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CLARIFICATION OF WATER IN THIN-BEDDED SEDIMENTATION TANK

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To identify the possibility of the effective use of thin-bedded sedimentation tanks for clarification of surface waters similar to river waters of the foothill zone of the Chui valley, experimental studies were performed in the laboratory conditions of the Department of Construction of the Kyrgyz-Russian Slavic University.

The experimental setup included devices for supplying feed /source water, a reagent dispenser, a perforated mixer, a flocculation chamber combined with a tube settler. The experiments on this model were carried out at an angle of inclination to the horizon of about 60° (the so-called “inclined” type of sedimentation tank). It should be noted that the vortex type hydraulic flocculation chamber adopted in the design of the settler model, in the place of a conically expanding inlet, was loaded with gravel (5-12 mm in size) to a height of 3.0 cm. Caustic soda was used as alkaline reagents.

The control and measurement of the flow rate in the sedimentation tank, as well as the injected doses of the reagents, were carried out by the volumetric method. Suspension concentration in all samples was determined using a photoelectrocollorimeter - PEC-N-57. At the same time, other physical and chemical parameters of the source and treated water were determined, such as pH, alkalinity, suspended materials, color, etc.

During experimental studies, the clarification effect was chosen as a measure of the effectiveness of the tube settler

$$Э = \frac{F\ source - Fsedimentation\ tank}{F\ source} \text{x}100\%, \qquad (1)$$

where: Э – clarification effect, %; F_{source} *– suspension concentration in the source water, mg/l;* $F_{sedimentation\ tank}$ *– suspension concentration in a settling-vat water, mg/l.*

Research on the first sample of natural water was carried out using the mathematical method of planning the experiment, which made it possible to minimize the number of required experiments while obtaining a reliable relationship between the studied parameters. On the second sample, verification (sampling) experiments were carried out.

It should be noted that in this case, an excessive decrease in the rate of water flow in the sedimentation tank or an increase in the dose of kaolin will undoubtedly give a high effect of improving water quality, but it is technically and economically not feasible. Therefore, the choice of the domain of determination was carried out in accordance with generally accepted data: according to the flow rate of water through a tube settler with a reagent for clarification of natural waters, and the choice of X_{II} was carried out based on the results of the determination of sedimentation of suspensions.

Figure 1 shows the sedimentation curves of suspensions when kaolin is added to the source water as a coagulating substance.

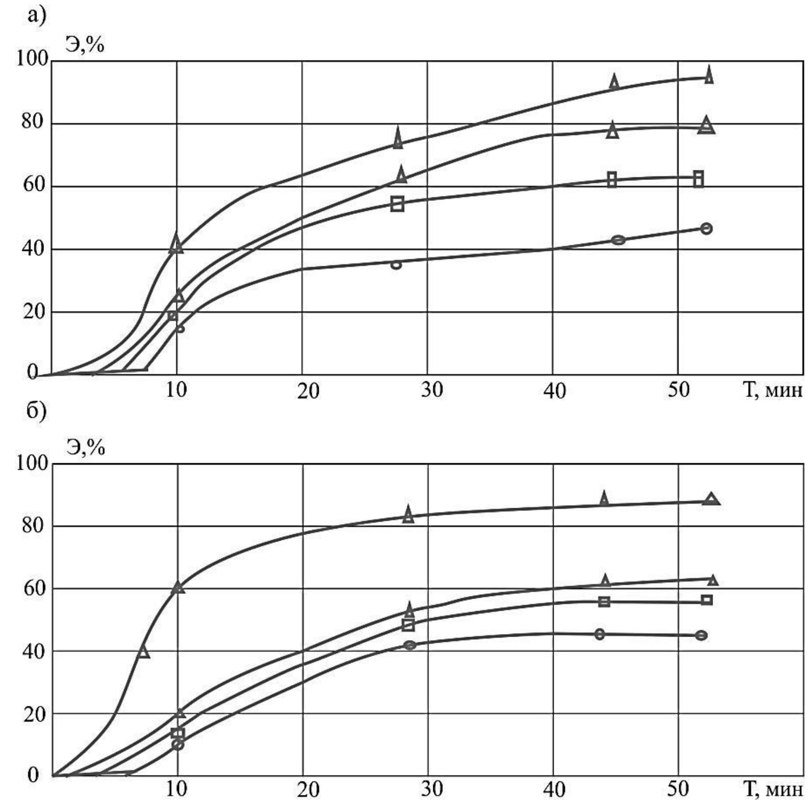

Fig. 1 Curves of sedimentation of suspended materials in a homogeneous medium during trial alkalization: a) at Msource = 2000 mg / l and b) at Msource = 1000 mg / l:

