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# Development and Recommendations on the Stabilization of Water of the River Kigach to Improve its Quality

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**Abstract:** As shown by the study, the stability of water, characterized metrizable Langelier index (lL = pH rNS) Rizner (lR = 2rNS - pH), the potential precipitation of calcium carbonate (µSaSOz = 50 (Shcho - SCHS) mg / l, the indicators Lemma-stability (Ps =), amount of carbon dioxide in an aggressive form, is different for the three conditionally designated zones along the water line, "Ast-Rahan-Mangyshlak." By the number and composition of microorganisms was given estimation to microbiocenosis of water in water source of river Kigach and transported water conduit “Astrakhan-Mangyshlak”, shown dependence of microorganisms number from seasonal factors and anthropogenic stages. Evaluated saprophytic bacteria as environmental indicators of water quality on the basis of one-time comprehensive definition of them at different points in conduit “Astrakhan-Mangyshlak”, differing from each other by fouling factor and character of polluting, as well as hydro biological regime. Microorganisms growing in the water conduit are in a complex interaction with the environment.

**Key words:** Water quality · Evaluating the effectiveness of water disinfection · Coagulant

## INTRODUCTION

If at the beginning of the water conduit (LPDS "Kigach") changing parameters stability of river water depends on the dose of active chlorine in its disinfection, then as far as passing, that the water is due to the change of the processes that occur at the interface and in the bulk water phase, mainly hydro and microbiological - namely, the absorption of the residual-governmental organisms, dissolved oxygen and release carbon dioxide, yes. Increasing the concentration of $CO_2$ decreases the stability of water, process intensification fied water main construction material corrosion - are 17G1S and dissolution by the concentration of its deposits at the surface. The highest content of aggressive carbon dioxide characteristic of water in the water main point is 323 km, where there is a lease of structured bathrooms organisms [1, 2].

Coagulation at the EGM "Kigach" and "Kulsary" using sulfuric acid aluminum in the drinking water transported by conduit destabilizes water through hydrolysis of $(SO_4)$ 3 and hydrocarbon decomposition with the release of carbon dioxide:

$$A1_2\,(SO_4)\,3 + 6H_2O \rightarrow 2A1\,(OH)\,3 + 6H\bullet + 3\,SO_4\,2-,$$
$$H\bullet + HCO_3 - \rightarrow CO_2 \rightarrow + H_2O$$

Additional chlorination of drinking water and water insecurity deepens, according to the sanitary requirements, determines the necessity of its treatment with alkaline reagents allowed for use in systems of drinking water (calcium oxide, sodium hydroxide or sodium carbonate - soda ash).

## MATERIALS AND METHODS

The stability of water transported by water lines, in different paragraphs determined by the carbonate tests. Stabilization processing of drinking water in Kigach and Kulsary as defined doses alkaline reagent was performed

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using a solution of calcium oxide, sodium hydroxide and sodium carbonate. Solution of calcium hydroxide Ca (OH) 2 was prepared from almost pure reagent contained in vials of standard samples for pH-meter (pH = 12.45). After dissolving in distillate CaO in solution was 420 mg / l. To obtain a solution of sodium hydroxide NaOH and sodium carbonate $Na_2CO_3$ used reagents qualifications tion "h." The concentration of the sodium carbonate solution accepted 5.0% and NaOH - 2.0% [2].

Methodically stabilizing treatment of water was carried out in action-tion of 500 ml flasks with narrow long neck. Flasks filled with test water through the hose closed stream, dropped to the bottom of the flask, the hose removed, the flask was injected dose given an alkaline agent, thoroughly mixed and analyzed in time (20 min) after 1, 2, 3, 5, 10, 20 min. At the same time observed the kinetics of establishing a permanent pH, ie completion of the process of stabilization processing water. In the original and the processed water was determined temperature, the hydrogen index, alkalinity, hardness, calcium, the amount of ions for the calculations is the stability parameters of water. In order to optimize the process of stabilization of the water graphically established dependence of the potential precipitation of calcium carbonate and Langelier index of the dose of added reagent.

## RESULTS

The results obtained carbonate tests and stabilization of water treatment are shown in Tables 1, 2 and Figures 1-3. As Table 1, during the summer and autumn 2010, the original low-water river water in-krustabelna characterized by a positive potential deposition at its optimum values of + 7.5 mg $CaCO_3$ / l, correlates well with the calculated + 9.0 mg $CaCO_3$ / l, with an indicator of stability Ps = 1.08 and the index and calculated Langelier +0.75 +0.67. Chlorination reduces the stability of the water, but with the dosage of the inhibitor KW-2353 (15 mg / l) the potential deposition of transported water for 1 km is in the positive area + 1 mg $CaCO_3$ / l. The sharp decline in the stability of the water-denotes noted by 323 km in the aerobic zone, where the potential deposition takes the value to -10 mg/L, the experimentally determined in some the losses of carbon dioxide during sampling [3].

