TREATMENT TECHNIQUES FOR IMPROVING ORGANOLEPTIC QUALITIES OF THE WATER FOR HUMAN CONSUMPTION

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Abstract. In order to improve the quality of the potable water, respectively the organoleptic qualities, both on the European level and in our country, there are used various methods, such as: water chlorination, water percolation, ozonization, UV disinfection, electrical methods and the oligodynamic method. This paper studies the improvement of drinking water by adding some chemicals, such as aluminum sulfate and calcium hydroxide in different doses.

Keywords: water treatment, potability, treatment techniques, aluminum sulfate, calcium hydroxide.

Rezumat. Tehnici de tratare a apelor destinate consumului uman în vederea îmbunătăţirii calităţilor organoleptice. În vederea îmbunătăţirii calităţii apei destinată consumului uman, respectiv a calităţilor organoleptice, atât pe plan european cât şi la noi în ţară se folosesc diferite procedee, cum ar fi: clorizarea apei, percolarea apei, ozonizarea, dezinfecţia cu radiaţii ultraviolete, folosirea metodelor electrice, cât şi metoda oligodinamică. Lucrarea de faţă studiază îmbunătăţirea potabilităţii apei prin adăugarea unor substanţe chimice precum sulfat de aluminiu şi hidroxid de calciu în diferite doze.

Cuvinte cheie: tratamentul apei, potabilitate, tehnici de tratare, sulfat de aluminiu, hidroxid de calciu.

INTRODUCTION

Water is a prerequisite for human existence (TCHOBANOGLOUS & EDWARD, 1987). The quality of drinking water must meet the requirements of consumption, according to Law 452/2002 regarding drinking water quality and the EC Directive. Each water source is unique, but the quality of raw water varies from case to case, having different features for treatment (BURTICĂ et al., 2000). Different methods are used in order to improve the quality indices (DEGREMONT, 2007). The physical methods include the use of UV radiation facilities, which have bactericidal action and have no side effects and do not lead to transformation reactions; the electrical methods have the effect of directing the ions, respectively the dissolved salts to one of the poles etc. (BAES & MESMER, 1976). The chemical processes appeal to reagents such as chlorine in the percolation and chlorination process, involved in the oxidation of organic substances, preventing the coagulation process (BURTICĂ et al., 2002). The ozone is a strong oxidant acting on taste, odor and turbidity of water, with high bactericidal action (FAUST & OSMAN, 1998). In addition, there are used different substances such as aluminum sulfate and coagulation adjuvant, which are involved in the potabilization process (CICAL et al., 2007). The oligodynamic method is based on the bactericidal property of heavy metal ions (silver, copper), which completely destroy bacteria and viruses (FLOREA et al., 2006).

MATERIAL AND METHODS

The study was carried out during 2009 period, within the Water Treatment Plant Işalniţa. The water was treated with the Crystal product, which has the following composition: aluminum oxide is 13.12% min., soluble substances in water 0.55% max., free acidity 0.65% max., iron 0.22% max., and arsenic 0.002% max. It was also applied aluminum sulfate and calcium hydroxide in order to coagulate the depositing substances. There have been taken water samples from different sections of the treatment plant and the water was analyzed physically, chemically, and bacteriologically, interpreting the results according to the standards in force. Tests were performed by applying two treatments at different times, in the following sections: when entering the station (raw water source Jiu), after settling, after filtration and chlorination.

RESULTS AND DISCUSSIONS

This study was undertaken based on the recommendations from the literature. Since there cannot be acted on the water quality of the Jiu river and on the decanters constituents, the only way to improve the water quality is to achieve a good chemical treatment using the current system of preparation and dosage of aluminum sulfate but with the introduction of adjuvant treatments such as polymer coagulation.

This method was used because the water of the Jiu river has low temperatures and low turbidity values, which determine the phenomenon of "washing" the suspension layer. The phenomenon is also repeated when the water temperature exceeds 25^0C.

There were taken water samples from the following sections:

- At the station entrance - raw water - the source of the Jiu River (Table 1);
- After settling;
- After filtration and chlorination.

Table 1. The characteristics of raw water at the sampling point – the Jiu River – Entry of the Treatment Station Işalnița (February 25, 2009). / Tabel 1. Caracteristicile apei brute în punctul de recoltare – râul Jiu – Intrare Stație de Tratare Işalnița (25.02.2009).

