtain pure water, particularly for industrial purposes; flotation and ultrafiltration, but in special cases of water sources or where water quality has to meet the criteria of drinking water [5].

Through intensive water treatment methods, the emphasis is on the widespread use of chemical reagents and mechanical processes with high efficiency [6]. The retention time of the water in these systems is short in comparison to the natural history of similar phenomena. Directive 98/83/EC on quality of water intended for human consumption aims to protect human health from the adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean [7].

According to this Directive, Member States shall take all measures necessary to ensure that it carries out periodic water quality for human consumption, in order to check that the water available to consumers meets the requirements of this Directive and in particular the values of quality parameters established [8]. Samples should be taken so as to be representative of the quality of the water consumed throughout the whole year [9]. In addition, it should be taken all necessary measures to ensure that, if the preparation or distribution of water intended for human consumption have the disinfection stage to be checked the efficiency of the treatment process applied and that any contamination with by-products after disinfection remains to the lowest level possible, without compromising disinfection.

To meet the rules imposed, the competent authorities have to establish appropriate monitoring programs for all water intended for human consumption and also the sampling points. Member States shall ensure that inspections are carried out additionally on a case by case for the substances and microorganisms which have not established parametric values, if there are reasons indicating the presence of such substances or microorganisms in a quantity or a number representing a potential danger to human health [10]. They shall ensure that for any failure to meet the parameters set, they should carry out an investigation to identify the cause. Whether parametric values were respected or not, Member States shall ensure that any supply of water for human consumption which constitutes a potential danger to human health is restricted or taking any measures needed to protect human health.

**email: camelia_capatina@yahoo.com*

Table 1
VALUES OF PHYSICO-CHEMICAL PARAMETERS OF DRINKING WATER [14, 15]

Parameters	Measurement units	98/83/EC Directive on quality of water intended for human consumption		STAS 1342-91 with changes of the Law No.458/2002, supplemented by Law no. 311/2004
		Recommendable concentrations	Maximum allowable concentration (MAC)	Maximum allowable concentration (MAC)
pH	pH units	6.5 – 8.5	-	6.5 – 8.5
Conductivity	µS/cm at 20°C	400	-	2500
Turbidity	mg/L on silica scale	1	10	≤ 5
Ammonium	mg/L	0.05	0.50	0.50
Nitrate	mg/L	25	50	50
Nitrite	mg/L	-	0.1	0.50
Chlorides	mg/L	25	-	250
Free residual chlorine	mg/L	0.3	0.5	0.5
Total hardness, minimum	german degrees	-	-	5
Aluminium	µg/L	50	200	200

Water quality required for each type of use is a very topical issue and it can be said that,in the present, it is the factor that decides the using of water supply [11]. Besides the fact that this should correspond perfectly to the requirements of consumers, it is one that establishes the category of source of water that can be used and treatment technology required to achieve quality indicators requested, determining factors in desinging of a power water system [12].

The quality problems of water sources and water supplied to consumers have been lately given special attention from specialists in the field to address all issues appeared. In a drinking quality assessment, the decision-making based on water quality data is a crucial point due to the number of parameters endangered its quality [13]. Traditionally, the drinking water quality status is determined by comparing the individual parameters to guideline values [13].

Consequently, the purpose of this paper is to assess the quality of drinking water supplied in Tg. Jiu and to track the quality of its on entry into the distribution network and the consumer in representative points by analyzing some of physico-chemical parameters.

Experimental part

The central water supply system in Targu-Jiu provides drinking water for about 80 000 inhabitants and is composed of four main sectors: capture, processing, storage and distribution. Water needs of the city Tg. Jiu are ensured by two rivers, Susita Verde and Sohodol which flow Vulcan Mountains. Both sources are surface water which, according to the Order 161/2006 concerning the classification of surface water, are included in I class quality. The water of the two rivers is captured and transported by gravity through pipes with a length of approximately 33 km: 18 km Susita and 15 km Sohodol respectively. Sohodol source is captured and transported through two pipelines with a diameter of 800 mm and 450 mm. Water from Susita source is transported through a single pipe with a diameter of 600 mm. The mean volume of water produced by the treatment plant Tg. Jiu is 11 000 m^3/day.

Values and maximum allowable concentrations (MAC) for physico-chemical parameters of quality of drinking water tracked in this study are presented in table 1, in accordance with the provisions of STAS 1342-91 – Potable Water with the amendments of Law No. 458/2002 supplemented by Law no. 311/2004 [14, 15].

Water sampling was performed according to the conditions stipulated in STAS 2852-94 *Drinking water sampling* [16]. A first condition of samples subjected to laboratory tests is that they are representative (typical samples) for considered bulk water. Sampling must be done with special requirements, since water can change its composition even during harvest or inhomogeneous sample can rise or during transport under the influence of temperature, pressure, water may alter its composition. Sampling was followed by conservation, marking and transport to the laboratory.