At 449 km in the transition zone, that the water potential of the deposition increases to - 5 mg $CaCO_3$ / l and finally, in the anaerobic zone ( Zhanaozen city 973 km) water regains stability by increasing the capacity of almost optimal region to +3.5 mg $CaCO_3$ / l. [4].

Thus, the most aggressive to calcium carbonate has transported water with a maximum content of carbon dioxide in the aerobic zone in paragraph 323 km.

Table 1: Results of tests of water carbonate settlement of Kigach and transported via conduit (September 2010)

| | Linear Operating Dispatcher Station Kigach | | Kulsary | | Atyrau | Zhanaozen |
|---|---|---|---|---|---|---|
| | River ref. water $16.09.15^{15}$ | 1 км $16.09.\ 16^{20}$ | 448 км $19.09.16^{00}$ | 449 км (BHC-8) $19.09.\ 16^{35}$ | 323 км $23.09.11^{10}$ | 973 км $26.09.\ 15^{30}$ |
| Indicators | Before contact с $CaCO_3$ | | | | | |
| t,°C | 20.0 | 19.0 | 20.2 | 21.0 | 20.0 | 21.2 |
| pH | 8.61 | 8.15 | 7.69 | 7.85 | 6.60 | 8.30 |
| $Щ_o$, mg - eq / L | 2.05 | 1.92 | 2.0 | 1.80 | 1.85 | 2.05 |
| | After contact с $CaCO_3$ | | | | | |
| t,°C | 20.5 | 21.2 | 20.8 | 19.9 | 21.0 | 22.0 |
| $pH_S$ | 7.97 | 8.08 | 7.86 | 7.87 | 7.90 | 7.95 |
| $Щ_S$, mg - eq / L | 1.90 | 1.90 | 2.05 | 1.9 | 2.05 | 1.95 |
| $pH_{S\ calc.}$ | 7.94 | 8.00 | 7.93 | 7.99 | 7.98 | 7.94 |
| $Щ_{S\ calc.}$ | 1.87 | 1.91 | 2.03 | 1.81 | 2.27 | 1.99 |
| | The results of tests of carbonate | | | | | |
| $\Delta Щ_i$, mg - eq / L | +0.15 | +0.02 | -0.05 | -0.1 | -0.2 | +0.07 |
| $I_{Lexperimental}$ | +0.74 | 0.07 | -0.17 | -0.02 | -1.30 | +0.35 |
| $\mu CaCO_3$., mg/L | +7.5 | +1.0 | -2.5 | -5.0 | -10.0 | +3.5 |
| $П_c$ experimental. | 1.08 | 1.01 | 0.98 | 0.95 | 0.90 | 1.04 |
| $I_L$ calc. | +0.67 | +0.15 | -0.24 | -0.14 | -1.38 | +0.36 |
| $\mu_{CaCO_3}$ calc.mg/L | +9 | +1.4 | -3.4 | -1.4 | -41.8 | +2.9 |
| $П_c$ calc. | 1.1 | 1.01 | 0.99 | 0.99 | 0.81 | 1.02 |
| $I_{R\ calc.}$ | 7.27 | 7.85 | 8.17 | 8.13 | 9.36 | 7.58 |
| $I_{R\ experimental.}$ | 7.33 | 8.01 | 8.03 | 7.89 | 9.20 | 7.60 |

Table 2: Results of the experiments conducted in the spring flood of 2010, water from the test on-site coagulation conduit "Astrakhan-Mangyshlak"