Characteristics			**In laboratory**		
Aspect, color, odor			Turbid, yellowish, odorless		
Temperature (^{0}C)			18		
Turbidity (SiO_2 degrees)			201.12		
pH parameter at 20°C			7.69		
Hydrogen sulfide and sulfides (mg/dm^3)			-		
Carbon dioxide (mg/dm^3)			4.40		
Dissolved Oxygen (mg/dm^3)			-		
Conductivity (μS / cm)			282.72		
CATIONS	mval/dm^3	mg/dm^3	ANIONS	mval/dm^3	mg/dm^3
Calcium Ca^{2+}	3.40	68.14	Hydroxyl OH^-	0	0
Magnesium Mg^{2+}	0.40	4.86	Nitrites NO_2^-	0.001	0.055
Sodium Na^+			Nitrates NO_3^-	0.07	4.12
Potassium K^+			Chlorides Cl^-	0.96	34.03
Iron Fe^{2+3}	0.01	0.30	Bromides Br^-	-	-
Manganese Mn^{2+3}	0.003	0.08	Iodides I^-	-	-
Aluminum Al^{3+}	0	0	Bicarbonate HCO_3^-	2.36	144.07
Nickel Ni^{2+}	0.001	0.03	Carbonates CO_3^{2-}	0	0
Copper Cu^{2+}	0.0006	0.02	Sulfates SO_4^{2-}	1.41	67.62
Chromium Cr^{3+6+}	0	0	Phosphates PO_4^{3-}	0.003	0.08
Cadmium Cd^{2+}	0.00004	0.002	Cyanide CN^-	-	-
Zinc Zn^{2+}	0.003	0.10			
Lead Pb^{2+}	0.0004	0.046			
Ammonium NH_4^+	0.004	0.07			
Total	4.80	96.19	Total	4.80	294.98
	$KMnO_4$ CCO-Mn	8.83			
	CBO_5	-			
	Permanent	0			
	Total "m"	2.36			
Acidity					
	Total (at 105°C)		516		
	Unfiltered (at 105^0)		250		
	Fixed (at 105 ° C)		266		
total SiO_2			-		
Hardness (^{0}d) German degrees	Total	10.64			
	Temporary	6.61			
	Permanent	4.03			

The concentration values determined for most of the analyzed indicators for this sample do not meet quality requirements in terms of color, odor, turbidity, manganese and zinc content. Following the treatment with the Crystal product, it is observed a decrease in the cations content after decanting the water and after its filtration and chlorination. The water quality has been improved, this meeting the standards in force in terms of organoleptic effects (Figs. 1; 2).

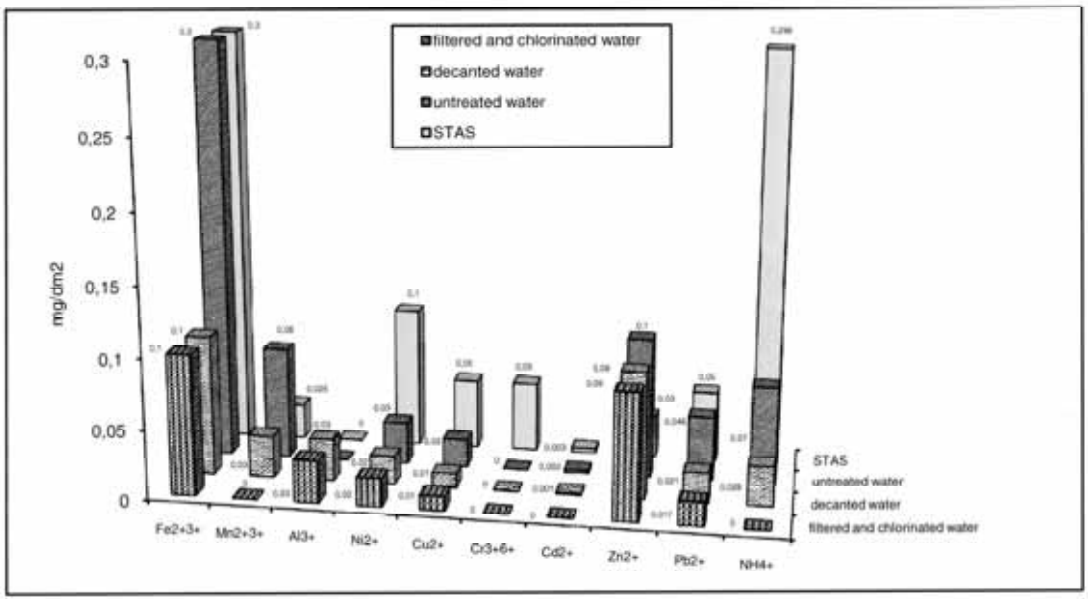

Figure 1. The cation content during water treatment in the Işalnița station.
Figura 1. Conținutul în cationi în timpul procesului de tratare a apei în stația Işalnița.

