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USING NATURAL MATERIALS IN THE PURIFICATION OF DRINKING WATER

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Abstract: Coagulation and flocculation are processes in which colloidal impurities, which are very hard to precipitate, are transferred to the precipitated form. To speed up the process and increase the effect of precipitation tests were conducted with dosing of natural material, in this case, quartz flour as mechanical means of improving the precipitation process. The essence of quartz flour to the fact that particles of quartz flour weight increase already coagulation particles and easier to precipitate. It should be noted that this is not intended to replace the aluminum sulfate with quartz flour, but to the common dosage speed up and improve the process of sedimentation.
Keywords: drinking water, natural materials, quartz flour

1. INTRODUCTION

The quality of drinking water sources, methods of its protection and quality of drinking water are regulated by specific regulations. Some natural waters meeting with regulations and are usually subject only to disinfect. However, most of the natural water does not meet the regulations, but must be processed to obtain hygienic drinking water, esthetically pleasing, drinkable and satisfying price.

Surface waters are usually processed technological process which includes: pre-chlorination, coagulation and flocculation, sedimentation, filtration and disinfection. Such technological process typically removes discoloration, turbidity, increased organic matter, bacteria and other harmful substances, which are characteristics of surface waters.

Precipitation, as a central part of mentioned water purification technology, takes place in depositing large cross section so that the speed reduction of water flow, comes to precipitation of suspended particles. Precipitation undergoes raw water which is pre-coagulated and pass the flocculation. Coagulation can remove turbidity (organic and inorganic), color, harmful bacteria and other pathogens, then algae, plankton organisms and also substances that make water smell and taste.

As the main coagulant in this technology used aluminum sulfate, which meets the required standards on the use of chemicals for drinking water treatment. Extra coagulant used is polyelectrolyte. Coagulant dosages are determined by reference to the quality of raw water.

They tend to be artificial materials in the process of drinking water treatment replacement of natural materials, in whole or in part, so in this paper deals with the use of quartz flour as an aid in the process of sedimentation.

2. QUARTZ FLOUR

Silicon (Si) is a chemical element of group IV, 3rd periods of the Periodic System, serial number 14, atomic weight 28.086. After oxygen is the most abundant element in the earth's crust, as SiO_2 (quartz) and it is an ingredient of many silicate rocks and minerals.

- **Quartz**, a mineral in nature is one of the most widespread modification of silicon oxide SiO_2. It occurs in several forms, clean, colorless and transparent quartz or a rock crystal, colored amethyst (purple), citrine (yellow) and sooty (brown), and was used as a gemstone. Quartz is found in many rocks (quartz wire, sandstone) or quartz sand used for the manufacture of refractory bricks, glass, ceramic, concrete, as well as filter media in water treatment process. It melts at 2635-2660˚C, the density is 2600-2700 kg/m^3, and hardness is 7 Mohs. It is resistant to acid (except hydrofluoric), but not to alkali. Quartz is stable, inert and insoluble in water.
- **Quartz flour** is obtained by grinding quartz sand, which should be of greater purity with higher SiO_2 content (97-98%). Impurities and accompanying minerals are usually clay, iron compounds, alumino-quartztes and oxides Al_2O_3, CaO, MgO, K_2O, Na_2O. Can be produced in different grades depending on your needs. It is added in products such as toothpaste, detergents for washing and scrubbing, in paints and varnishes, etc.

3. DOSAGE OF QUARTZ FLOUR

For the study of joint action of aluminum sulfate and quartz flour in the process of settling tests were conducted in laboratory conditions (Flock test) and in the process of purifying drinking water. Tests were performed on the Purification plant "Kraljevica", in Public Utility Company of water supply, Zajecar.

Laboratory tests include analysis of Flock tests as an imitation of the process of coagulation and flocculation in the experimental conditions. Flock tests are performed with cups containing 500 ml of raw, untreated water. The water is dosed with pipettes of 5% solution of aluminum sulfate and 0.1% solution of polyelectrolyte, so that these quantities correspond to certain doses can be dispensed in the process. In addition to these chemicals that are commonly added to the precipitation process, were added different amounts of quartz flour and 5; 7,5; 10; 12,5; and 15 g/m^3. Thus prepared glasses with test doses were put on a magnetic stirrer and mixed as long as they could to take residence time of flocculation water in the precipitator type "pulsator". After the expiration of the Flock test and after an hour of standing it was sampled clarified water from the cup and from the surface, which corresponds to the collection of clarified water in sewers pulsators. Of water taken from the cup, made the following analyzes: pH, turbidity, $KmnO_4$ consumption, OR – Pb, the content of sulphate and aluminum, as well as the amount of precipitated sludge in Imhof funnel after 30 and 60 minutes.

3 sets of laboratory test are made with different raw water quality, particularly different turbidity and organic matter content.

Process dosage of quartz flour was done 2 times, also in periods when the raw water has special characteristics. Adding quartz flour was carried out discontinuously, for 15 minutes, by hand, in a tub with a 5% solution of aluminum sulfate, in the raw water before entering the pulsator. Doses of quartz flour were changed from 5 to 7,5 up to 10 g/m^3, and the parameters monitored in the process were: pH, turbidity, $KmnO_4$ consumption, OR – Pb, the content of sulfate and aluminum sulfate and aluminum content and the raw water, after sedimentation in the final water.

Results of laboratory and process test results are shown in tables and graphs.