Given that in most cases the content of substances on which the analyzes are done is extremely small, the precision equipments, fully functional, as well as standardized methods for each indicator in part have been used for the accurate determining of its concentration.

Water samples were analyzed at intervals of no more than 10-12 h after sampling, and *p*H and residual chlorine indicators analyzes were performed in situ, immediately after sampling. There were analyzed in terms of physico-chemical evolution of a standard number of 36 water samples/year sampled from entering in the network and a standard number of 48 samples/year sampled from distribution network. The sampling frequency was determined by taking into account a number of factors including: the frequency of improper samples in the past 12 months, the quality of the raw water, the number of water sources, the efficiency of the treatment procedures and capacity of treatment station, the risks for water contamination on the source and in the distribution network, network size and complexity, the number of outbreaks recorded in the last 12 months, and the risks of an epidemic spreading. The possibility of discovering a pollution phenomenon that occurs periodically rather than by chance increases if sampling is performed at different times during the day and different days of the week.

Analyses carried out in the period 2013-2015 followed the evolution of some physico - chemical: *p*H, conductivity,

Table 2

MINIMUM AND MAXIMUM VALUES OF PHYSICO-CHEMICAL INDICATORS DETERMINED FROM ENTERING IN THE NETWORK (2013)

Determined parameter	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH (pH units)	7.4	7.2	-	7.3	7.8	7.98	8.0	8.1	8.2	8.1	8.2	8.3
	8.1	7.4	-	8.0	8.2	8.2	8.4	8.4	8.6	8.6	8.5	8.5
Conductivity (µS/cm)	104	105	132	137	132	121	132	134	132	109	124	139
	132	155	175	156	168	175	160	161	151	157	169	177
Turbidity (NTU)	0.5	0.6	0.8	0.7	0.6	0.6	0.7	0.9	0.6	0.6	0.6	0,9
	1.0	4.6	2.6	2.3	4.5	3.5	5.9	4.9	1.2	4.2	5.4	3.1
Ammonium (mg/L)	0.05	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.02	0.04	0.03	0.04
	0.1	0.1	0.1	0.1	0.04	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Nitrite (mg/L)	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.04	0.01	0.01
	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.09	0.1	0.04	0.05
Nitrate (mg/L)	6.9	6.2	-	-	7.5	7.5	10.3	8.3	2.6	3.5	5.7	5.1
	10.2	17.3	-	-	8.8	11.4	15.4	14.7	8.8	7.5	7.5	7.3
Chlorides (mg/L)	3.5	3.5	4.6	4.6	5.3	4.9	5.2	4.9	4.2	4.4	4.2	4.7
	5.9	5.7	14.3	6.3	6.7	7.03	6.3	6.5	6.0	6.9	7.0	6.8
Hardness (German degrees)	4.1	3.6	4.9	5.2	4.7	5.2	5.2	5.3	5.2	5.2	5.2	5.4
	7.7	6.7	7.3	7.9	7.8	6.8	6.9	7.5	6.9	6.9	7.0	7.4
Aluminium (mg/L)	-	-	0.06	0.04	0.04	0.02	0.06	0.02	0.03	0.03	0.06	0.03
	-	-	0.07	0.2	0.06	0.04	0.1	0.03	-	0.08	0.2	0.04

Table 3

MINIMUM AND MAXIMUM VALUES OF PHYSICO-CHEMICAL INDICATORS DETERMINED FROM THE NETWORK (2013)

