CALCULATION OF THE QUANTITY OF SLUDGE SEDIMENT IN THE FOREBAY OF IRRIGATION PUMPING STATIONS

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Abstract. *In the article, the work of calculating the amount of silt and sand particles in the forebay and water intake department of the PK-1512+01 KFK and SShK1 irrigation pumping station located in the large Fergana canal was carried out. By calculating the amount of turbid sediments, there are details on how to evenly distribute the flow in the forebay, how to prevent cavitation processes in the suction pipes of the pump, and how to increase the efficiency of the pump station operation mode.*

Keywords: *Water intake unit, forebay, pump, pump unit, pumping station, sediment, water transfer, flow, sand particles, turbidity, turbidity sedimentation, channel.*

РАСЧЕТ КОЛИЧЕСТВА ИЛОВЫХ ОСТАНОВОВ В ФОРМЕ БУЛАВА НАСОСНЫХ СТАНЦИЙ ОРОШЕНИЯ

Аннотация. *В статье проведена работа по расчету количества илистых и песчаных частиц в аванзаливе и водозаборном отделении ПК-1512+01 КФК и оросительной насосной станции СШК1, расположенных на большом Ферганском канале. При подсчете количества мутных отложений приведены сведения о том, как равномерно распределить поток в аванзаливе, как предотвратить кавитационные процессы во всасывающих патрубках насоса, как повысить эффективность режима работы насосной станции.*

Ключевые слова: *Водозаборный узел, аванзалив, насос, насосный агрегат, насосная станция, нанос, водоперенос, поток, частицы песка, мутность, мутноотложение, русло.*

INTRODUCTION

Nowadays, there are 4.2 thousand hectares of irrigated land in our Republic, 2.3 thousand hectares of which are irrigated using pumping stations.[1] The reason for this is that the irrigated croplands are located in the upper part of the pumping station and it is necessary to transfer them under pressure.[2,3,13,14] At present, the most optimal solution to the land areas is water with the help of machine water transfer. However, when receiving water from canals, open watercourses and rivers, the muddy and sand particles in the water are causing the pump station to malfunction, the ability to transfer water, and the service life of constructions to be reduced. [4]

MATERIALS AND METHODS

The main part of the PK-1512+01 KFK and SShK1 pumping station in Rishton district of Fergana region today provides water for 4103 hectares of land in Altariq region and 910 hectares of land in Rishton district. The power of the pumping station is N-1000 kW, 20 NDS D3200-75 brand 3 pumps, diameter ∅-1200, length L-6050 meters, height H-50 meters are delivering water to the land area, Q-5600 m3/hour.

It is known that the KFK is affected seasonally by the sand and turbidity in the water, that is, the operation modes of the van camera change seasonally due to the water fall from the weather, floods and rains. [6]

In view of the above, the methods of calculation by researchers of the filling of the forebay due to turbid sediments are expressed in the form of the following equations:

$$\frac{\partial p}{\partial l} + \gamma b \frac{\partial z}{\partial t} = 0 \quad (1)$$

Here: p-pressure, l-length, z-depth, g-relative weight, t-time, b - width.

Formula (1) was expressed by some scientists as follows:

$$(p_1 - p_2)\Delta t = (z_1 - z_2)\Delta l \gamma b, \qquad \frac{p_1}{\gamma} = H_1 \quad (2)$$

$W_3 = (z_1 - z_2)\Delta l b$ Considering that

$$dW_3 = (H_1 - H_2)dt \quad (3)$$

These equations were used by other researchers in their scientific research work. These methods used the formulas $s = f(q, h, v)$ and $s = (q, h, u)$ in different forms to calculate the flows from each other.[7, 8,11,15,16]