4. EXPERIMENTAL AND PROCESS RESULTS

EXPERIMENTAL RESEARCH – I series of Flock tests

Experimental research in the first series of Flock tests was done with raw water that had specific characteristics: turbidity from 12 to 14 NTU and KmnO4 consumption was 13 mg/l. Such as this water were added chemicals with the following doses: 30, 40, 50 and 60 gr/m^3 Aluminium sulfate and always 0.2 gr/m^3 polyelectrolyte (PE). Quartz grain flour was 71 μm, dosed in proper glasses in the concentration of 5 and 10 gr/m^3. Higher doses of flour were out of the question because of the unfavorable results obtained in the previous series of Flocktests.

» Flock Test No. 1 (with dosing of quartz flour)

Chemicals used in this laboratory experiment and fit the solutions that were used in the process:

The parameters of used raw water:

- 5% aluminum sulfate (Al_2SO_4)
- 0.1% polyelectrolyte
- Quartz grain flour 71 μm
- $UV_{254\ nm}$ = 0.144 A
- turbidity = 12 NTU
- consumption of $KmnO_4$ = 13.02 mg/l

Table 1. Turbidity, 12 NTU (%)

Dosing of chemicals						
Number of cups (500 ml)	1	2	3	4	5	6
Aluminum sulfate (g/m^3)	30	30	30	40	40	40
Polyelectrolyte (g/m^3)	0,2	0,2	0,2	0,2	0,2	0,2
Quartz flour (g/m^3)	0	5	10	0	5	10
Results						
Height of sludge (mm) - duration of the process 30 min	0,3	0,2	0,3	0,5	0,2	0,4
Height of sludge (mm) - duration of the process 60 min	0,4	0,35	0,45	0,95	0,45	0,55
Turbidity, NTU (%)	7,2	7,9	7,4	6,7	5,2	6,6
$KMnO_4$ consumption (mg/l)	16,75	11,7	11,7	17,07	10,43	11,38
$UV_{254\ nm}$ (A)	0,115	0,118	0,114	0,104	0,088	0,101
Aluminum - Al (mg/l)	0,422	0,455	0,424	0,401	0,326	0,358

» Flock Test No. 2 (with dosing of quartz flour)

Chemicals used in this laboratory experiment and fit the solutions that were used in the process:

The parameters of used raw water:

- 5% aluminum sulfate (Al_2SO_4)
- 0.1% polyelectrolyte
- Quartz grain flour 71 μm
- $UV_{254\ nm}$ = 0.210 A
- turbidity = 14 NTU
- consumption of $KMnO_4$ = 13.02 mg/l

Table 2. Turbidity, 14 NTU (%); $UV_{254\,nm}$ = 0.210 A

Dosing of chemicals						
Number of cups (500 ml)	1	2	3	4	5	6
Aluminum sulfate (g/m^3)	50	50	50	60	60	60
Polyelectrolyte (g/m^3)	0,2	0,2	0,2	0,2	0,2	0,2
Quartz flour (g/m^3)	0	5	10	0	5	10
Results						
Height of sludge (mm) - duration of the process 30 min	0,55	0,95	1	1,5	0,8	1,1
Height of sludge (mm) - duration of the process 60 min	0,8	1,05	1,2	1,55	0,9	1,2
Turbidity, NTU (%)	6,1	5,0	5,1	3,8	3,4	2
$KMnO_4$ consumption (mg/l)	11,16	8,99	8,99	10,54	8,37	8,68
$UV_{254\,nm}$ (A)	0,120	0,096	0,099	0,081	0,075	0,060
Aluminum - Al (mg/l)	0,441	0,397	0,468	0,431	0,431	0,313