| No experience | Reagents. Mg/L | | | | Nature of flocculation after 5 minutes | Analysis of water quality | | | | | Cleaning effect, % | | Date and time of experience |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coagulants | | Flocculating Adofoam | | | | | | | | | | |
| | $A1_2(SO_4)_3$/ $A1_2O_3$ | Аква-Аурат-30по $A1_2O_3$ | Praestol RT650 | PHMG Biopag | | T,°C | pH, ед. | Щ, экв-экв/л | M, мг/л | Ц, градХКШ. | By turbidity | By chromaticity | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | 1. River water pr.Kigach (before chlorination) | | | | | | | | | | | | |
| 1 | 0 | 0 | 0 | 0 | - | 18.5 | 8.42 | 2.9 | 6.10 | 34 | - | - | 15.06.03 14 hour 20min |
| | 5/1.49 | - | - | - | The flakes are very small | 18.0 | 8.32 | 2.85 | 0.64 | 21 | 89.5 | 38.2 | |
| | 10/3.0 | - | - | - | Small flakes of light | 18.0 | 8.20 | 2.80 | 0.59 | 17 | 90.2 | 50.0 | |
| | 20/5.95 | - | - | - | Medium fast settling | 18.2 | 8.10 | 2.70 | 0.47 | 15 | 92.3 | 55.9 | |
| Ï | - | - | - | 1.0/0.2* | Small | 18.5 | 8.52 | 2.85 | 0.41 | 19 | 93.3 | 74.4 | 15.06.03 10: 00 hour |
| | - | - | - | 2.0/0.25* | | 18.4 | 8.51 | 2.87 | 0.44 | 17 | 92.8 | 50.0 | |
| | - | - | - | 3.0/0.35* | Medium fast settling | 18.5 | 8.44 | 2.84 | 0.47 | 14 | 92.3 | 75.9 | |
| | - | - | - | 4.0/0.70* | | 18.4 | 8.44 | 2.84 | 0.70 | 14 | 88.5 | 75.9 | |
| | - | - | - | 5.0/1.0* | | 18.6 | 8.52 | 2.88 | 0.80 | 14 | 86.9 | 75.9 | |
| III | 5.0/1.49 | - | - | 1.0/0.15* | Small flakes of light | 18.2 | 8.1 | 2.7 | 0.16 | 0 | 97.3 | 100 | 15.06.03 12 h 15 min |
| | 5.0/1.49 | - | - | 1.5/0.2* | Small dense flakes | | 18.2 | 8.17 | 2.7 | 0.25 | 0 | 95.9 | 100 |
| | 5.0/1.49 | - | - | 2.0/0.25* | medium dense | 18.4 | 8.15 | 2.69 | 0.29 | 0 | 95.2 | 100 | |
| 1V | 0 | 0 | 0 | 0 | - | 20.5 | 8.12 | - | 3.2 | 40 | - | - | 15.06.03 10.00 hour |
| | 15/4.48 | - | 0.1 | - | Big flakes, quickly settling | 22 | 7.43 | 2.3 | 0.19 | 19 | 93.7 | 52.5 | |
| | 15/4.48 | - | 0.3 | - | | 23.5 | 7.36 | 2.35 | 0.11 | 16 | 96.6 | 60 | |
| | 15/4.48 | - | 0.5 | - | | 23.5 | 7.30 | 2.2 | 0.09 | 13 | 97.2 | 67.5 | |
| V | - | 1.5 | - | - | Flakes are small, sluggish settling | 25 | 7.75 | 2.50 | 0.29 | 21 | 90.9 | 47.5 | 15.06.03 11.00hour. |
| | | 3.75 | - | - | | 22 | 7.62 | 2.40 | 0.20 | 21 | 93.8 | 47.5 | |
| | | 8.00 | - | - | | 22 | 7.26 | 2.35 | 0.15 | 15 | 95.3 | 62.5 | |
| V1 | 25/7.46 | - | 0.3 | - | Big flakes, quickly settling | 24 | 6.87 | 2.05 | 0.15 | 5 | 95.3 | 87.5 | 15.06.03 11 hour |
| | 25/7.46 | - | - | 2.0 | | 24 | 6.98 | 2.05 | 0.15 | 7 | 95.3 | 82.5 | |
| | - | 10 | 0.3 | - | | 24 | 7.21 | 2.15 | 0.11 | 11 | 96.6 | 72.5 | |
| | 2. Water from the reservoir ZHBR v = 6000 m3 to BOC Kigach (prior to "flow" after the double chlorination) - 0 km | | | | | | | | | | | | |
| 1 | 0 | 0 | 0 | 0 | - | 22 | 7.73 | 2.2 | 1.26 | 32 | - | - | 26.05.03 16h 50 min |
| | 5.0/1.48 | - | - | - | Small flakes | 24.0 | 7.68 | 2.18 | - | 19 | - | - | |
| | 10.0/3.0 | - | - | - | | 25.0 | 7.68 | 2.15 | - | 19 | - | - | |
| | 15.0/4.46 | - | - | - | | 25.0 | 7.70 | 2.15 | - | 11 | - | - | |
| II | 0 | 0 | 0 | 0 | - | 21 | 7.8 | 2.3 | 1.7 | 24 | - | - | 27.05.03 10.00 hour |
| | 5/1.48 | - | - | - | Small flakes | 21.5 | 7.69 | - | 1.2 | 19 | 29.4 | 20.8 | |
| | 10/3.0 | - | - | - | Small flakes | 22.3 | 7.68 | 2.17 | 1.1 | 19 | 35.3 | 20.8 | |
| | 15/4.48 | - | - | - | Small flakes | 23.5 | 7.65 | - | 1.0 | 13 | 41.2 | 45.8 | |
| | 20/5.95 | - | - | - | Medium fast settling. | 23.5 | 7.65 | 2.14 | 0.5 | 7 | 70.6 | 70.8 | |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| III | 0 | 0 | 0 | 0 | - | 22 | 7.67 | 2.2 | 1.60 | 24 | - | - | 27.05.03 12 hour 30min |
| | - | 0.75 | - | - | Finely dispersed suspension | 24.8 | 7.69 | 2.19 | 0.17 | 19 | 89.4 | 20.8 | |
| | - | 2.25 | - | - | Big flakes, quickly settling. | 25.0 | 7.65 | 2.16 | 0.14 | 10 | 91.3 | 58.3 | |
| | - | 3.75 | - | - | | 24.5 | 7.71 | 2.16 | 0.12 | 7 | 92.5 | 70.8 | |
| 1V | 0 | 0 | 0 | 0 | - | 19.5 | 7.55 | 2.35 | 1.57 | 16 | - | - | 14.06.03 15 hour 45min |
| | 5/1.49 | - | - | - | The rapid formation of large flakes, rapid precipitation | 22 | 7.19 | 2.2 | 0.14 | 0 | 91.0 | 100 | |
| | 15/4.48 | - | - | - | | 22 | 7.09 | 2.0 | 0.14 | 0 | 91.0 | 100 | |
| | 25/7.46 | - | - | - | | 22 | 7.06 | 1.85 | 0.13 | 0 | 91.7 | 100 | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |

Table 2: Continued

| No experience | Reagents. Mg/L<br>Coagulants<br>$A1_2(SO_4)_3$/ $A1_2O_3$ | Аква-Аурат-30по $A1_2O_3$ | Flocculating Adofoam<br>Praestol RT650 | PHMG Biopag | Nature of flocculation after 5 minutes | Analysis of water quality<br>T,°C | pH, ед. | Щ, экв-экв/л | М, мг/л | Ц, градХКШ. | Cleaning effect, %<br>By turbidity | By chromaticity | Date and time of experience |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V | 15/4.48 | - | 0.1 | - | The rapid formation of large flakes, rapid precipitation | | | | | 19 | 7.08 | 1.9 | 0.13 0 |
| | 91.7 | 100 | 14.06.03 | | | | | | | | | | |
| | 15/4.48 | - | 0.3 | - | | 22 | 7.09 | 1.85 | 0.12 | 0 | 92.4 | 100 | |
| | 15/4.48 | - | 0.5 | - | | 22 | 7.09 | 1.9 | 0.07 | 0 | 95.6 | 100 | |
| VI | - | 0.75 | - | - | Flakes are small, poorly settle | | | 21 | 7.41 | 2.27 | 0.29 | 13 | 81.5 1 8 . 8 |
| | 14.06.03 | | | | | | | | | | | | |
| | - | 1.5 | - | - | | 22 | 7.40 | 2.12 | 0.21 | 0 | 86.6 | 100 | |
| | - | 3.75 | - | - | | 22 | 7.36 | 2.18 | 0.14 | 2.5 | 91.0 | 84.4 | |
| 3. vendible water from the water main "Astrakhan-Mangyshlak" at 448 km to the BOC Kulsary | | | | | | | | | | | | | |
| 1 | 0 | 0 | 0 | 0 | - | 25.5 | 7.87 | 2.7 | 3.88 | 20 | | - | 30.05.03 11.00 |
| hour | | | | | | | | | | | | | |
| | - | 0.75 | - | - | Friable flakes, flake formation slow | | | | | 7.95 | 2.8 | 3.30 | 9 2 2 . 5 |
| | 55 | | | | | | | | | | | | |
| | - | 2.25 | - | - | | 25.3 | 7.91 | 2.8 | 2.90 | 9 | 25.3 | 55 | |
| | - | 3.75 | - | - | | 25.5 | 7.89 | 2.8 | 2.72 | 8 | 30.4 | 60 | |
| | - | 10.0 | - | - | | 25.0 | 7.64 | 2.7 | 1.26 | 8 | 67.5 | 60 | |
| 4. Commodity water at the EGM Kulsary item after the separator (at the entrance to the filters), chlorinated, ost. C12 = 1.5 mg / l | | | | | | | | | | | | | |
| 1 | 0 | 0 | 0 | 0 | Very small flakes | 11.8 | 7.70/13°C | 2.6 | 3.20 | 30 | - | - | 31.05.03 9 hour 20 mi n |
| | - | 0.75 | - | - | | | 7.80/18°C | - | 0.10 | 10 | 96.9 | 66.7 | |
| | - | 1.5 | - | - | | | 7.83/18.7°C | 2.2 | 0.32 | 8 | 90 | 73.3 | |
| | - | 3.75 | - | - | | | 7.77/19.3°C | - | 0 | 12 | 100 | 60.0 | |
| | - | 10.0 | - | - | | | 7.68/19.8°C | 2.3 | 0 | 5 | 100 | 83.3 | |
| II | - | 3.75 | 0.1 | - | Very small flakes | 20.7 | 7.67 | 2.4 | 0 | 9 | 100 | 70.0 | 31.05.03 11hour 25min |
| | - | 3.75 | 0.3 | - | | 20.7 | 7.75 | 2.5 | 0 | 8 | 100 | 73.3 | |
| | - | 3.75 | 0.5 | - | | 20.5 | 7.78 | 2.5 | 0 | 8 | 100 | 73.3 | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 5. Water sampled at the EGM after separators (before filter) | | | | | | | | | | | | | |
| III | - | 3.75 | - | 2.0 | Large flakes | 21 | 7.75 | 2.5 | 0 | 5 | | | 31.05.03 12.00 hour |
| 1V | 0 | - | - | - | - | 12.8 | 7.70 | 2.6 | 3.24 | 31 | - | - | 31.05.03 13 hour 10 min |
| | 5/1.49 | - | - | - | | 18.7 | 7.69 | 2.6 | 0 | 10 | 100 | 67.7 | |
| | 15/4.48 | - | - | - | | 18.6 | 7.45 | - | 0 | 7 | 100 | 77.4 | |
| | 20/5.95 | - | - | - | | 18.7 | 7.41 | - | 0 | 7 | 100 | 77.4 | |
| | 25/7.46 | - | - | - | | 20.1 | 7.40 | - | 0 | 7 | 100 | 77.4 | |
| V | 15/4.48 | - | 0.1 | - | | 20.5 | 7.49 | - | 0 | 10 | 100 | 67.7 | 31.05.03 14.00 hour |
| | 15/4.48 | - | 0.3 | - | | 20.1 | 7.53 | - | 0 | 8 | 100 | 74.2 | |
| V1 | 15/4.48 | - | - | 0.2 | | 20.3 | 7.54 | - | 0 | 9 | 100 | 71.0 | 31.05.03 15.00 hour |
| | 15/4.48 | - | - | 2.0 | | 18.8 | 7.87 | - | 0.05 | 9 | 99.5 | 71.0 | |