Determined parameter	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH (pH units)	7.3	7.0	-	7.6	7.8	7.9	7.8	7.3	7.8	7.9	8.1	8.2
	8.4	7.7		7.9	8.1	8.1	8.3	8.4	8.6	8.6	8.4	8.4
Conductivity (µS/cm)	108	105	139	139	136	137	137	132	131	110	130	138
	147	159	173	153	160	175	154	189	176	204	161	157
Turbidity (NTU)	0.5	0.6	0.6	0.9	0.8	0.7	0.7	0.9	0.5	0.6	0.8	1.0
	4.6	2.6	3.1	2.4	4.1	2.5	4.3	4.6	2.2	5.8	5.2	2.9
Ammonium (mg/L)	0.09	0.02	0.02	0.07	0.04	0.07	0.03	0.04	0.04	0.1	0.09	0.06
	0.1	0.1	0.1	0.12	0.1	0.13	0.1	0.1	0.1	0.13	0.18	0.12
Nitrite (mg/L)	0.03	0.04	0.01	0.02	0.02	0.01	0.01	0.01	0.03	0.04	0.01	0.02
	0.04	0.07	0.04	0.05	0.05	0.05	0.04	0.04	0.07	0.1	0.03	0.05
Nitrate (mg/L)	5.3	6.6	-	-	7.8	10.0	10.2	9.0	5.6	5.5	5.3	5.1
	12.8	17.2	-	-	9.8	11.6	17.7	15,4	10.0	6.6	8.5	6.9
Chlorides (mg/L)	3.5	3.5	4.3	4.9	5.2	5.1	4.9	4.2	4.4	4.5	4.2	5.46
	6.5	6.4	13.5	6.4	6.6	7.2	6.1	7.1	6.6	6.7	6.2	-
Residual chlorine (mg/L)	0.25	0.2	0.3	0.2	0.3	0.3	0.25	0.25	0.2	0.2	0.3	0.3
	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.4
Hardness (German degrees)	3.8	3.62	5.2	5.1	5.7	5.2	5.2	5.3	4.8	4.9	5.2	5.7
	7.5	6.4	7.2	6.9	7.2	6.7	6.9	7.5	6.8	6.4	6.5	7.3
Aluminium (mg/L)	-	-	-	0.03	0.02	0.04	0.02	0.01	-	0.02	0.02	-
	-	-	-	0.04	0.2	-	0.03	0.02	-	0.04	0.1	-

Table 4

MINIMUM AND MAXIMUM VALUES OF PHYSICO-CHEMICAL INDICATORS DETERMINED FROM ENTERING IN THE NETWORK (2014)

Determined parameter	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH (pH units)	8.1	8.2	7.9	8.0	8.4	7.8	8.5	8.7	8.7	7.8	7.8	7.7
	8.5	8.5	8.5	8.6	8.6	8.6	8.9	8.9	8.9	8.9	8.1	8.0
Conductivity (µS/cm)	133	139	143	132	123	123	130	131	136	122	119	107
	149	153	171	187	161	143	145	145	153	169	135	128
Turbidity (NTU)	0.7	0.7	1.1	1.1	0.7	0.7	0.6	0.7	1.0	1.3	0.9	0.5
	2.4	4.1	3.8	4.4	1.9	3.0	2.6	3.9	4.9	4.8	3.8	2.3
Ammonium (mg/L)	0.04	0.04	0.01	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03
	0.1	0.13	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.07	0.06	0.06
Nitrite (mg/L)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	0.08	0.04	0.04	0.03	0.05	0.05	0.05	0.09	0.07	0.05	0.06	0.05
Nitrate (mg/L)	4.61	5.09	3.05	3.9	4.6	5.7	5.5	5.4	5.5	7.2	6.2	7.2
	6.31	6.5	7.2	6.33	8.1	8.9	18.3	11.8	10.2	9.46	9.9	9.5
Chlorides (mg/L)	4.25	4.6	4.6	4.9	4.6	5.2	4.6	4.4	5.1	5.3	5.14	5.1
	6.37	6.3	6.2	6.4	5.8	5.88	6.0	6.8	5.9	6.0	6.31	6.1
Hardness (German degrees)	5.16	5.16	5.1	5.5	5.1	5.7	5.4	5.2	5.2	5.2	5.3	5.4
	6.74	6.9	6.6	6.5	6.5	6.9	7.2	6.8	6.3	7.03	6.28	7.03
Aluminium (mg/L)	-	0.04	0.01	0.12	0.19	0.08	0.11	0.08	0.16	0.18	0.17	-
	-	-	0.12	0.17	-	0.19	0.17	0.19	0.18	0.19	0.19	-

Table 5

MINIMUM AND MAXIMUM VALUES OF PHYSICO-CHEMICAL INDICATORS DETERMINED FROM THE NETWORK (2014)