In order to improve the turbidity, there was used a basic poly aluminum and calcium hydroxide, the optimum coagulation pH = 7 upH, leading to a decrease from 210 UNT to 6.8 UNT, the used dose being of 4.73 mg/l. The dose was established as a result of experiments conducted initially in the pilot station, starting from the administration of increasing amounts of aluminum sulfate concentration (Fig. 3).

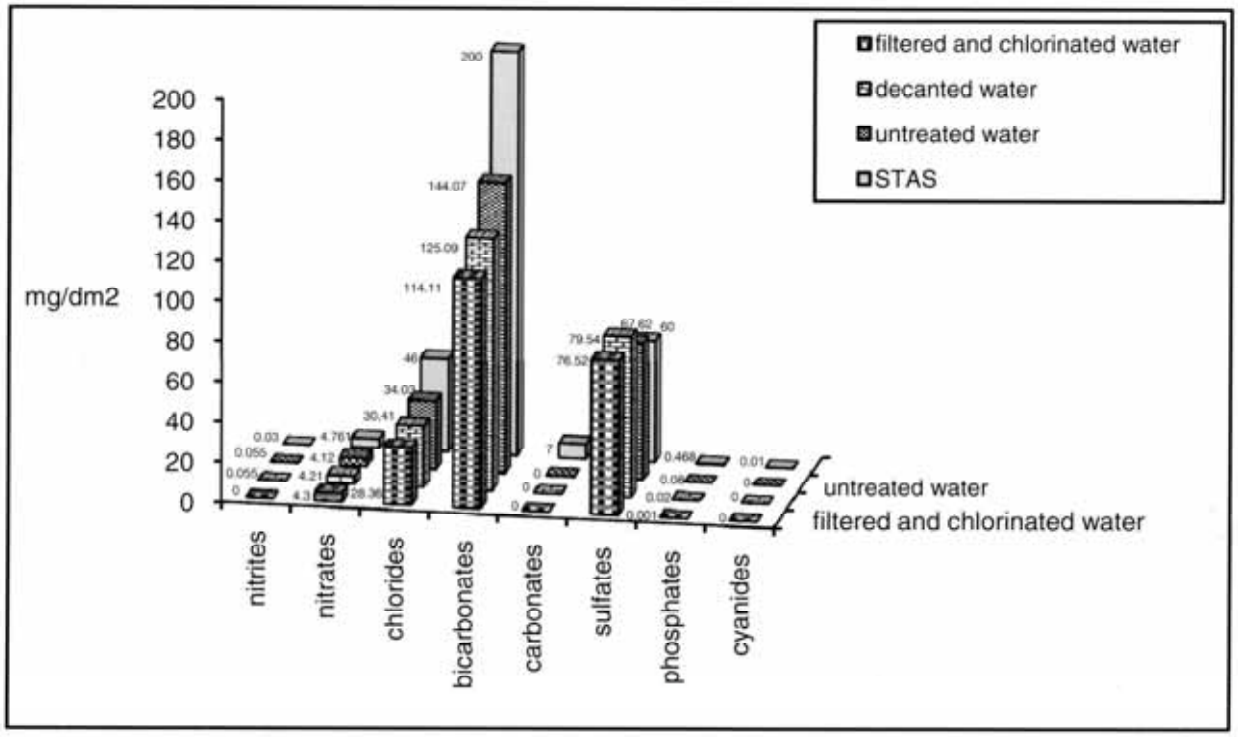

Figure 2. The anion content during water treatment in the Işalnița station.
Figura 2. Conținutul în anioni în timpul procesului de tratare a apei în stația Işalnița.

