OXIDABILITY, ALUMINUM AND SULPHATES AT THE RAW WATER SONIC REGIME TREATMENT

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1. INTRODUCTION

Untreated water used in water plants comes mostly from surface water. Surface waters from rivers are often troubled, because the shifting riverbed train and maintain colloidal suspension as fine particles and larger particles that are suspended. Colloidal particles in suspension generally consist from many molecules groups. The size of these particles varies between 1 and 100 μm. Liquid water particles in suspension more than 100 mm in size [4,5]. To remove these particles drinking water treatment plants use aluminum-based coagulants (aluminum sulfate, aluminum polihydroxicloride). Their use often leads to high concentrations of aluminium in treated water (higher than in raw water).

High levels of aluminum in drinking water is a concern worldwide due to the potential association of aluminum with serious diseases affecting the nervous system (Lan Gehrig's and Parkinson's disease, Alzheimer's disease) or may affect other medical conditions: anemia, osteomalacia, etc. [9].

Untreated water may be cloudy and unpleasant appearance and the presence of microorganisms over the allowable limits and bacteria, and people who use untreated drinking water can become sick. To determine the germ, etc. streptococci the bacteriological analysis of water are made. Since processing in terms of bacteriological tests takes between 36 and 72 hours to remove possible contamination and rapid intervention in the process, determine the chemical "*oxidability*" water - oxidizable organic substances in water. The sample for this indicator of water quality and immediately processed according to the result may occur in the process water treatment**.** This indicator of water quality is very important for each stage of the process technology of drinking water**.** Current technologies [4,5,9] attempt to obtain low values for these quality indicators, and one of them is a new technology [2,3] done with sonic installations for treating raw water.

2. SONIC INSTALLATION FOR RAW WATER TREATMENT

Sonic treatment plant raw water is an experimental installation designed water plants containing only the first phase of the raw water treatment process of drinking waters, namely: clarification. Sonic installation for raw water treatment is the experimental equipment (Fig. 1) for

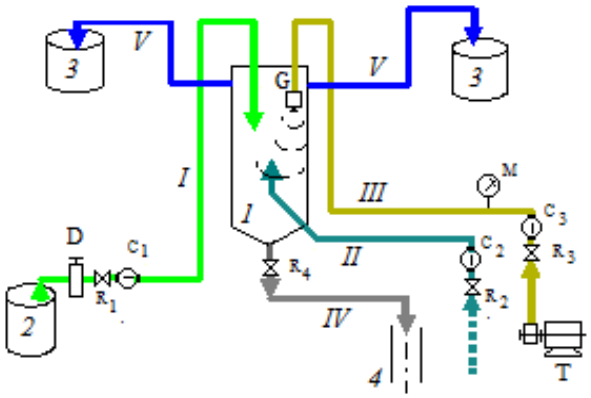

Figure 1. Sonic installation for raw water treatment :1-*settler; 2- coagulant tank; 3- decanted water tank; 4- sewerage; G-sonic generator; D- coagulant dozer;* R_1*- coagulant flow control valve;* C_1*-coagulant monitoring meter;* R_2*-raw water regulating valve;* C_2*- meter raw water monitoring; T- turbocharger;* R_3*- air pressure regulating valve; M- manometer;* R_4*- sludge discharge control valve.*

drink water plants. It is containing only the first phase of the treatment of raw water for drinking, namely clarification. The experimental sonic settler (Fig. 2) with the volume of 4 m³ is fed raw water (the Danube) by a pipeline which are mounted a valve and a meter for controlling and monitoring of raw water.

Sonic settler is powered aluminum sulfate solution through a system (Fig. 3) which are mounted a control valve and a meter to monitor coagulant. Coagulant used to treat raw water in the pond is aluminum sulfate AL2 (SO4) 3 • 16H2O, an inorganic coagulant for water produced according to European Standard EN 878/2004 and is marketed in the form of solid with a density of 2.71 g / cm^3. In

Figure 2. Sonic settler (top view).