Determined parameter	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH (pH units)	8.0	8.2	7.9	8.1	8.3	7.2	8.2	8.1	8.7	7.7	7.1	7.8
	8.5	8.5	8.4	8.5	8.6	8.7	8.8	8.8	8.9	8.9	8.7	8.0
Conductivity (µS/cm)	137	141	142	138	129	118	131	132	137	126	127	107
	165	167	171	197	153	150	169	156	154	165	167	130
Turbidity (NTU)	0.7	0.9	1.1	1.0	0.8	0.4	0.8	0.7	0.9	1.2	0.8	0.6
	2.1	3.1	3.5	4.5	1.8	2.2	2.3	4.6	4.0	4.9	2.3	2.4
Ammonium (mg/L)	0.04	0.04	0.01	0.03	0.03	0.02	0.03	0.02	0.03	0.04	0.03	0.03
	0.09	0.1	0.06	0.09	0.06	0.07	0.07	0.2	0.06	0.07	0.18	0.06
Nitrite (mg/L)	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	0.07	0.04	0.04	0.04	0.05	0.05	0.05	0.11	0.07	0.05	0.16	0.04
Nitrate (mg/L)	4.6	4.6	3.2	4.2	4.8	5.9	6.1	5.8	7.0	7.4	6.2	7.8
	7.6	7.4	7.2	6.9	7.9	8.9	16.4	9.8	9.8	9.5	12.0	9.6
Chlorides (mg/L)	4.6	4.6	4.3	4.25	4.6	5.2	4.6	4.6	5.1	5.2	5.2	5.1
	6.5	6.3	6.21	5.95	5.9	5.9	6.2	6.5	6.2	6.3	6.9	6.1
Residual chlorine (mg/L)	0.25	0.2	0.2	0.3	0.3	0.2	0.25	0.3	0.2	0.2	0.2	0.2
	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.4
Hardness (German degrees)	4.5	4.9	5.2	5.2	5.0	5.3	5.2	5.2	5.2	5.2	5.2	5.3
	6.5	6.8	6.5	6.5	6.4	6.7	6.9	6.9	6.5	7.0	6.5	6.6
Aluminium (mg/L)	-	-	0.12	0.18	-	-	-	0.07	0.16	0.18	0.08	-

turbidity, ammonia, nitrites, nitrates, chlorides, residual chlorine, hardness, aluminum. Minimum and maximum values recorded in the monitoring period conducted are presented in tables 2-7.

Results and discussions

Assessing the quality of drinking water treatment plant supplied by Tg. Jiu was conducted in accordance with Law no. 458/2002 on drinking water quality, amended by Law 311/2004 which regulates drinking water quality aiming the protection of human health against the effects of any

Table 6

MINIMUM AND MAXIMUM VALUES OF PHYSICO-CHEMICAL INDICATORS DETERMINED FROM ENTERING IN THE NETWORK (2015)

Determined parameter	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH (pH units)	7.8	7.7	7.7	7.6	7.9	8.0	8.0	8.0	7.9	7.8	8.2	7.9
	8.1	8.5	8.3	8.0	8.5	8.3	8.2	8.5	8.1	8.2	8.1	8.5
Conductivity (µS/cm)	111	80	132	133	132	141	136	128	96	115	126	72
	121	148	137	144	142	151	147	141	132	134	143	138
Turbidity (NTU)	0.5	0.6	0.8	0.7	1.3	0.7	1.5	0.7	1.0	0.7	0.6	0.7
	3.8	3.6	4.3	4.1	4.1	2.4	4.9	4.2	4.7	3.8	2.7	3.3
Ammonium (mg/L)	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.02	0.03	0.02	0.02	0.03
	0.05	0.06	0.07	0.06	0.07	0.05	0.07	0.06	0.05	0.05	0.03	0.07
Nitrite (mg/L)	0.02	0.01	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.02
	0.04	0.04	0.05	0.05	0.05	0.05	0.04	0.04	0.05	0.05	0.03	0.04
Nitrate (mg/L)	6.96	6.0	7.36	6.33	7.83	8.27	7.12	8.23	6.93	7.34	7.76	8.55
	9.3	9.12	8.79	9.03	9.5	9.3	8.76	9.11	8.9	9.23	9.43	8.95
Chlorides (mg/L)	4.9	5.2	5.1	5.2	5.1	4.6	4.9	5.4	4.9	5.3	5.2	5.2
	5.8	6.4	6.4	5.8	6.2	5.7	5.8	7.0	5.7	6.2	6.7	6.4
Residual chlorine (mg/L)	0.2	0.5	0.2	0.3	0.5	0.5	0.2	0.4	0.3	0.2	0.3	0.4
	0.5	0.6	0.3	0.4	0.7	0.6	0.3	0.5	0.4	0.3	0.4	0.5
Hardness (German degrees)	5.32	4.82	5.16	5.32	5.07	5.16	5.27	5.34	5.16	4.71	4.9	5.38
	6.39	5.96	5.96	7.24	6.07	6.18	6.4	5.76	5.75	6.48	5.63	5.83
Aluminium (mg/L)	0.13	0.13	0.13	0.12	0.09	0.11	0.13	0.09	0.12	0.09	0.14	0.07
	-	0.17	0.16	0.18	0.14	0.15	0.19	-	0.16	-	-	-

Table 7

MINIMUM AND MAXIMUM VALUES OF PHYSICO-CHEMICAL INDICATORS DETERMINED FROM THE NETWORK (2015)