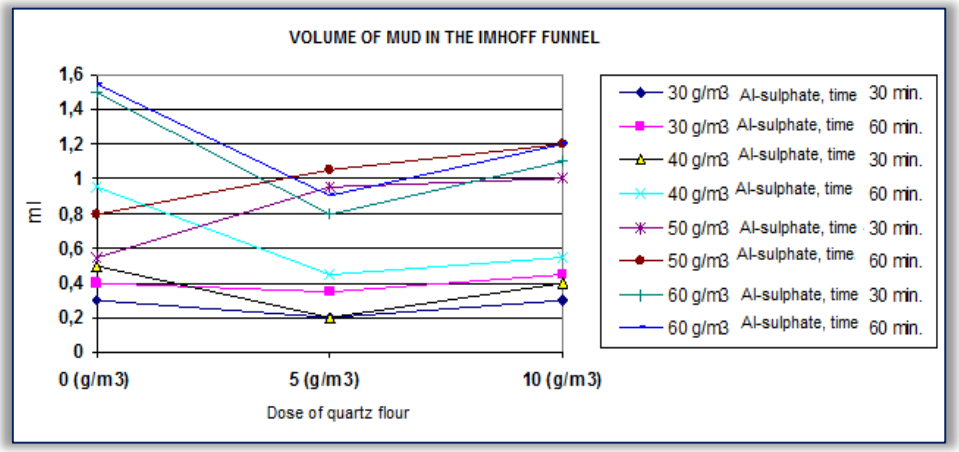

Figure 1. Diagrams of the experimental results dosing of quartz flour

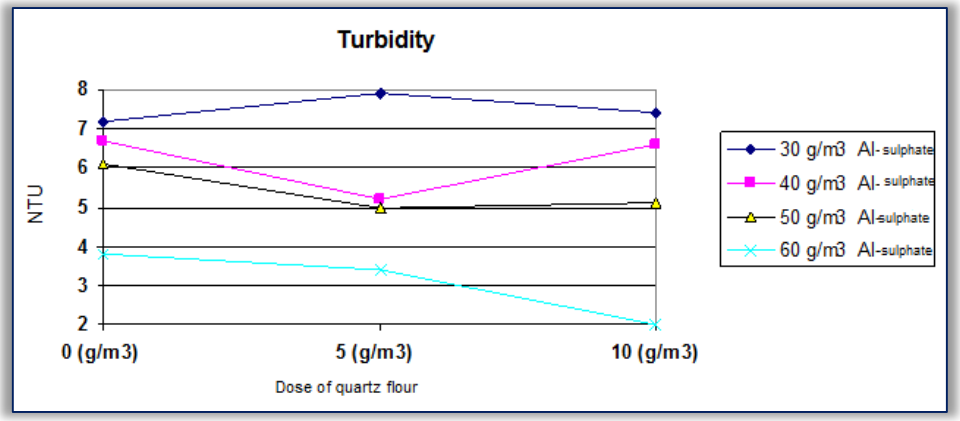

Figure 2. Diagrams of the Turbidity

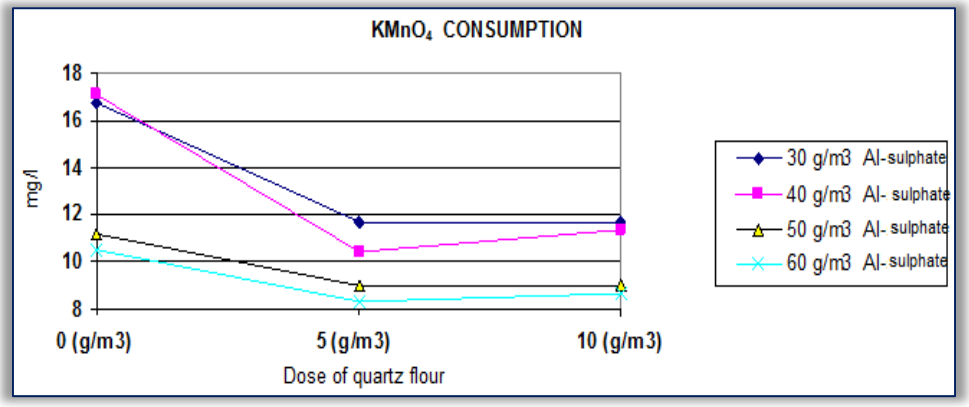

Figure 3. Diagrams of the $KMnO_4$

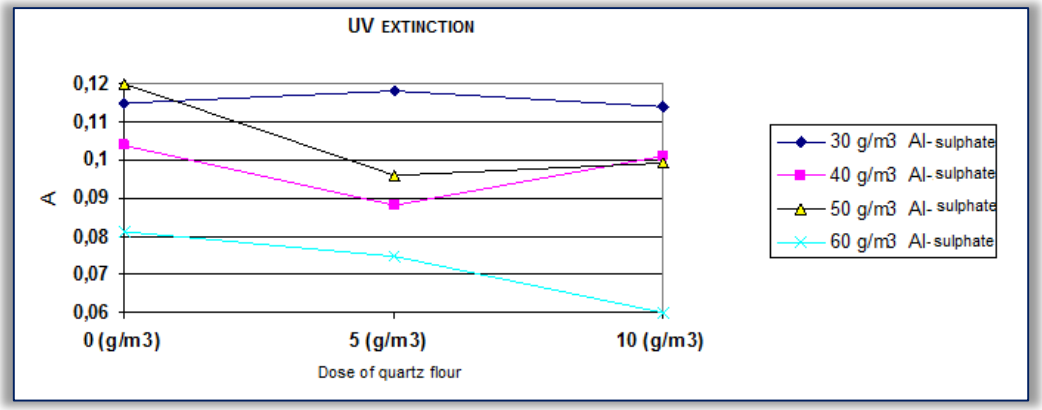

Figure 4. Diagrams of the UV EXTINCTION

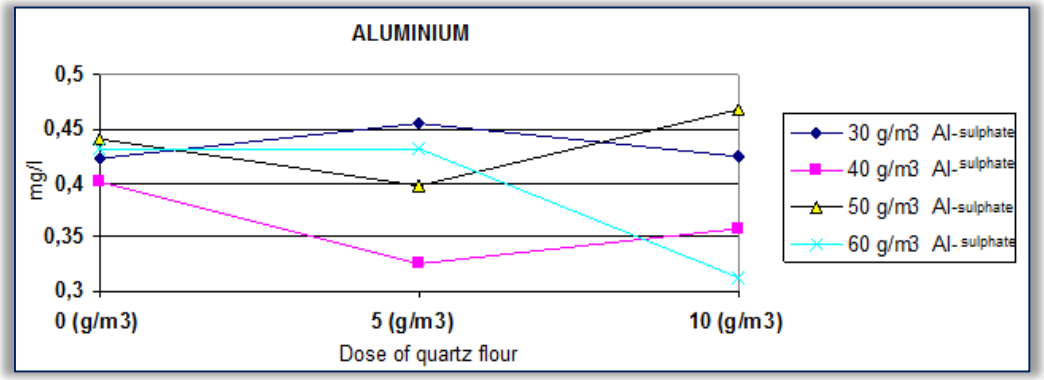

Figure 5. Diagrams of the ALUMINIUM

» ANALYSIS OF THE EXPERIMENTAL RESULTS

Volume of sludge in a simple precipitation was performed in Imhof cone gauge and noted after standing 30 and 60 min. for all samples. Graphic on page 3 clearly shows the increase in the amount of sludge with increasing doses of aluminum sulphate. Adding quartz flour is not achieved increased volumes of sludge, except at a dose of 50 g/m^3 Al-sulphate.