Figure 3. The aluminum sulfate solution input system of sonic settler (dozer, pipe, valve, meter)

plant technology was used as aluminum sulfate solution with a density of 1.032 g/dm³, it provided for the classic settlers corresponding raw water turbidity ranging between 18 and 21 degrees NTU and water temperature ranging between 24 and 26° C.

Pressurized air supply comes from a sonic generator turbocharger (SRD type 20, flow of 220 m3 / h, working pressure 0.05 MPa) through a pipe on which are mounted a control valve and a

Figure 4. The air supply pressure of the sonic generator (pipe, valve, gauge).

manometer to monitor air pressure, Fig. 4. The air-jet sonic generator used in this installation is shown in Fig. 5. The generator is one with two frequency

Figure 5. The two-frequency sonic generator

(sound-ultrasound) and have the following parameters: sound frequency of 10.76 kHz and ultrasound frequency of 21.520 kHz. Acoustic emission intensity level at the sound frequency of 109.88 dB, is slightly bigger on the 1.8 dB than acoustic intensity of 108.09 dB for ultrasound frequency. The overall sound intensity produced by the generator is 112.32 dB. The sonic generator is placed inside the mixing chamber (see Fig. 6) of

Figure 6. Reaction chamber (mixing chamber is situated inside)

experimental settler at the depth of 0.75 m above the water level. Based on prior research was considered a duty cycle for an hour (depending on the speed of ascent in the raw water clarifier) with effective operating and alternating periods of rest. Based at the experimental measurements carried out it was chosen the optimum operating cycle for 5 minutes with 15 minutes break. Effects of sonic generator take place in reaction chamber (Fig. 6), which leads to amplification of physical- chemical

reactions that produced at the molecular level and accelerates the process of coagulation - flocculation.

Decanted water is taken by pipeline taking V (Fig. 1) from the top of the sonic settler. The floccules results from the process of coagulation - flocculation is deposited at the bottom of the sonic settler and the certain time periods are discharged through a discharge pipe IV on which is mounted a valve for controlling maneuvers.

3. SONIC TREATMENT EFFECT ON THE WATER OXIDISABILITY

It is considered one hour running time consists of three cycles, each for 5 minutes of effective operation of the generator followed by a 15-minute break. The principle method for determining water oxidisability (oxidizable organic matter in water) is synthesized as follows: organic substances are oxidized with potassium permanganate in acidic or alkaline at boiling. Excess unused potassium permanganate oxidation reaction is reduced and the excess oxalic acid oxalic acid is titrated, hot potassium permanganate to the persistence of weak ties pink [6]. Oxidisability value of raw water, the Danube for the period in which these determinations were made was of 3.36 mg O_2 / *l,* while the water was decanted in decanter experimental 1.84 mg O_2 / *l.* From Fig. 7 it is observed that the oxidisability value of sonic

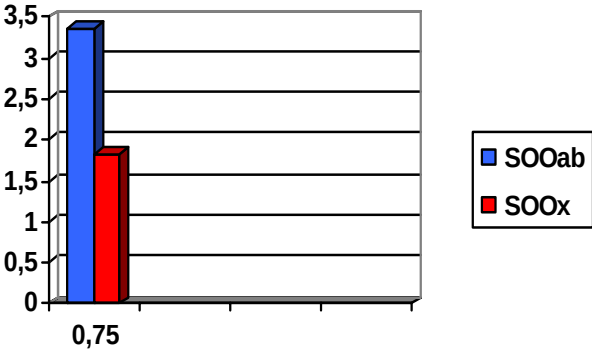

Figure 7. Oxidisability value for sonic decanted water and for raw water (SOOab - raw water oxidisable organic substance; SOOx – sonic decanted water oxidisable organic substance).

treatment decanted water decreased and is 1.826 times smaller than the value determined for the raw water. Replacing sonic generator with an aerator the showed the average increased oxidisability decanted water (Fig. 8)