Determined parameter	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
pH (pH units)	7.5	7.7	7.8	7.2	7.8	7.8	7.6	8.0	8.0	8.0	8.0	7.9
	7.8	8.4	8.1	7.7	8.0	8.4	8.1	8.2	8.1	8.2	8.1	8.3
Conductivity (µS/cm)	109	80	132	131	129	140	137	129	117	114	130	77
	120	147	133	143	141	151	141	134	132	125	140	136
Turbidity (NTU)	0.6	0.6	0.9	0.8	0.7	0.8	1.4	0.6	0.9	1.5	0.7	0.8
	3.1	3.9	4.2	3.6	3.9	1.4	3.1	2.3	2.9	2.0	1.7	1.9
Ammonium (mg/L)	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.01	0.02	0.01	0.03
	0.04	0.05	0.06	0.04	0.06	0.05	0.04	0.05	0.03	0.04	0.02	0.06
Nitrite (mg/L)	0.02	0.01	0.02	0.02	0.01	0.03	0.02	0.02	0.03	0.02	0.01	0.01
	0.04	0.03	0.04	0.03	0.02	0.04	0.03	0.04	0.05	0.03	0.03	0.03
Nitrate (mg/L)	7.1	5.46	6.7	6.7	7.8	8.1	5.9	6.4	7.7	4.8	4.2	4.8
	9.2	9.1	8.4	9.0	9.2	8.4	8.6	8.8	8.2	8.8	8.9	8.5
Chlorides (mg/L)	5.17	4.89	5.1	5.15	5.28	5.31	5.38	5.03	4.96	5.45	5.1	5.21
	5.75	5.88	5.87	5.7	5.9	5.5	5.76	5.6	5.32	6.2	6.29	5.67
Residual chlorine (mg/L)	0.3	0.2	0.1	0.3	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.25
	0.4	0.5	0.3	0.4	0.6	0.5	0.3	0.4	0.3	0.2	0.3	0.4
Hardness (German degrees)	5.6	4.96	5.1	5.2	5.2	4.97	4.9	4.94	5.11	4.98	5.11	5.16
	6.2	5.9	5.9	6.6	5.8	6.07	6.07	5.7	5.5	6.27	5.44	5.54
Aluminium (mg/L)	0.11	0.11	0.1	0.9	0.06	0.09	0.11	0.07	0.11	0.06	0.12	0.06
	-	0.15	0.12	0.15	0.11	0.13	0.17	-	0.15	0.08	-	-

kind of drinking water contamination by providing clean and sanogenous water.

The first phase of activity regarding monitoring the water quality in terms of physico-chemical parameters analyzed was taking water samples from entering and in some representative points of the distribution network. For the distribution network, sampling points were set randomly every month, both in fixed (tanks, pumping stations), and in alternative points (heads of network, agglomeration spaces, high-risk of contamination areas).

The second stage was to determine quality indicators, through the chemical analysis, using standardized analytical methods. In the next stage, the primary data processing and conversion into synthetic data in order to

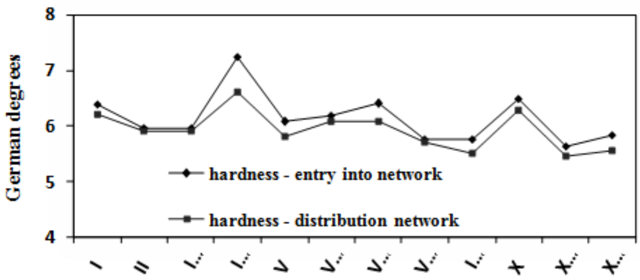

Fig. 1. Variation of hardness in 2015, entry into networking and consumer/ distribution system (maximum values)

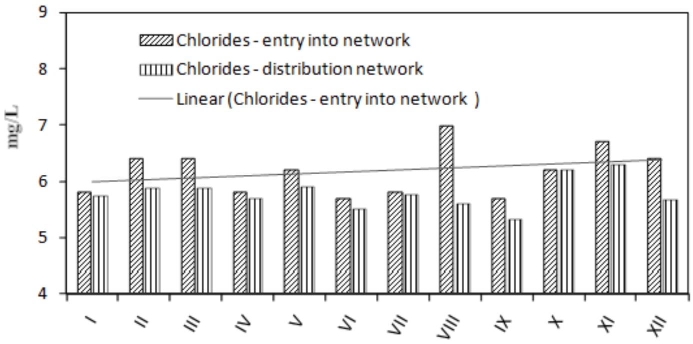

Fig. 2. Variation of chlorides content in 2015 (maximum values) entry into network and consumer/distribution system