The effect of turbidity reduction increased with increasing doses of aluminum sulfate to 40% (30 g/m^{3}Al-sulphate) to 73% (for 60 g/m^3 Al-sulfate). By adding 5 g/m^3 and 10 g/m^{3}quartz flour yielded results only at higher doses of the primary coagulant, and the largest decrease in turbidity of 76% was achieved in 60 g/m^3 Al-sulfate + 5 g/m^{3}of quartz flour, and a decrease than 86% were at doses of 60 g/m^3 Al-sulphate and 10 g/m^{3}of quartz flour.

The reduction of organic substances found only at a dose of 50 g/m^3 to 60 g/m^3 Al-sulphate (without the addition of flour), and by about 15-20%. The use of quartz flour effect of reducing significantly increased in all the cups and at all doses of primary coagulant and a maximum of 31-36%. It is interesting that the same effect of reducing the organic matter achieved with doses of 5 g/m^3 and 10 g/m^{3}quartz flour.

Comparing the results of UV-Pb observed to decrease this parameter only with the high dose of aluminum sulfate of 60 g/m^3, with a decrease of raw to clarified water to 61%. Adding quartz flour 5 g/m^3 reduction was 64% with 10 g/m^3 reduction was 71%.

Residual aluminum, in all containers which did not contain quartz flour (cup 1 and 4, Flock Tests 1 and 2), ranged from 0.40 to 0.44 mg/l. Reducing the use of aluminum, quartz flour showed at doses of 40 g/m^3 Al-sulfate, mostly at doses of 60 g/m^3 Al-sulphate and 10 g/m^{3}quartz flour and 27%.

Summarizing the overall results of series II of Flock test, it is concluded that the effect of adding a quartz flour but only at high doses of the primary coagulant (aluminum sulfate) of 60 g/m^3, while reducing turbidity, UV and Pb content of aluminum, while the addition of quartz flour $KMnO_4$ consumption reduced at any dose of aluminum sulphate.

Bearing in mind that the aim of this analysis was that the addition of quartz flour reduced dose of aluminum sulphate, it must be noted that it is not proved possible, except in the case of the overthrow of organic matter.

» PROCESS RESEARCH

Quartz flour, grain size 71 μm, dosed during the period when it was increased turbidity of raw water from 17.02. until 27.02. year. To blurred water fromthe place named "Grliste", which came on the processing, came still

from 15.02., with the dose of aluminum sulphate gradually increasing more than 30 g/m3 to 60 g/m3, and polyelectrolyte of 0.15 g/m3 to 0.2 g/m3.

