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Study on the rehabilitation and retehnologization of water management unit in the locality Sannicolau Mare, Timis county

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Abstract: The paper analyzes the need and opportunity for rehabilitation and modernization of water management unit by filling a water treatment station from a source depth in Sânnicolau Mare, located in the west of the Country, and the treatment process efficiency achieved. In this aim it studied the variation of raw water quality indicators, into the water system and the values of these parameters from the process water treatment suggested and implemented. Determinations were performed laboratory tests both raw water and the treated water for the period December 2015 ÷ December 2016 after integrating treatment plant in water management unit. Based on these laboratory determinations, was chased the correction of quality parameters of drinking water and treatment plant efficiency. Water quality is analyzed comparing its values quality indicators with limits permitted by the relevant legislation (Drinking Water Act no. 458/2002, as amended by Law no. 311/2004, republished).

Keywords: rehabilitation, modernization, quality indicators, water management unit, water treatment

1. INTRODUCTION

Water is the most important food. It cannot be replaced. The man in extremis is deprived of water for other uses, but not for drinking water. Hang on for quite some time without food, but without water short time. Found water in various foods, but not be deprived of liquid water. Therefore the most important water for man has been, is and will be drinking water. Water treatment means the removal of most organic, inorganic and biological components present in the water, so the water produced to meet national and international standards regarding drinking water. Drinking water is part of the fresh waters having a purity (on bacteria and toxic) high that is suitable for drinking or for human cuisine. Problems that may arise regarding the deteriorating water quality are besides an inappropriate source, water plants that do not meet the hygienic point of view. A good quality drinking water should be cold (5°), with a pleasant taste, colourless and odourless with an average content of minerals (calcium carbonate, magnesium, sulphate salts with metals mentioned). The concentration of the mineral hardness sets. Centralized water use in population centers are a matter of the nearest future, related to the continued growth of the comfort and civilization. No longer conceive today socio-economic development of the territory without this leading utility, which is water quality is not ensured proper technical conditions [1] and [2].

2. PRESENTATION OF WATER MANAGEMENT UNIT IN SÂNNICOLAU MARE CITY, TIMIS COUNTY

2.1. DESCRIPTION OF THE CURRENT SITUATION

This village is located in the western county of Timis, at a distance of approx. 70 km from Timisoara, has an area of 9.18 km2 and a total of 13 904 inhabitants.

Up to the rehabilitation of water management unit and realization of treatment station, the town had a water supply system comprising:

• drilling depth (9 pieces) of which 7 functional, situated in the locality Sânpetru Mare, pumping water from wells directly off the storage tanks;

• raw water inflow OL Dn100 ÷ 300mm, distribution network consists of various pipe materials and diameters;

• water management unit consists of two water storage tanks (one of 2,000 cubic meters and one 500 cm), pumping stations (8 pumps, some inoperable) of water in distribution network.

2.2. DESCRIPTION OF EXISTING TREATMENT TECHNOLOGY INTO WATER MANAGEMENT UNIT

Water treatment abstracted from underground consisted of disinfection by chlorination. Chlorination of raw water was carried out by means of dosing equipment.

After analyzing the water abstracted and distributed, were found above the maximum limits of iron, manganese and total coliform bacteria above the limits stipulated by the legislation on drinking water quality for human consumption. In these circumstances, the system did not comply with the

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rules on water treatment, water treatment requiring mandatory.

To correct the abovementioned indicators was proposed building within existing water management unit, a Water Treatment Plants.

3. WATER QUALITY MONITORING INTO AND OUT OF TREATMENT PLANT

Raw water abstracted from boreholes is pumped through submerged pumps at existing water management unit through the feed pipe, partially rehabilitated.

Raw water quality parameters used in the design of the treatment process are presented in the following table. Quality parameters which are exceeding the limits are highlighted.