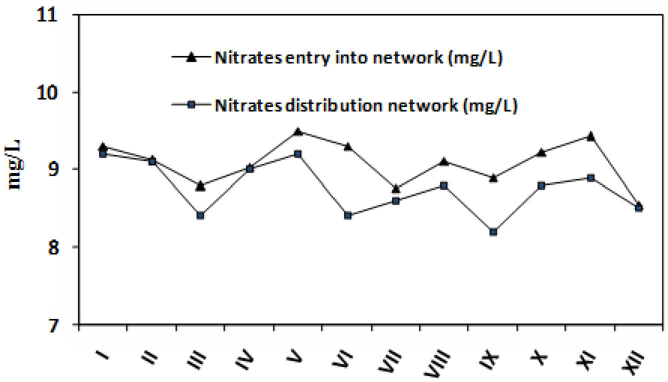

Fig. 3. Variation of the maximum amounts of nitrates during 2015 into the entry of network and consumer/ distribution system

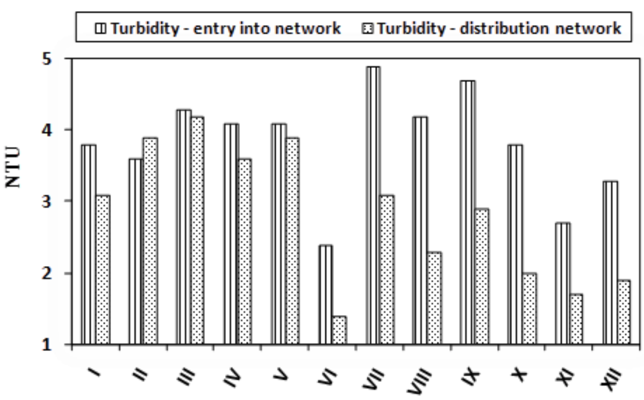

Fig. 4. Turbidity variation during 2015 (maximum values) into networking and consumer/ distribution system

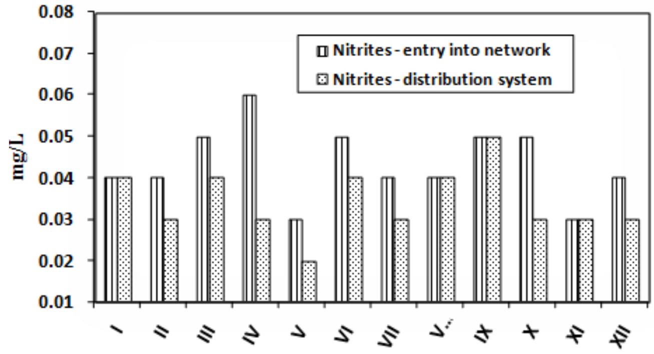

Fig. 5. Variation of nitrites content in 2015 into networking and consumer/distribution system (maximum values)

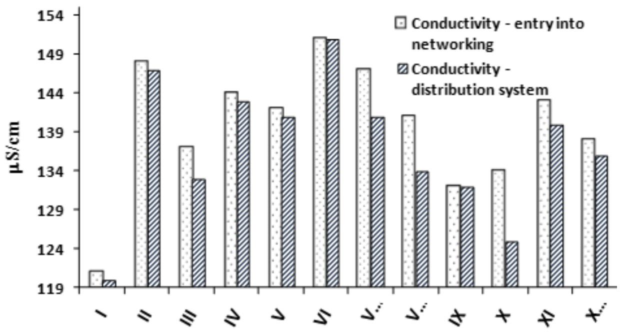

Fig. 6. Variation of conductivity values in 2015 into networking and consumer/distribution system (maximum values)

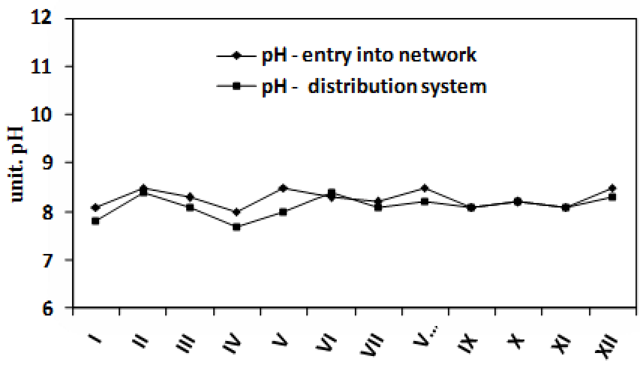

Fig. 7. Variation of p*H* values in 2015 into networking and consumer/distribution system (maximum values)

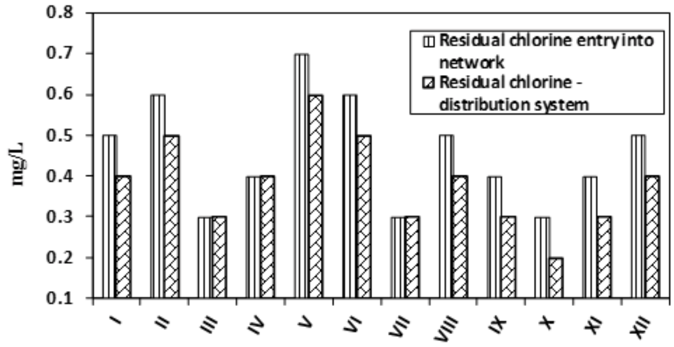

Fig. 8. Variation of residual chlorine content in 2015 into networking and consumer/distribution system (maximum values)

characterize the quality of the water, recording and storage of data, their valorisation were carried out.