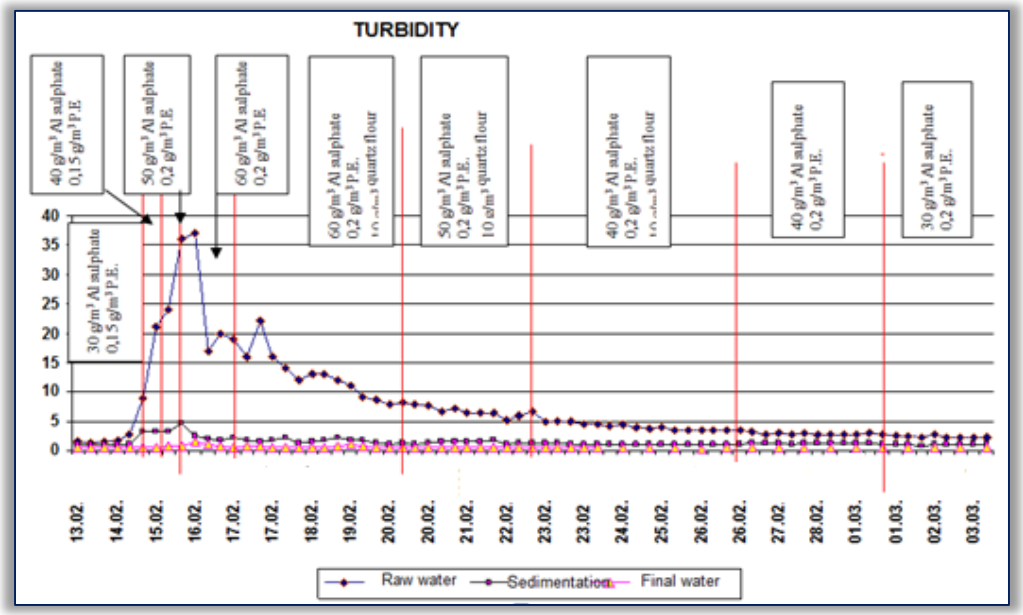

Figure 6. Graphic presentation of results dosing quartz flour – TURBIDITY

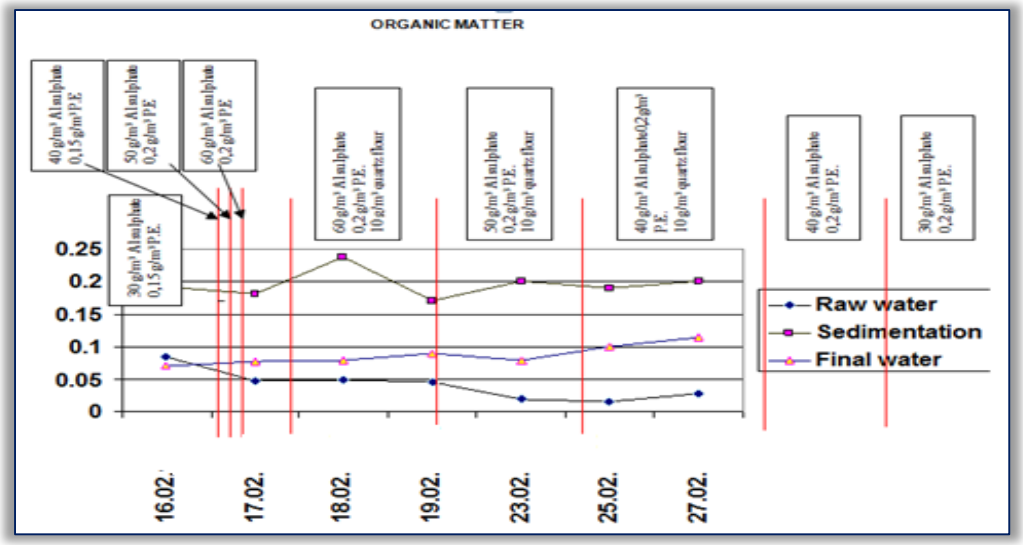

Figure 7. Graphic presentation of results dosing quartz flour – ORGANIC MATTER

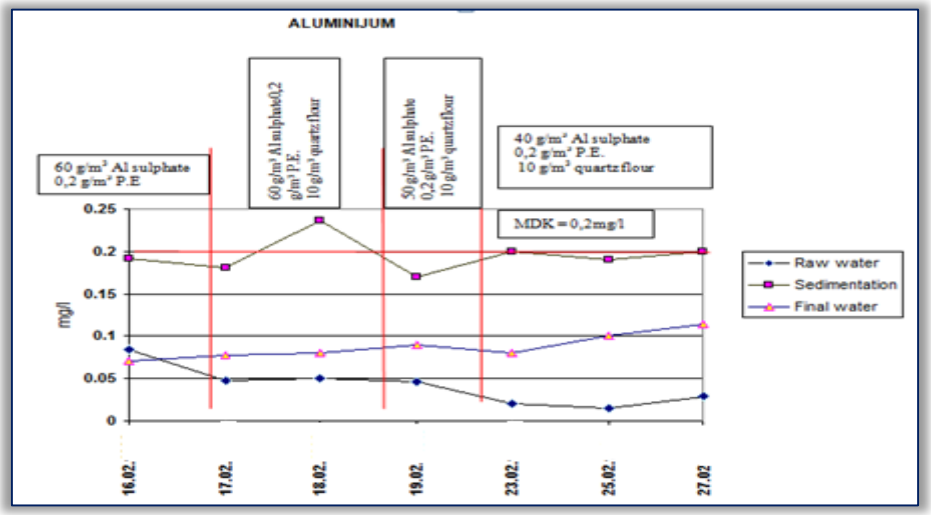

Figure 8. Graphic presentation of results dosing quartz flour – ALUMINIJUM

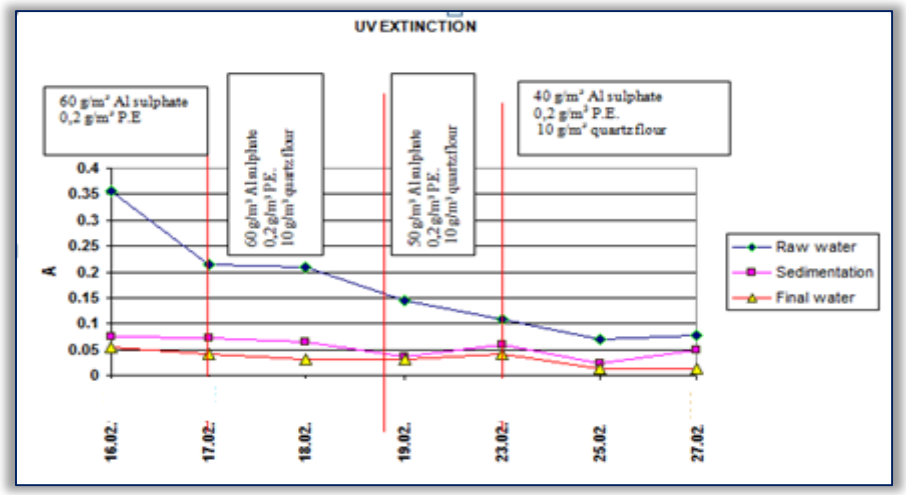

Figure 9. Graphic presentation of results dosing quartz flour – UV EXTINCION

Quartz flour was added to both the bath to create a solution of aluminum sulphate and at a dose of 10 g/m3, which has not changed. Maximum turbidity of 36 NTU in the raw water was at 16.02.1998, which resulted in blurred water sedimentation in the final water. After that, the turbidity gradually decreased from 20 NTU to 3 NTU. Proportional reduction of turbidity in raw water, lowered the dose of aluminum sulphate from 60 g/m3 to 30 g/m3, while the polyelectrolyte dose of 0.2 g/m3 and quartz flour of 10 g/m3 continuously maintained. (figures 6, 7, 8, 9).