Note: * - the concentration of residual Biopag PHMG

As shown in Table 1, obtained at water treatment plants "Kigach" and "Kulsary 'drinking water is not stable. So, in the water, selected after installation "jets" at the EGM "Kigach" depending on the dose of chlorine deposition potential range from (-1.4) to (-20.3) mg $CaCO_3$ / l, which necessitates different doses of an alkaline agent in the stabilization process water.

At the EGM Kulsary value of potential deposition in drinking water varies over a narrow range of negative (-5.2) - (-7.0) mg $CaCO_3$ / l. The results showed a stabilization process following optimum conditions for checking (Figure 1-3):

- Minimum dose of sodium hydroxide at drinking water treatment BOC "Kigach" (when the optimal range of the deposition potential $\mu$ = 4-10 mg / L) is 3 mg of NaOH / l. The value of Langelier index of 0.4;
- To achieve $\mu$ = 4 mg / L at the EGM "Kigach" dose of calcium oxide CaO was 3.8 mg / l and the dose of sodium carbonate for the same water is 15 mg $Na2CO_3$ / L, which is 4 times greater;
- Dose of calcium oxide to stabilize the water from the reservoir "Tengiz" 4.5 mg / L and the dose of sodium 18 mg / l, which is also 4 times the dose of CaO.

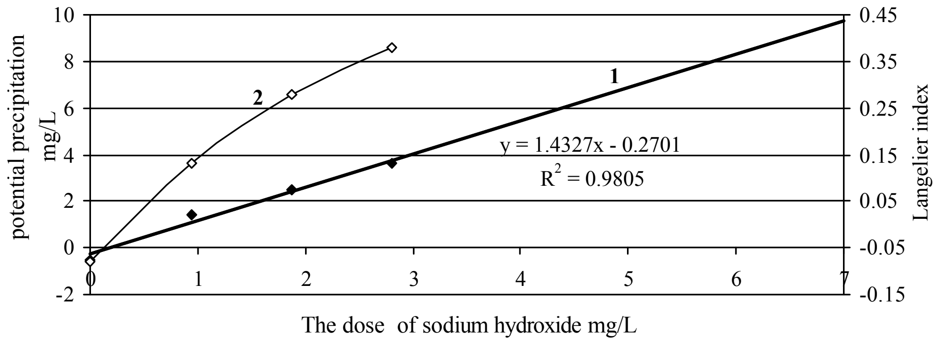



Fig. 1: The relationship between the potential precipitation (1) and Langelier index (2) the dose of sodium hydroxide (NaOH, mg / L) for water BOC "Kigach" 09/15/03 tap laboratory (10 h 5 min)

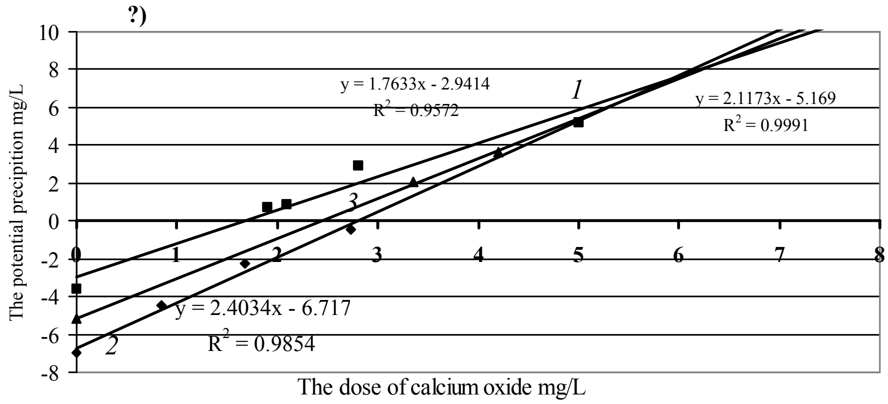



Fig. 2: The relationship between the potential precipitation of calcium carbonate (a) and Langelier index (b) of the dose of calcium oxide