Table 1. Physical, chemical and microbiological parameters of raw water in the period 2011 ÷ 2014

Parameter	U.M.	PARAMETERS OF RAW WATER			Maximums allowed values in drinking water	Obs.
		minimum values	averages	maximum values		
Oxidability-Permanganate index	mgO2/l	0,32	0,94	1,54	5	according to Law 458/2002, Law 311/2004, OG11/2010 and OG1/2011
pH		7,7	7,9	8,0	6.5 – 9.5	
Turbidity	NTU	0,4	1,1	2,7	max. 1	
Ammonium	mg/l	0,083	0,118	0,201	max. 0,5	
Calcium	mg/l	66	74	90	-	
Chlorides	mg/l	33,7	37,9	40,3	250	
Alkalinity	mval/l	4,7	5,5	6,5	-	
Acidity	mval/l	0,1	0,2	0,7	-	
Nitrites	mg/l	0,005	0,008	0,011	0,50	
Nitrates	mg/l	0,5	0,5	0,5	50	
Iron	mg/l	0,11	0,35	0,53	max.0,2	
Manganese	mg/l	0,04	0,11	0,17	max 0,05	
Total hardness	grd. G	14	16	19	min.5	
Total coliform bacteria	Nr./100 cmc.	0	0	21	0	
Enterococci	Nr./100 cmc.	0	0	0	0	
Escherichia coli	Nr./100 cmc.	0	0	1	0	

From the analysis of raw water, resulted overcome following qualitative parameters:

- **Turbidity** which must be below 1 NTU. The method of reduction below 1 NTU consists in retaining the suspensions in filter with sand under pressure;
- **Iron and Manganese** Since the limit values are exceeded in iron and manganese dissolved and the pH is high enough it is proposed that the reduction of iron and manganese to be done by aerating for 30 minutes the raw water to oxidize iron which should be in a proportion of more than 80% and manganese in a proportion of less than 20%, but by slow filtration on manganese sand filters may also be further reduced at least 50%. In order to ensure the reduction of iron and manganese below the limits can be achieved, an additional dosage of NaOH - 20% in order to increase the pH value to 8.5, and an additional oxidation with chlorine to obtain a sufficient manganese process of quartz sand that provide the retention of oxides of manganese on the quartz sand grains.
- **Iron - Fe (dissolved)** which must be below 0.2 mg / l. The method for reducing the amount below 0.2 mg / l is iron oxidation through aeration, precipitation of this, in the form of iron oxide and retention in sandy filters under pressure;
- **Manganese - Mn (dissolved)** which must be below 0.05 mg / l. The method of reducing the amount of less than 0.05 mg / l is the oxidation of manganese, the first phase through aeration in the aeration tank, after phase oxidation of iron and then will be oxidized if necessary Cl2 immersed in water, its precipitation in form of manganese dioxide and retention in pre-manganesed sandy filters and phase two by oxidation and retention of manganese dioxide in pre-manganesed filtering layer of sand filters. The amount of manganese in water is sufficiently low that only high value of pH of raw water and the use of filters with manganesed quartz sand (or use 10% manganese dioxide in filters) to reduce the amount of manganese in the water filtered under 0.05 mg / l. Also during water disinfection with chlorine oxidize the manganese, but in this case manganese oxides will settle in treated water storage tanks.

Coliforms bacteria, Enterococci and Escherichia coli from raw water removed by oxidation - disinfection process with chlorine dissolved in filtered water (hypochlorous acid).

Table 2. Values of quality indicators analyzed in the period December 2015 December 2016 ÷

Parameter	U.M.	TREATED WATER PARAMETERS			Maximums allowed values in drinking water	Obs.
			averages			
Oxidability-Permanganate index	mgO2/l		<1		5	according to Law 458/2002, Law 311/2004, OG11/2010 and OG1/2011
pH	Units of pH		7,5		6.5 - 9.5	
Turbidity	NTU		-		max. 1	
Ammonium	mg/l		<0,10		max. 0,5	
Calcium	mg/l		97		-	
Chlorides	mg/l		-		250	
Alkalinity	mval/l		7,2		-	
Acidity	mval/l		0,4		-	
Nitrites	mg/l		-		0,50	
Nitrates	mg/l		1,3		50	
Residual chlorine	mg/l		0,40		0,50	
Iron	mg/l		<0,010		max.0,2	
Manganese	mg/l		<0,03		max 0,05	
Total hardness	Grd. G		15		min.5	
Total coliform bacteria	nr./100 cmc.		<1		0	
Enterococci	nr./100 cmc.		<1		0	
Escherichia coli	nr./100 cmc.	-	<1		0	