» Analysis of the results of process dosing quartz flour

After adding aluminum sulfate 60 g/m^3 and 0.2 g/m^3 polyelectrolyte, the state of the sedimentation filter and the final water has stabilized and the next days was not significantly changed despite the decrease in turbidity of raw water, the simultaneous dosing of aluminum sulphate and adding quartz flour. Even after the end of dosing quartz flour 27.02, the process did not show any changes.

Diagrams of turbidity, organic matter, content of aluminum and UV - Pb give a clear picture of the phenomenon described in the treated period from 13.02 to 03.03.

EXPERIMENTAL RESEARCH - II series of Flock test

A second series of Flocktests (No. 3, 4, 5 and 6) was performed in the period from 01.04. to 04.04. This series of tests was performed for a comparative analysis of the effects of various quartz grain flour. Quartz flour that was used had a grain size 71 μm and 95 μm and purchased from the manufacturer "Quartz" Rgotina.

Analysis consisted in the fact that the different dose combinations of aluminum sulfate (30 and 40 g/m3) and polyelectrolyte (0.15 and 0.2 g/m3), doses 5 and 10 g/m3 quartz flour both grain. In addition, in a glass, no flour, was raised a dose of aluminum sulphate by 5 g/m3, which served as a comparative experiment to assess the required effects. The following parameters were: UV - Pb, turbidity, KMnO4 consumption, and aluminum sulphate content and volume of sludge deposited in Imhof cone gauge after 30 and 60 minutes.

» Flock Test No. 3 (with dosage of different quartz grain flour)

Chemicals used in this laboratory experiment and fit the solutions that were used in the process:

The parameters used raw water:

- 5% aluminum sulfate (Al_2SO_4)
- 0.1% polyelectrolyte
- I - quartz grain flour 71 μm
- II – quartz grain flour 95 μm
- Al = 0 mg/l
- $UV_{254\ nm}$ = 0.040 A
- turbidity = 1.4 NTU
- consumption of $KMnO_4$ = 12.87 mg/l
- SO_4 = 36 mg/l

Table 3. Turbidity, 14 NTU (%); $UV_{254\ nm}$ = 0.040 A

Dosing of chemicals						
Number of cups (500 ml)	1	2	3	4	5	6
Aluminum sulfate (g / m^3)	30	30	30	30	30	35
Polyelectrolyte (g / m^3)	0,15	0,15	0,15	0,15	0,15	0,15
Quartz flour (g / m^3)	0	5 (71μm)	10 (71μm)	5 (95μm)	10(95μm)	0
Results						
Turbidity, NTU (mm)	3,8	3,9	3,5	3,1	3,0	2,7
KMnO4 consumption (mg / l)	11,30	11,93	10,99	10,36	10,67	9,73
Aluminum Al (mg / l)	0,825	0,850	0,730	0,680	0,640	0,600

» Flock Test No. 4 (with dosage of different quartz grain flour)

Chemicals used in this laboratory experiment and fit the solutions that were used in the process:
The parameters used raw water:
- 5% aluminum sulfate (Al_2SO_4)
- 0.1% polyelectrolyte
- I - quartz grain flour 71 µm
- II – quartz grain flour 95 µm
- Al = 0 mg/l
- UV $_{254\ nm}$ = 0.055 A
- turbidity = 1.5 NTU
- consumption of $KMnO_4$ = 12.56 mg/l
- SO_4 = 33 mg/l

Table 4. Turbidity, 15 NTU (%); $UV_{254\ nm}$ = 0.055 A; SO_4 = 33 mg/l

Dosing of chemicals						
Number of cups (500 ml)	1	2	3	4	5	6
Aluminum sulfate (g / m^3)	40	40	40	40	40	45
Polyelectrolyte (g / m^3)	0,15	0,15	0,15	0,15	0,15	0,15
Quartz flour (g / m^3)	0	5 (71µm)	10 (71µm)	5 (95µm)	10 (95µm)	0
Results						
Turbidity, NTU (mm)	3,2	3,5	3,3	3,3	3,4	3,0
KMnO4 consumption (mg / l)	10,75	11,70	12,01	11,38	12,96	12,33
Aluminum Al (mg / l)	0,68	0,68	0,65	0,64	0,68	0,62

» Flock Test No. 5 (with dosage of different quartz grain flour)

Chemicals used in this laboratory experiment and fit the solutions that were used in the process:
The parameters used raw water:
- 5% aluminum sulfate (Al_2SO_4)
- 0.1% polyelectrolyte
- I - quartz grain flour 71 µm
- II – quartz grain flour 95 µm
- Al = 0 mg/l
- UV $_{254\ nm}$ = 0.055 A
- turbidity = 1.5 NTU
- consumption of $KMnO_4$ = 12.56 mg/l
- SO_4 = 27.5 mg/l

Table 5. Turbidity, 15 NTU (%); $UV_{254\ nm}$ = 0.055 A; SO_4 = 27.5 mg/l

Dosing of chemicals						
Number of cups (500 ml)	1	2	3	4	5	6
Aluminum sulfate (g / m^3)	30	30	30	30	30	35
Polyelectrolyte (g / m^3)	0,2	0,2	0,2	0,2	0,2	0,2
Quartz flour (g / m^3)	0	5 (71µm)	10 (71µm)	5 (95µm)	10 (95µm)	0
Results						
Turbidity, NTU (mm)	2,7	2,4	2,4	2,4	2,0	1,8
KMnO4 consumption (mg / l)	11,93	12,24	12,56	11,93	12,87	11,93
Aluminum Al (mg / l)	0,84	0,79	0,8	0,71	0,66	0,68