The decanted water oxidisability value when the sonic generator was replaced with an aerator is the 2.40 mgO / l. This value is at 1.3 times higher than for using sonic generator case, which

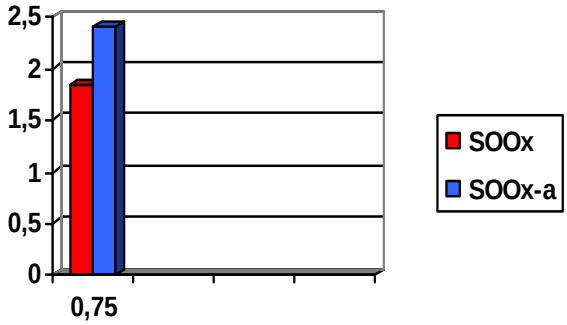

Figure 8. Oxidisability value for sonic decanted water and for the aerated water (SOOx-a - aerated water oxidisable organic substance; SOOx – sonic decanted water oxidisable organic substance)

shows the pure effect of two frequency acoustic field on the water treatment. Determinations were carried out and where the raw water was treated only with coagulant, sonic generator is stopped. The oxidisability value of water in this case was 2.48 mg O_2 / *l.* In Figure 9 shows that this value is about 1.35 times higher than that obtained with using sonic generator.

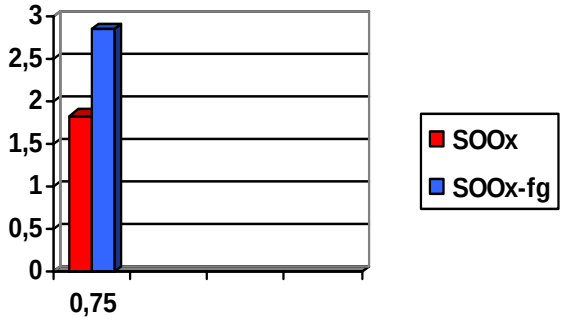

Figure 9. The amount of water oxidisability decanted after the shareholders obtained from the generator without the generator drive.

In order to appreciate the effect of sonic treatment compared with conventional technology, parallel determinations were made in the two types of settlers, shown in the figure below From figure 10 it is observed that water oxidisability

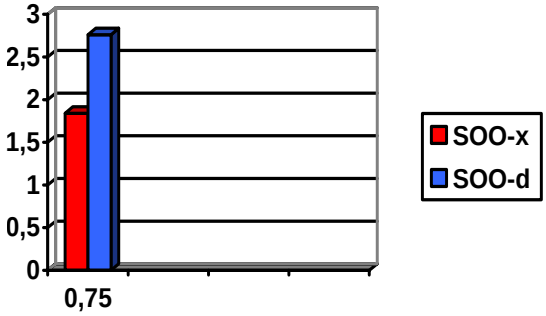

Figure 10. The oxidisability value of treated water obtained with the experimental sonic settler and with the classic.

obtained by the classic settler is a 1.5 times higher than that obtained by the experimental sonic settler. The value of water oxidisability decanted by classic settler is 2.76 mg O_2 / *l.*

4. EFFECT OF SONIC TREATMENT ON THE CONTENT OF ALUMINUM IONS IN WATER

As in the previous cases was considered an hour of operation consists of three cycles: five minutes of actual operation of the generator followed by a 15 minute break. The generator submerged depth is also the 0.75 m above the water surface. The principle method for determining the content of aluminum ions in the water, can be summarized as follows: aluminum ions form with aluminona at pH = 4 red colored complex whose absorbance is measured at wavelength of 525 mm [8]. The value of aluminum ion content of raw water (Danube) was 0.03 mg / l (30 mg / l). The test results showed (Fig. 11) that the decanted water content of aluminum ions obtained by sonic settling (Al-x = 0.12 mg / l)) is 1.66 times smaller than the