4. MOTION FOR EXECUTION OF A WATER TREATMENT PLANTS IN THIS TOWN

The perimeter available for carrying out the construction of the treatment plant is situated within the water management unit from Sânnicolau Mare, located in the south-eastern village on DJ 682.

Table 3 shows the flow of water abstracted from the groundwater source for Sânnicolau Mare

Table 3. Flow for sizing Treatment Station

Type flow	Reference	Measurement units	Raw water flow
maximum daily	Qin 1	mc/day	3661

Treatment process proposed for this source water includes [3]:

- aeration (optional oxidation hiperclorinate water)
- rapid filtration under pressure with sand filter
- rapid filtration under pressure with granular activated carbon
- disinfection
- water treatment of filter washing.

Treatment Plant proposed has the following structure design (Figure 1 - Flow diagram of the technological process):

1 Aeration tank with role of degassing, oxidation, homogenization (mandatory); Aeration blowers, household reagents;

2 Filtration in rapid sand filters under pressure and the GAC filters;

3 Treatment of washing: Decanter sequentially, sludge pumping station, sludge beds;

4 Disinfection / final Chlorination;

5 Storage and distribution;

6 Building Treatment Station.

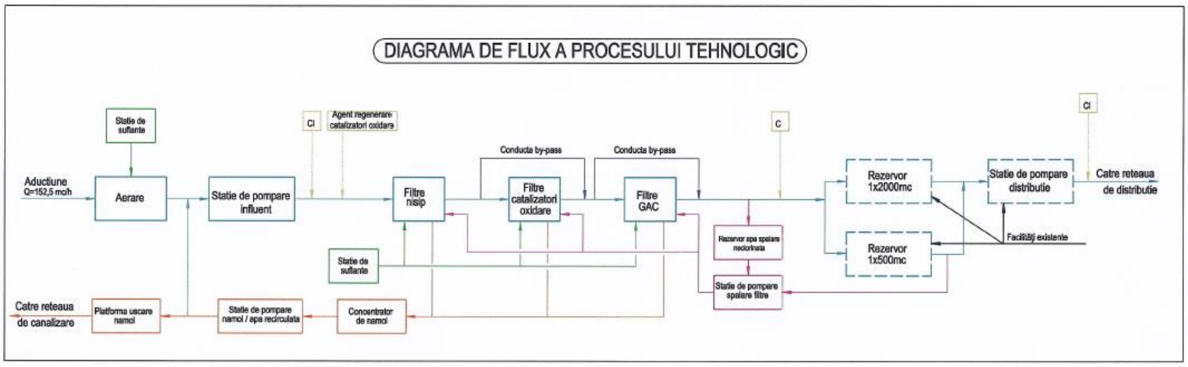

Figure 1. Flow diagram of proposed technological process for Treatment Station

4.1. INTAKE

For water abstraction is proposed rehabilitation of existing boreholes. The rehabilitation works aimed the feed pipe of PE-ID with 125 mm ÷ De 315 mm from boreholes (raw water) to existing storage tanks (rehabilitated).At the entrance to the existing household water was installed an electromagnetic flowmeter Dn200 mm and a pH sensor, temperature and conductivity transducer.

4.2. AERATION AND REAGENTS

The presence of iron and manganese in water in concentrations that exceed allowable limits for drinking water, present some disadvantages. Aeration-oxidation process aims to improve the oxygen content of the water and correct the overall balance of Fe and Mn compounds so as to enable their subsequent detention by filtration. Also aeration realize the removal of free CO_2 (reducing the aggressiveness of the water), H_2S, NH_3, smell and unpleasant taste of the water and at the same time increasing the amount of dissolved oxygen due to the aeration indirectly contribute to improving the biological degradation of the pollutants from the water.