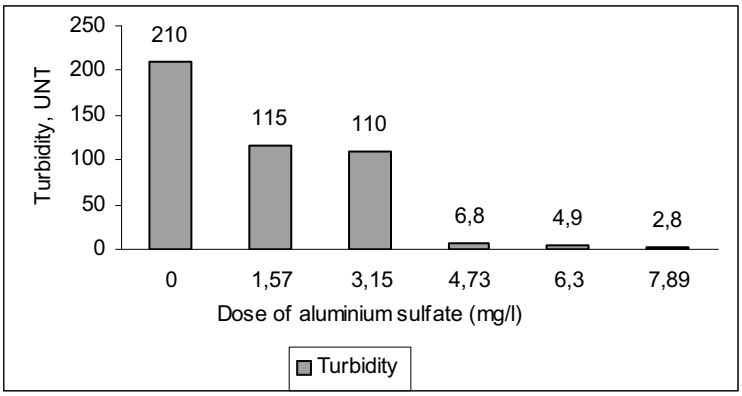

Figure 3. The turbidity variation depending on the dose of aluminum sulfate.
Figura 3. Variația turbidității funcție de doza de sulfat de aluminiu.

The application of aluminum sulfate and calcium hydroxide had also effect on the oxidisability of water (Fig. 4).

Bacteriologically speaking, the determined value of the coliform bacteria in raw water has a value of 5,420 total coliforms/100 cm^3 in comparison to the maximum admissible concentration of 10,000 total coliforms/100 cm^3.

The value of faecal streptococci is of 17 units/100 cm^3, normal value. From the microbiological point of view, the water falls into the first category of quality.

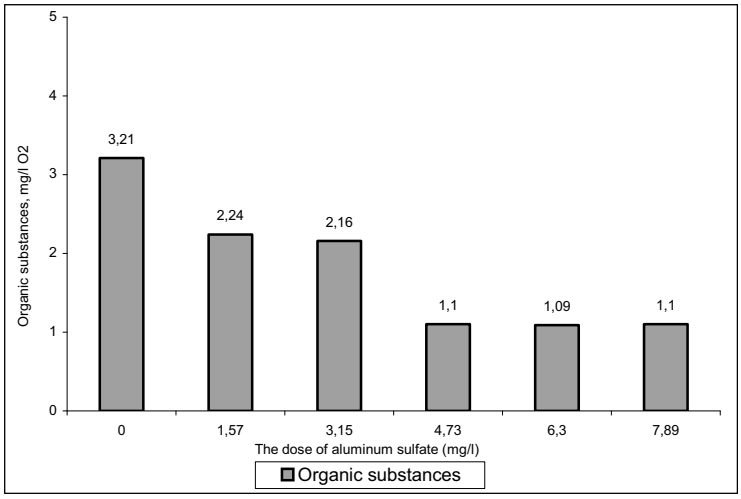

Figure 4. The oxidisability variation (organic substance) depending on the dose of aluminum sulfate.
Figura 4. Variația oxidabilității (substanță organică) funcție de doza de sulfat de aluminiu.

CONCLUSIONS

The use of treatment technology and the addition of aluminum sulfate and calcium hydroxide led to the reduction in cations and anions content, water turbidity and oxidisability.

In the pilot station there was established the useful dose of aluminum sulfate and calcium hydroxide, an optimal value to reduce turbidity and oxidisability (4.73 mg/l active ingredient).

REFERENCES

BAES C. F. & MESMER R. E. 1976. *Hydrolysis of Cations*. John Wiley & Sons. New York: 225-238.

BURTICĂ G., VLAICU I., NEGREA A. 2002. *Tratarea cu clor a apei în scop potabil*. Edit. Politehnica. Timişoara: 242-266.

BURTICĂ G., VLAICU I., NEGREA A., PODE R., PODE V., MICU D. 2000. *Tehnologii de tratare a efluenților reziduali*, Edit. Politehnica. Timişoara: 136-140.

CICAL E., BURTICĂ G., MECEA M. 2007. *Unele aspecte privind tehnici noi de tratare a apei*. Environment & Progress. Cluj-Napoca. **9**: 113-119.

DEGREMONT G. 2007. *Water Treatment Handbook*. 7–th ed. Lavoisier. Paris: 73-92.

FAUST S. D. & OSMAN M. 1998. *Chemestry of water treatament*. 2-nd ed. Butterworth Publishers. Stonenham. M. A.: 55-64.

FLOREA T., HUSZTI S., COSTIN GH. M. 2006. *Heavy metal contaminants in milk and cheese*. The Annals of the University Dunărea de Jos. Galați. **4**: 26-32.

TCHOBANOGLOUS G & EDWARD D. 1987. *Water quality*. Addison – Weslet Publishing Company. Reading. Melbourne. M. A.: 103-124.

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