1 - BOC "Kigach" after the "jets" 17.09.03 at 11 h;

2 - BOC "Kulsary" from the collector to the "Tengiz" 19.09.03 at 11 h;

3 - BOC "Kulsary" from the collector to the "Tengiz" 20.09.03 at 11 h 5 min.

Thus, the results of studies of the stabilization treatment of drinking water at the EGM "Kigach" and "Kulsary" the quantitative dependence of the parameters of stability (potential precipitation of calcium carbonate and Langelier index) allowing to calculate the dose of alkaline reagents for a variety of conditions in the water system BOC conduit "Astrakhan-Mangyshlak" [5].

Assessment of various reagents for water disinfection Astrahan-Mangyshlak. As agents for water treatment chosen two of the most widely used coagulant - Aqua-Aurat-30 (aluminum oxychloride) and purified aluminum sulfate and as flocculants - Praestol RT-650 and PHMG - Biopag (hydrochloride polyhexamethyleneguanidine). Aqua-coagulant Aurat-30 ($A1_2$ (OH) 5C1) features a large percentage of $A1_2$ $O_3$ - up to 30%, well at low temperatures, forms a dense precipitate reagent doses 1.5-2.0 times lower than aluminum sulfate. Produced by the JSC "Aurat" refined aluminum sulphate contains 15% or 40-45% $A1_2$ $O_3$ $A1_2$ $(SO_4)$ 3.

Flocculant Praestol RT650 - cationic polyelectrolyte is allowed in drinking water supply of the Russian Federation and is widely used as an additive to the main coagulant, providing increased efficiency of water purification [6].

Biocidal cationic flocculant Biopag PHMG has high flocculating and disinfecting properties, find application in many areas of the economy, pharmacology and medicine, is approved for drinking water Sanitary Inspection of RF can be used alone or in combination with coagulant.

Verification of these reagents for the purification of river water and product water line on the subject of "Astrakhan-Mangyshlak" is of considerable interest, given as inhibiting and alkalizing properties of certain chemicals studied.

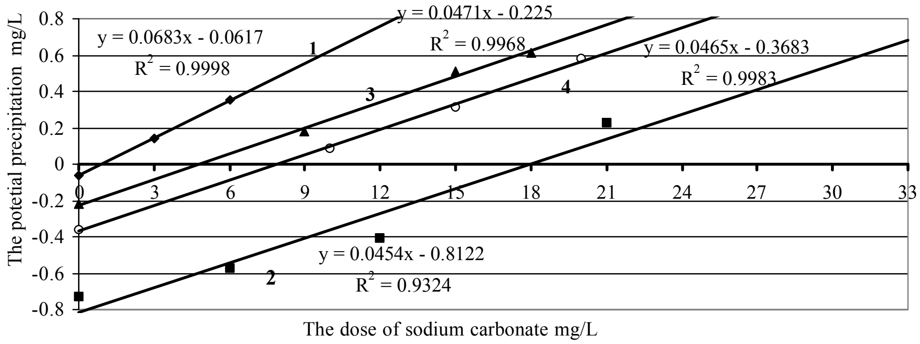
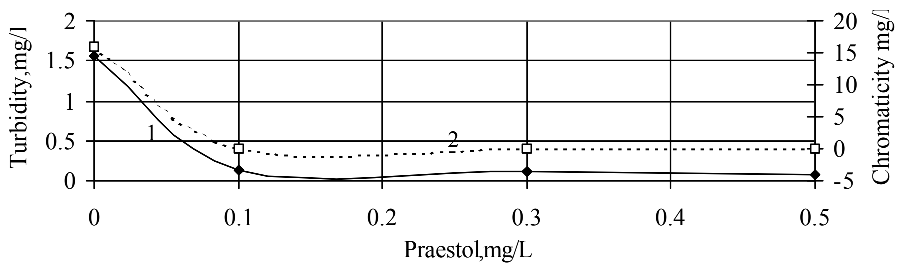



Fig. 3: The relationship between the potential precipitation of calcium carbonate (a) and Langelier index (b) of the dose of sodium carbonate (Na2CO$_3$ , mg / l):
1 - BOC "Kigach" tap 15.09.03g laboratory. at 15 h 50 min;
2 - BOC "Kigach" after the "jets" 15.09.03g. in 14 hours;
3 - BOC "Kigach" after the "jets" 16.09.03g. 12h 30 min;
4 - BOC "Kulsary" from the collector to the "Tengiz" 9/20/03 at 11h 5 min.