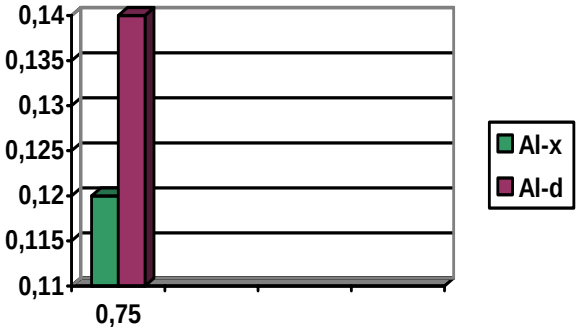

Figure 11. The content of aluminum ions from water obtained by sonic technology and with a classical treatment

value obtained at the classic settling (Al-d = 0.14 mg / l). It should be noted that the effect of reducing the content of aluminum ions sonic treated water is beneficial to aquatic ecosystems and human health.

5. EFFECT OF SONIC TREATMENT ON THE CONTENT OF SULFATE IONS IN WATER

They kept the same working conditions as before: three cycles of 5 minutes of operation of the generator followed by a 15-minute break. Depth of immersion of the generator was 0.75 m. The principle method for determining the content of sulfate ions in water can be synthesize as follows: the average alcohol sulphates in the presence of barium sulfate barium chloride are titrate using Thorin as indicator to turn color from yellow to pink, persistent [7]. The experimental results showed (Figure 12) that the sulphate ion content

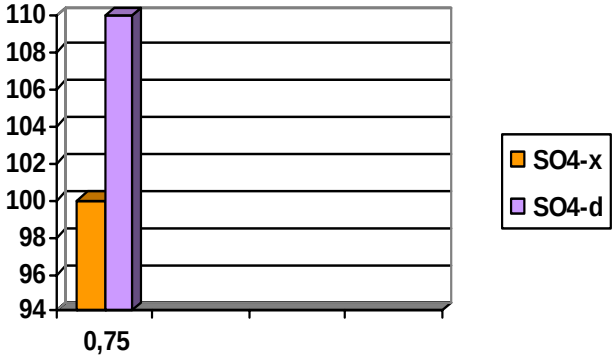

Figure 9. The amount of water oxidisability decanted after the shareholders obtained from the generator without the generator drive.

obtained with sonic settling (SO4-x = 100 mg / l) is lower than determined value for classic settling (SO4-d=110 mg/l). The value of sulfate ion content in the raw water (Danube) was 70 mg/l.

6. CONCLUSIONS AND RECOMMENDATIONS

On the platform of Braila water treatment plant the experimental installation for treat the raw water was made, that contains: vertical settler, two-frequency sonic- ultrasonic type air-jet generator, and necessary systems for raw water supply, for air pressure, for coagulant solutions. Were studied physic-chemical indicators of water quality: oxidisability, content of aluminium and sulphate ions. It was considered an hour of operation consists of three 5-minute cluri effective operation of the generator followed by a 15-minute break at a depth of 0.75 m above the water level in the settler. Thanks to the two-frequency acoustic field (sonic frequency of 10.76 kHz, 21.520 kHz ultrasonic frequency, the overall sound intensity of 112.32 dB) were obtained the following effects:

- decreased the water oxidisability value (oxidizable organic substances) in 1.5 times compared with that obtained by classical technology and at 1.826 times compared the raw water;
- reduced water content of aluminum ions in 1.66 times compared with classical technology;
- decreased from 110 mg / l to 100 mg / l the sulfate ion content in water for sonic decantation compared to the classic decantation.

Replaced the sonic generator with an aerator in experimental settler was observed that value of decanted water oxidisability becomes more than 1.3 times compared with water treatment with generator. This confirms that parallel aeration and degassing by bubbling water take place and the cavitation processes.

Results confirm the beneficial effects of the water treatment with two-frequency sound - ultrasound acoustic field and finally on the environmental and public health systems, given that drinking water is part of the daily needs of each individual.

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