By connecting pipe, raw water from wells is pumped directly into the Treatment Station respectively in the aeration basin.

Aeration tank has a volume of 112.5 cubic meters for a minimum contact time of 30 minutes and consists of 4 sections, each with drain pipe with valve: Inlet basin, aeration basin, reagents basin and aspiration basin.

Related aeration tank there is a pumping station blowers that includes two blowers 1A + 1 R, Q = 71 Nm^3 / h on the blower at a pressure of 700 mbar and Pn = 4 kW, driven variable speed, for adjusting the air flow introduced in the aeration tank and for providing adjustment of a preset amount of dissolved oxygen in aerated water (approximately 2 mg O_2 / l).

Household reagents: If it will not be able to ensure the reduction of iron and manganese by aeration, oxidation with Cl_2 and retaining on sand filters, on the suction pipe of the water aerated there would be an injection solution of NaOH (caustic soda) concentration 20 %, which helps to increase water pH to 8.5. A high value of the pH is necessary to accelerate the oxidation of iron and manganese.

4.3. FILTRATION

Continued treatment line, filtering, represents in technological line the step through separating the impurities from the water subjected to treatment. Through filtration are retained gravimetric and colloidal suspensions, organic matter and minerals, chemical compounds, microorganisms and bacteria. The degree of clarification water is dependent on the rate of filtration, on the size and concentration of particles in the suspension, the nature, grain size and filter layer thickness.

Aerated raw water is pumped from the aeration basin using pumping station influential in sand filters. Influent pumping station (Figure 2) consists of three centrifugal pumps (2A + 1R) + variable speed + frequency converter, each pump with the following features: Flow Q = 100 m^3 / h, pumping head H = 20.2 mCA and power Pn = 7.5 kW.

The role influent pumping station is to wash GAC filters. GAC filters washing will be done with non-chlorinated water.

The filters are washed in counter current with filtered water and compressed air, water caring the deposition of the granules of coal, and compressed air contribute to the blowing and washing the granules of coal. GAC filters are washed alternately with sand filters.

Figure 2. Treatment Plant proposed - influent pumps / wash filters

Sand filters: the filtration process with silica sand were provided 6 fast filters under pressure, DN 2600mm, made of carbon steel, with the purpose of retention of the compounds of Fe and Mn being sized so as to provide a specific speed of filtration of 4.98 m / h in the case of all the six filter units of the filter and 5.98 m / h in the case when one filter is in the filtration wash or maintenance. The principle of filtering and control of filters will be of filtration type with different flow through each filter unit and equal pressure at inlet respectively outlet water at the entrance of each filter unit.

Filters GAC: in the filtration process after quick filters with sand were provided three filtration units with granular activated carbon (GAC) under pressure, DN2600mm, made of carbon steel, sized to provide specific speed filtering 9.97 m / h in the case of filtration through the filtration of 3 units and 14.95 m / h when the filter is the filter in the wash. The principle of filtering is similar to that of the sand filters (Figure 3).

Figure 3. Proposed Treatment Plant - sand filters + GAC filters

Bellows filters sand and GAC: air needed during sparging process of washing sand filters and filters GAC process is provided by a blower station consists of two blowers, S1 and S2 (1A + 1R), located in the new hall design .

4.4. WASH WATER TREATMENT

Water treatment process includes the recovery of wash water filters. It is proposed that filters wash water is discharged into a buffer tank, sequentially settler (Figure 4) with a total volume of 40 cubic meters. After gravity sedimentation, the sludge will be pumped through pump group 2A + 1R (each pump with Q p = 8 cm / h, H = 30 mCA, Pn = 3 Kw) to drying beds (2x12mc) respectively to sewerage and the water decanted it may re-entered in treatment system not to exceed 10% of the nominal flow of station.

Provide two platforms of drain / drying / storage of the slurry with dimensions L x l x h = 3 x 2 x 2 m. Platform for drying sludge must be able to take water volume from the settling of the drain case thereof. The slurry concentrate is pumped through a pipe located at half the width of the platform. A platform for drying sludge volume is 12 cubic meters for 207 days of storage / dehydration.