» Flock Test No. 6 (with dosage of different quartz grain flour)

Chemicals used in this laboratory experiment and fit the solutions that were used in the process:
The parameters used raw water:
- 5% aluminum sulfate (Al_2SO_4)
- 0.1% polyelectrolyte
- I - quartz grain flour 71 µm
- II – quartz grain flour 95 µm
- Al = 0.011 mg/l
- UV $_{254\ nm}$ = 0.055 A
- turbidity = 1.6 NTU
- consumption of $KMnO_4$ = 10.67 mg/l
- SO_4 = 30 mg/l

Table 6. Turbidity, 16 NTU (%); $UV_{254\ nm}$ = 0.055 A; SO_4 = 10.67 mg/l

Dosing of chemicals						
Number of cups (500 ml)	1	2	3	4	5	6
Aluminum sulfate (g / m^3)	30	30	30	30	30	35
Polyelectrolyte (g / m^3)	0,2	0,2	0,2	0,2	0,2	0,2
Quartz flour (g / m^3)	0	5 (71µm)	10 (71µm)	5 (95µm)	10 (95µm)	0
Results						
Turbidity, NTU (mm)	3,7	3,3	3,1	3,1	3,7	3
KMnO4 consumption (mg / l)	9,73	8,79	8,79	9,10	11,93	9,10
Aluminum Al (mg / l)	0,82	0,8	0,71	0,72	0,77	0,64

» Analysis of the experimental results

Results of Flock test no.3, which had the lowest dose (30 g/m3 aluminum sulphate and 0.15 g/m3 polyelectrolyte), are shown on pages 9 and 11 by tables and charts. More effective precipitation yielded quartz grain flour 95 µm and with approximately the same doses of 5 and 10 g/m3. Smaller grain quartz flour of 71 µm gave a minimal effect of turbidity reduction parameters, consumption of KMnO4 and aluminum and only with a dose of 10 g/m3. The best results were achieved by increasing the dose of the primary coagulant (Al sulfate) to 5 g/m3 and no dosage flour.