The followings figures provided graphic representations of variation indicators of quality of drinking water such as: hardness, chlorides, nitrates, turbidity, nitrates, conductivity, *p*H, residual chlorine, ammonia and aluminum (figs.1-10) at entry into network and consumer (distribution network) for 2015.

After monitoring in 2015, the hardness indicator values recorded were within the limits established by legislation according to STAS 1342-91 amended by the Law no. 458/ 2002, completed with Law no.311/2004. Figure 1 shows that the maximum values recorded were above the total mimimum hardness value namely, minimum 5 (degrees German). Minimum values of hardness in February, June, July, August and October were within the limits prescribed by law, but the difference from this limit is very low.

In terms of variation of maximum chloride content of water samples taken and analyzed during 2015, in figure 2 is observed that the values recorded are well below the limit Cl^- = 250 mg/L.

The maximum content of nitrates in drinking water recommended by Directive 98/83/EC on the quality of drinking water is 25 mg/L. The maximum values recorded in 2015 from the water quality monitoring points of distributed drinking water in Tg. Jiu were within the range of 8.2 mg/L in September and 9.5 mg L in May at entering the network (fig. 3). Samples from distribution network had lower values of nitrate and below the corresponding regulations.

After monitoring the turbidity indicator, the maximum values recorded (fig. 4) were within the limits established by legislation according to STAS 1342-91 amended the Law no. 458/2002, completed with Law no. 311/2004. They not exceed the maximum permissible concentration of ≤ 5 NTU. But, as can be seen in July (4.9 NTU) and September (4.7 NTU) values recorded are higher than the rest of the year and they are very close to the maximum allowable limit.

Nitrite content in drinking water is carefully monitored considering the health consequences of this ion. In reaction with blood hemoglobin nitrite lead to methemoglobin, a very stable compound, which prevents oxygen transport in body ensured by hemoglobin. In this manner may occur serious poisoning of the body, especially in case of children under one year old because the amount of water consumed is higher in relation to their body weight and also hemoglobin has a reduced immunity.

Figure 5 shows the variation of nitrite indicator in drinking water analyzed and it can be seen that its values are below the limit values according to Directive 98/83/EC on quality of water intended for human consumption (MAC value being 0.1 mg/L).

Another indicator monitored was water conductivity. For this parameter monitored in 2015, the recorded values were within the limits established by legislation 400 μS/cm, as shown in figure 6.

Maximum *p*H values recorded in 2015 (fig. 7) were within the maximum limit. It has to be mentioned that in February, May, August and December they have reached the maximum allowable limit (8.5) according to Law No.458/2002, supplemented by Law no. 311/2004.

An important parameter of drinking water quality is residual chlorine content. Treating water with chlorine may have several objectives: water disinfection, taste and odor removal, ensuring antibacterial qualities in the distribution system by providing a residual chlorine of distributed water. In the practice of treating water in our country, it took a general spreading of water sterilization through chlorination (although in developed countries, sterilization promotes cancer, which is why, although more expensive, method of water ozonization is more widely used). Added to water, chlorine acts on organic substances that are found in it, as well as destroying bacteria. In combination with water, chlorine forms hypochlorous acid and hydrochloric acid. Hypochlorous acid (HClO) is an unstable compound and it breaks down further into hydrochloric acid and oxygen. When these substances are obtained, free oxygen acts as a powerful oxidizing on the organic substances and bacteria that are found in water. The amount of oxygen and thus also the chlorine required for sterilization of the water must not be determined by the amount of pathogenic bacteria, but by the total amount of organic substances and organisms, as well as inorganic substances oxidizable found in the chlorinated water. The correct dosage of chlorine is important. An insufficient dose of chlorine can make it not manifest its disinfectant action. To design corrective plants, the dose of chlorine to be taken into account should proceed from the need to correct water during its maximum contamination(for example, during high levels of water). As proof that there was used a sufficiently large dose of chlorine is existing in the water of so-called *excess chlorine* (remaining in water from the