Coagulant (for aluminum oxide): aluminum sulfate - 1; Akva Aurat - 2, 3
Coagulant (for aluminum oxide): aluminum sulfate, 1, 2, 4, Aqua Aurat – 3

Fig. 4: Test coagulation ZHBR water from the tank (after double chlorination) to BOC Kigach
a) coagulant: aluminum sulphate, Aqua Aurat
b) coagulant (aluminum sulfate) 4.5 mg / l ($A1_2 O_3$ ) + flocculant: 1 - turbidity;
2 - color.

For research selected four specific points for water sampling:

- River water ducts of Kigach (before chlorination);
- River water from the reservoir volume 6000 m3 ZHBR after double chlorination before entering the BOC Kigach (before plants "flow");
- Commodity water at 448 km before entering the BOC § Kulsary;
- Water separators after BOC Kulsary before filters, additional chlorine at the EGM of the residual chlorine of 1.5 mg C12 / l [7].

During the spring flood of 2003 the river water etc. Kigach turbidity values varied from 3.2-6.1 mg / L and the color was 34-40 degrees. Pt-Co scale, the pH 8.1-8.42 units. Research results on the test water treatment coagulants and flocculants are presented in Table 46 and in Figures 4-5.

Figure 16 (a-c) shows a plot of reducing turbidity and color of the reagent dosage processing river water pr.Kigach to chlorination. Found that treatment of water only coagulant - aluminum sulfate and Aqua-Aurat-30 doses of 0.75 to 8.0 mg / L for $A1_2 O_3$ (Figure 18a) does not allow her to get a reliable bleaching, water treatment for turbidity and color are respectively 89-95% and 38-60%. Combined treatment of water aluminum sulfate dose 4.5 mg / l $A1_2 O_3$ (15 mg / L $A1_2$ ($SO_4$ ) 3) and flocculant Praestol RT650 doses 0.1-0.5mg / L did not significantly increase the cleaning effect of turbidity and color (93-97 and 47 - 60%), but are provided with SanPiN [8].

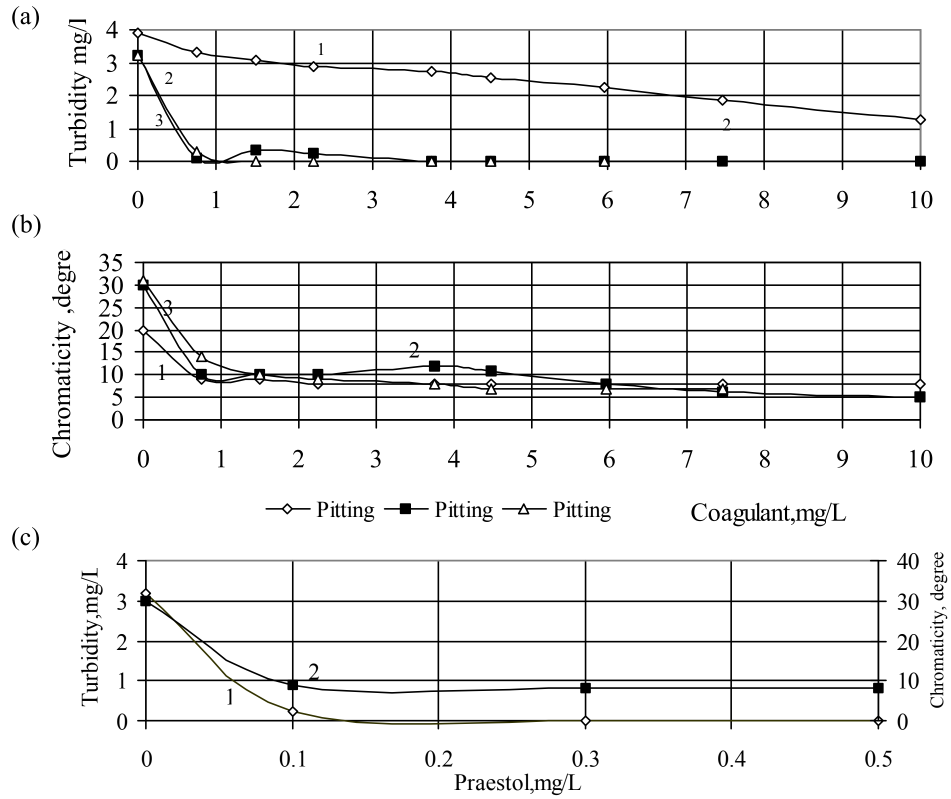



Fig. 5: Test coagulation commercial water samples are 448 km

a) coagulant (for aluminum oxide): Aqua Aurat to BOC 2 - Aqua Aurat - before filters BOC 3 - aluminum sulfate - the two filters;

b) + Aqua Praestol Aurat (3.75 mg$A1_2O_3$ / l): 1 - turbidity, 2 - color;

c) PHMG + aluminum sulfate (4.5 mg$A1_2O_3$ / l): 1 - turbidity, 2 - color.