△ - D_k-200 mg / l; ▲ – D_k = 150 mg / l; □ – D_k = 120 mg / l; ● – D_k = 80 mg / l

The transition from natural values of factors to coded values was carried out using the following transformation:

$$xi = \frac{Ci-Ci}{J}, \qquad (2)$$

where: xi- coded value of the factor (dimensionless quantity); Ci-Ci- is the natural value of the factor (respectively, its current value and value at the zero level); J is the natural value of the interval of variation of the factor Ci; i is the factor number.

Working matrix and implementation results, i.e. the obtained experimental data on the effect of clarification of water after a tube settler made it possible to determine the regression coefficient of the following equation:

$$\hat{U}u = b_0+b_1X_1+b_2X_2+b_12X_1X_2+b_{11}X_2+b_{22}X_2{}^2 \qquad (3)$$

After determining the values of the regression coefficients and as a result of the calculations, we found the clarification effect:

$$Э=78,7+0,605D_к-13V_0+0,52V_0^2\ , \qquad (4)$$

where: E - the effect of clarification of water in%; $D_к$ - dose of lime, mg / l; V_0 is the flow rate in the sump cells, m / h.

Figure 2 shows the dependences of the clarification effect on the rate of water flow in the sump cells and the dose of kaolin. These dependences were obtained on the basis of (4) by varying the values of one of the variables at a constant value — the second variable. This shows that in spite of the increased flow velocity in the sump cells – 6÷12 m / h, at lime doses of 40–80 mg / l, the effect of water clarification in the sump reaches 50÷80%. When the water flow rate in the sump is 6÷12 m / h, the retention time of the water in the sump is 10÷5 min, and the Reynolds number is in the range 22÷45.

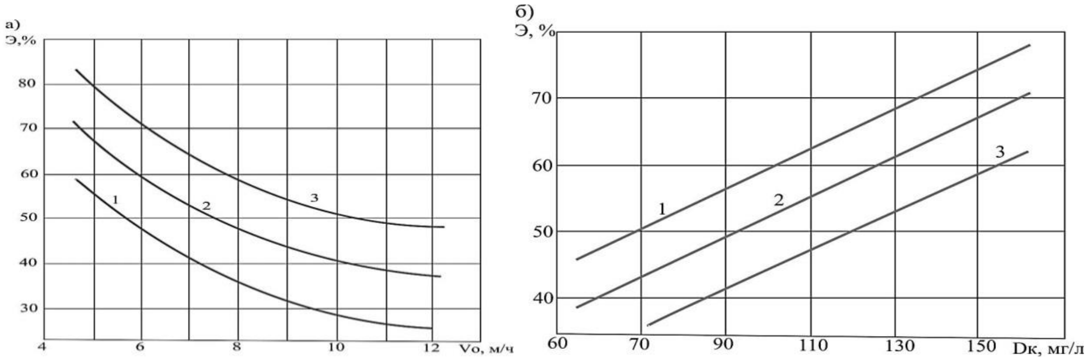

Figure 2. Change in the effect of clarification of water passing through a tube settler, depending on the flow rate in the cells of the sump (a) and alkali dose (b): a) at $D_и$ = const; b) with V_0 = const

Studies of the model of a tube settler on lime-treated water have shown that at a flow rate of 6 ÷ 12 m / h in the sump, a high effect of sedimentation of suspended materials of river water is achieved up to 80%.

The kinetics of sedimentation of suspended materials in the tube settler is characterized by a certain duration of the clarification cycle of the sump/sedimentation tank, which is equal to the period of its "protective" action and is 20 ÷ 50 hours. Removing settled sediment from the tube settler does not cause difficulties.

As a result of research, it was found that the adopted design of the flocculation chamber did not provide a constant contact layer formed from precipitation and the flocculation process is relatively sluggish, due to the imperfect design of the hydraulic flocculation chamber. A small installation model and a relatively small number of cellular elements created some unevenness in the distribution of flow within the model.

The indicated design flaws of the studied model, ultimately, were reflected in the operation of the sump, therefore, they should be taken into account in further studies.