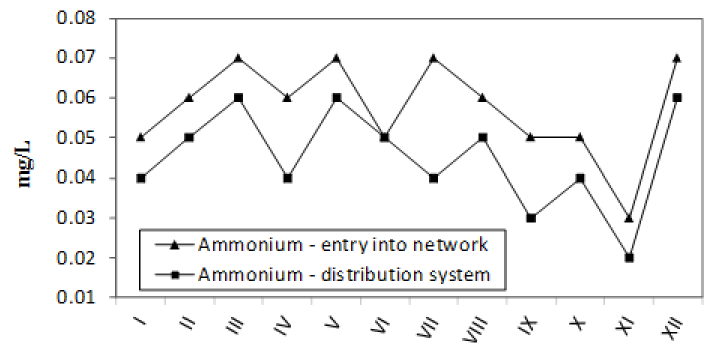

Fig. 9. Variation of ammonium content in 2015 into networking and consumer/distribution system (maximum values)

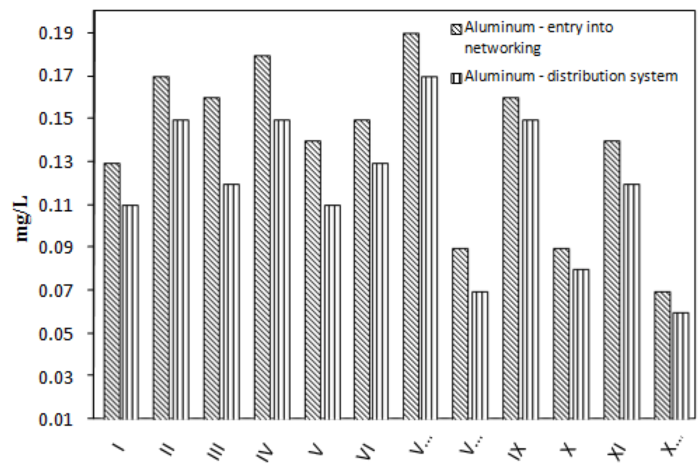

Fig. 10. Variation of aluminum content in 2015 into networking and consumer/distribution system (maximum values)

dose introduced after the oxidation substances that are found in water).

In case of drinking water analyzed in 2015, the maximum residual chlorine content is between 0.1 to 0.7 mg/L (fig. 8). Some of the values of the maximum residual chlorine content exceeding the limit of 0.50 mg /L according STAS 1342-91 with amendments stipulated by the Law No. 458/2002, supplemented by Law no. 311/2004 [14, 15].

Thus, it can be seen that, onto the entry in the network, it was recorded exceeding the maximum permissible value in the months of February, May, June of 2015, the highest value being 0.7 mg/L. In terms of samples from network, it was recorded one exceeding in May, 2015 (fig. 8).

Ammonium ion can be present in drinking water at an allowed maximum concentration of 0.5 mg/L [14, 15]. The variation of ammonium indicator values in 2015 (fig. 9) reveals that for the samples from entering to the network were seven maximum values that exceed the limit prescribed by the regulations in force. The recommendable concentration for ammonium ion is 0.05 mg/L in according to Directive 98/83/EC on quality of water intended for human consumption. Also, in case of samples from the network there were recorded three exceedings in March, June and December of ammonium maximum allowable concentration. Increased ammonium content can affect drinking water quality and can have consequences on human health, which requires careful monitoring of recorded values.

Regarding the aluminum content whose variation is shown in figure 10, it can be concluded that all values recorded are below the permissible maximum provided by law, ie below 0.2 mg/L [14, 15].

Conclusions

Continuous assessment of drinking water quality ensures prevention of illnesses due to consumption of contaminated water by early detection and mitigate or eliminate risk factors that might alter water quality and affect the health of consumers. Supervision of the drinking water distribution network consists of water control at entry points in the network and representative points. In this activity, it has to be taken into account the important aspects as sampling frequency, indicator determined and method used. Frequent examination of water quality through a simple method for a representative indicator is more valuable than less frequent examination of several indicators by complex methods.

Assessment of water quality should be based on the following points of principle: ensuring a judicious time tracking water quality by collecting and analyzing periodic water samples, characterizing water quality by considering the most representative quality indicators depending on the characteristics of the water source and the specific natural conditions.

In this respect, the aim of this work was to monitor the quality of drinking water distributed in the city of Targu-Jiu in the period 2013-2015 and to establish its quality by determining the values of physico-chemical quality parameters namely: *p*H, conductivity, turbidity, ammonia, nitrites, nitrates, chlorides, residual chlorine, hardness and aluminum ions content.

The values recorded in the period 2013-2015, were interpreted by relating them to the limit values regulated by STAS 1342-91 Drinking water, amended the Law No.458/ 2002, supplemented by Law no. 311/2004.

From the analyzes conducted monthly by sampling from entering into the network and the consumer (distribution network), it was found that the water distributed in the supply of Tg. Jiu corresponds to the physico-chemical parameters except ammonia and chlorine residual that were recorded exceeding of the maximum permitted levels.

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