Water from the sludge drainage will be collected by home set at the end of the platforms and will be discharged to existing domestic sewage. To prevent moisture of the sludge due to rainfall proposed drying beds sludge covering with cellular polycarbonate plates.

To ensure the evaporation of water from sludge by convection effect, polycarbonate roof perimeter must ensure a free space to ensure natural ventilation.

Figure 4. Sequential Decanter for water washing treatment

4.5. DISINFECTION

For completing the treatment process is envisaged and disinfection phase by chlorination. The proposed treatment process is used for oxidation preclorinare faster Fe and Mn compounds even NH4 (when needed). Chlorination for disinfection is achieved by two injections of treated water transmission pipelines, one before treatment water storage and two after leaving the tanks representing the correction of residual chlorine.

Thus, chlorination of the water occurs through three injection points chlorine, the chlorination station is provided with four metering of chlorine and three injectors of chlorine.

All three injections of chlorine will be such as to maintain the residual chlorine concentration of water (maximum 0.5 mg / l).

Metering chambers and storage containers with chlorine will be equipped with an automatic detection of chlorine gas leak complemented by a system of neutralization of chlorine gas.

4.6. STORAGE AND DISTRIBUTION

2,000 cubic meters storage tank and pumping station distribution existing were provided for rehabilitated (Figure 5).

Equipment and instrumentation will be monitored and controlled by the SCADA system. With the help of process equipment ensures online monitoring, local display and signalling dispatcher operating parameters and water quality as follows: turbidity, temperature, pH and conductivity.

Figure 5. rehabilitated tanks with total capacity of 2500 cubic meters; Pumping station rehabilitated

4.7. TREATMENT STATION FACILITY AND ARRANGEMENT FIELD

Treatment Station building is a new construction, made from a metal structure with pillars profiles, beams (frames) and closed with sandwich panels (Figure 6).

Figure 6. Treatment Plant Building

5. CONCLUSIONS

The purpose of the study was to analyze the need and opportunity to rehabilitate and modernization Water Management unit by adding a water treatment plant from source deep of this village in Timis County.

Raw water quality and treated subsequently in Treatment Plant analysis was performed by comparing the measured values with the limits stipulated in Law no. 458/2002 completed with Law no. 311/2004 on drinking water quality, republished.

Quality parameters of raw water and treated compare mainly were: oxidisability, pH, turbidity, chlorine, ammonia, nitrites, nitrates, iron, manganese, total hardness, coliforms, enterococci, Escherichia coli [6], [7] [8], [9], [10] and [11].

At existing water management unit resulted exceedances of drinking water quality indicators (iron, manganese, colifforme bacteria, enterococci, Escherichia coli), hence requiring the design and execution of a potable water treatment plant in the existing households.

After designing and execution of treatment station, water quality indicators registered at the exit

of the treatment station falls within the limits of current legislation on drinking water quality, mentioned above.

In conclusion, with the rehabilitation and upgrading of the system of water supply and so by making treatment station for Sânnicolau Mare locality, obtain a safe system in terms of operation and in terms of the quality of water delivered to consumers, largely due to the automation of technological processes that occur.

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[3] Realizare Staţie de Tratare a Apei în oraşul Sânnicolau Mare. P6/2013/2014 Beneficiar: Aquatim S.A

[4] Directiva Consiliului European 98/83/CE privind calitatea apei destinate consumului uman

[5] Legea nr. 458/2002 completata şi modificată de Legea nr. 311/2004;

[6] SR ISO 6060/96 privind determinarea oxidabilitatii;

[7] SR ISO 10523/97 privind determinarea pH-ului

[8] STAS 6323/88 privind determinarea turbidităţii;

[9] STAS 6328/85 privind determinarea amoniului;

[10] STAS 3048/2-96 privind determinarea nitritilor;

[11] SR ISO 6332; 6333 /96 privind determinarea fierului şi manganului din apă;