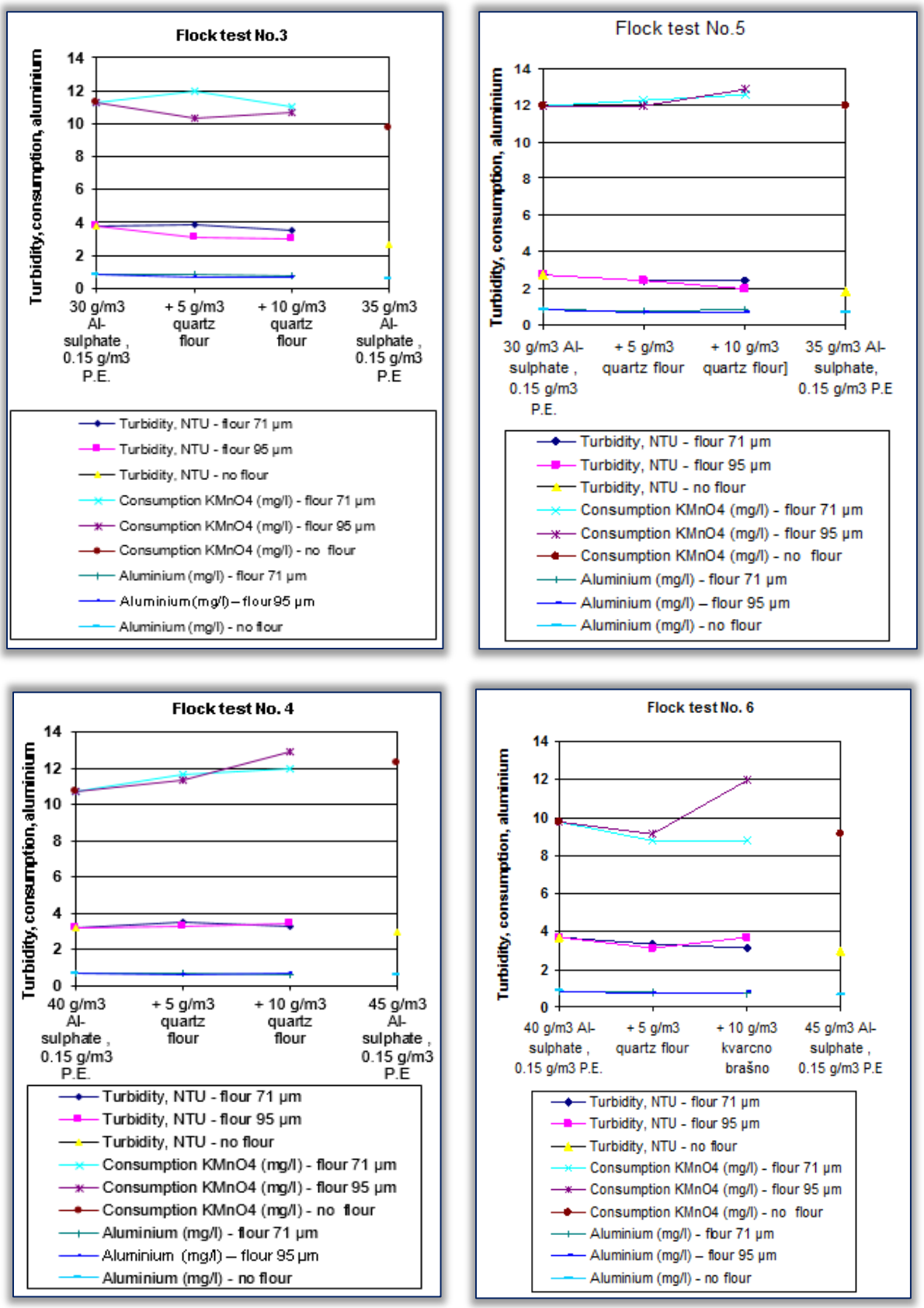

Figure 10. Diagrams of the experimental results dosing quartz flour

Doses of raw water treatment aluminum sulphate 30 g/m3 and 0.15 g/m3 polyelectrolyte, reduced turbidity of 3.8 NTU. Using quartz flour reached the lowest turbidity was 3.0 NTU (21% less) and increasing Al - sulfate to 35 g/m3 without dosing quartz flour, turbidity was brought down to 2.7 NTU (29%).

Consumption of KMnO4 is no flour was reduced to 11.3 mg/l, the use of quartz flour was reduced by 8%, while increasing the Al-sulfate to 35 g/m3 (no flour), was down throw to 14%.

Aluminum content of 0.825 mg/l was reduced to 0.64 mg/l (22.4%) by using 10 g/m3 quartz flour grain 95 μm. A better response is achieved by increasing the aluminum sulphate for 5 g/m3 (27.3%).
Flock test no. 4 with a dose of 40 g/m3 aluminum sulphate and 0.15 g/m3 polyelectrolyte, with the addition of quartz flour, did not show any of the monitored parameters, and even gone backwards KMnO4 consumption and turbidity and the use of both quartz grain flour.
Flock test no. 5 with a dose of 30 g/m^3 aluminum sulfate and 0.2 g/m^3 polyelectrolyte, showed improved most parameters dosing quartz flour. The only effect can be seen in the diagram turbidity and are better for large granularity.
Flock test no. 6 with a dose of 40 g/m^3 aluminum sulfate and 0.2 g/m^3 polyelectrolyte has shown that higher quartz flour grain of 95 μm gives higher levels of turbidity and organic matter (in a dose of 10 g/m^3), while the smaller grain size of 71 μm proved to be better with a slightly lower value of 16.2% for turbidity, organic matter of 9.7% and 13.4% for aluminum. A better response is achieved by simply increasing the dose of Al-sulfate at 45 g/m^3, without the use of quartz flour.
Summing up the series II of Flock tests can be noted that quartz flour grain plays a role in the precipitation of particles coagulation. In the bigger analysis conducted granulations flour a 95 μm proved favorable for the lower dose Al-sulfate of 30 g/m^3 and a small dose of polyelectrolyte of 0.15 g/m^3. Smaller grain-size composition of quartz flour of 71 μm is more fit to larger doses of Al-sulphate 40 g/m^{3}and polyelectrolyte 0.2 g/m^3. But the biggest effect of clearing, felling of organic matter and achieve better effect of precipitation is obtained by increasing the dose of the primary coagulant (Al-sulfate), without the use of mechanical means to improve the precipitation.

5. DISCUSSION AND CONCLUSION

The technology of purification of drinking water, among other technological operations, stands out a clarification process. The most frequently used chemicals in the process of clarification are: aluminum sulfate (primary) and polyelectrolyte (auxiliary coagulant). By coagulation and filtration can reduce suspended solids, iron, manganese, heavy metals, paint, algae, substances that give flavor and aroma, as well as part of the dissolved organic matter, so it is understandable that the precipitation process is a key operation in surface water treatment technologies.
This paper is an attempt to by now well-established precipitation process, enhance and promote the use of mechanical devices - quartz flour, rather than changing the current conventional means for clearing the newly discovered complex aluminum salts (Megaflok and Koaflok).
Results of laboratory tests, Flock tests series indicate that the use of quartz flour in the process of precipitation gives significant effects in terms of reducing: turbidity, and aluminum and organic matter in relation to the process of clarification in which the quartz flour is not used. The best effect of reducing undesirable substances in water gave a dose of 10 g/m^3 quartz flour, and so the bigger grain size (95 μm) has more effect in the use of lower doses of aluminum sulphate and polyelectrolyte, a smaller grain size (from 71 μm), gives a better effect with increasing doses of the primary and auxiliary coagulant. However, significantly better results are achieved by increasing the clearing dose of aluminum sulphate for minimum 5 g/m^3, even 10 g/m^{3}with mechanical means. Such a relationship is shown as financial unjustified use of quartz flour to improve the water treatment process, given that the ratio of price-Al sulfate and quartz flour 1.3:1.
Process testing of quartz flour dosing did not give the expected results, which have been shown in laboratory conditions. This could be the result of considering the lack of uniformly and constant dosing, and because of inadequate dosage of quartz flour. The quartz flour is dosed into the prepared 5% solution of aluminum sulfate (whose concentration also varies due to manual dosing) in periods of 15 minutes, with the observed accumulation of flour on the bottom of the tub for dispensing. It would probably be in the process of clearing achieve better results if the quartz flour added up in the sump (pulsator) by uniformly ' seeding" above the surface of the water mirror, so that it aggravated the already formed layer of sludge in the sump and clear it from the clarified water. Something like this with current technology could not be done, but it remains for a second attempt.
The constant need for the process of purification of drinking water improve and advance, there is the need of new and more sophisticated technology, whereby we must decide for efficiency and effectiveness, as well as technologies for the specified category of environmental.

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