The best results were obtained with the combined treatment of water Biopag dose of 1-2 mg / l and aluminum sulfate dose of 1.5 mg / l $A1_2O_3$ (5 mg / l of $A1_2$ ($SO_4$) 3. Cleaning effect of turbidity and color was 96-97% and 100%, water for these indicators are of high quality.

Figure 17 (a-c) shows the results of a test of water treatment, selected from the reservoir ZHBR after double chlorination at the AGM (to BOC Kigach). During the research of water ZHBR differed very low turbidity (1.26-1.7 mg / L and low color (16-32 degrees), making it difficult to water treatment and selection of the optimal dose in the experiments [9].

The best effect is obtained by purification of water co-processing of aluminum sulfate dose of 4.5 mg / l and $A1_2O_3$ Praestol flocculant dose 0.3 mg / l. Color of water was reduced to zero and the turbidity of up to 0.07 mg / L (Figure 4 (c).

Figure 5 (a-c) shows the results of treatment for turbidity and color commercial water samples are 448 km to the BOC Kulsary and water samples are BOC Kulsary after separators - before applying the filters. Water had additional treatment with chlorine at the EGM of the residual chlorine of 1.5 mg C12 / l. Source water also features a low turbidity and color (3.2-3.8 mg / l) and (20-30 degrees). Commercial water treatment coagulant Aqua Aurat doses 0.75-10 mg / l proved to be ineffective: for turbidity (E = 22-30%) and color (55-60%) (Figure 18 a).

Trial treatment of water, selected at the EGM a fter separators, is more efficient, in particular, with the co-processing aluminum sulfate and Praestols (Figure 5 b) doses, respectively, 3.75 mg / L $A1_2$ O and 0.1 mg / L, turbidity was reduced to zero and color to 5 deg.

## CONCLUSION

Similar results were obtained with only one water treatment coagulant Aurat at a dose 3.75 mg / l $A1_2 O_3$ (Figure 18b).

Use as a flocculant Biopag (Figure 5) with aluminum sulfate coagulant doses respectively 0.2 mg / L and 4.5 mg / l $A1_2 O_3$ also provides high cleaning effect of turbidity (to zero concentration) and chrominance to 5-8 deg. Biopag as cationic flocculants can be used alone doses of 1-2 mg / l. Biopag residual content in the leachate for these doses defined within 0.2-0.25 mg / l, which is below the permissible value for drinking water (1 mg / L), the effect of treatment (Figure 18 d) is also high. It is also necessary to note the observations of the nature of flocculation. When coagulation only coagulant flocculent loose structure, with the addition of flocculants flakes formed thicker, quickly settles to the bottom of the cylinder especially using Biopag [10].

The experimental study of water from the test coagulation conducted in spring flood of 2010, showed the following:

- Of the two treatment coagulants - aluminum sulphate and Aqua-Aurat-30 the best results on the effectiveness of the purification of river water and product were obtained for aluminum sulfate in almost equal doses compared with coagulant Aqua-Aurat-30. However, to achieve good results for color reduction, an additional supplement of flocculant;
- Use independently as a coagulant Aqua Aurat characterized slow kinetics of flocculation, formation of small flakes, deterioration of leachate;
- Best results in cleaning little muddy colored river and commercial water with high levels obtained with the combined reagent treatment using coagulant + flocculant. In this case, both the study of coagulant work about equally effective at optimal doses 1.5-4.5 mg / L for $A1_2 O_3$ . For example, at doses of flocculant Praestol 0.1-0.3 mg / L and a dose of Aqua Aurat or aluminum sulfate 3-4.5 mg / L reduction in turbidity $A1_2 O_3$ provided to 0.07-0.1 mg / L and color to zero;
- Use as a cationic flocculant Biopag PHMG can provide high levels of water treatment, as when used alone or combined with the use coagulant. Experimentally found that at a dose of 1.0-2.0 mg Biopag / L without coagulant and initial turbidity 6.1 mg / L and color 34 deg., The turbidity of the treated water is reduced to 0.55 mg / L and color to 5-8 deg. When combined with aluminum sulfate dose of 1.5 mg / L for $A1_2 O_3$ (5 mg / L $A1_2$ $(SO_4)$ 3 and Biopag dose of 1 mg / L color is reduced to zero and the turbidity of up to 0.1 mg / L;
- Important advantage Biopag PHMG is its high flocculating properties (approximately 10 times the polyacrylamide) and high disinfecting and inhibiting properties, which is promising for use at the water line "Astrakhan-Mangyshlak" [11].

The resulting water is fully compliant with the RK Sanitary 3.01.067-97 for turbidity, color, odor.

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