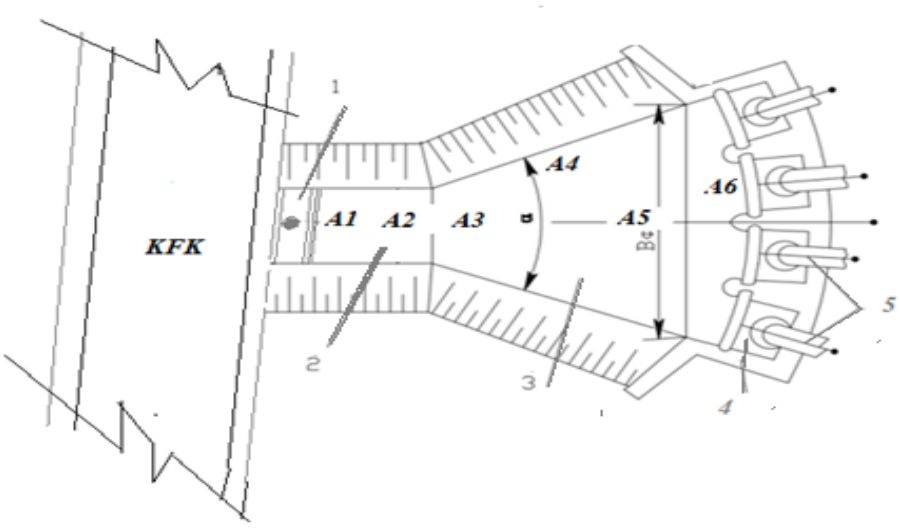

Fig. 1.

Forebay and water intake section of KFK and SShK1 pumping station.

1-water intake head: 2 - water channel; 3 - forebay; 4- water intake chamber; 5 - suction pipeline of the pump. A1, A2- water channel, A3- the edge of the forebay, A4, A5- the middle parts of the forebay, A6- the suction pipe of the pump

RESULTS

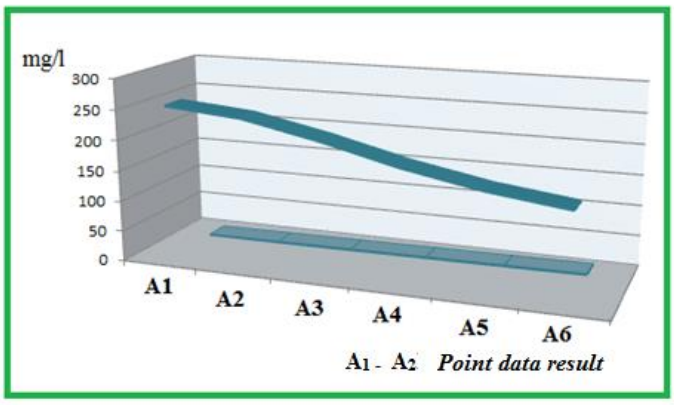

Fig. 2.

The amount of sedimentation of turbidity in water from the indicated points since June

Table 1

Point date result	A_1	A_2	A_3	A_4	A_5	A_6
Mg/l	254	243	217	186	162	146

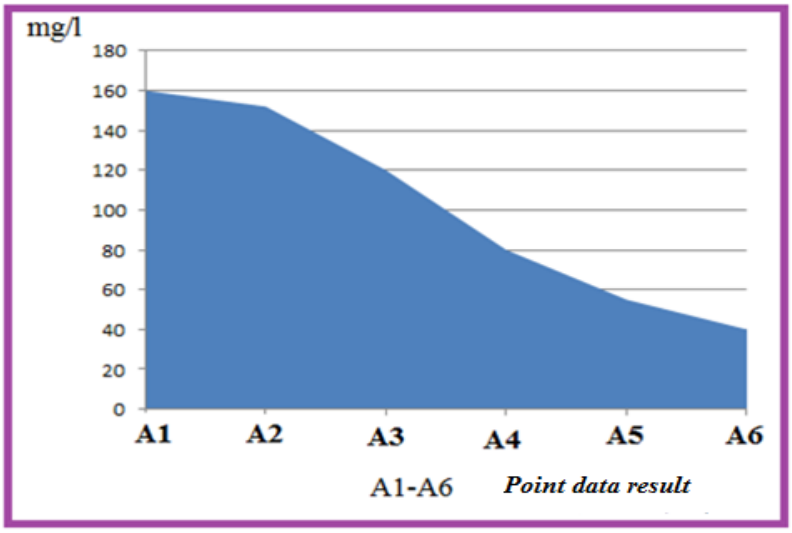

Fig. 3.

The amount of sedimentation of turbidity in water from the indicated points since July

Table 2

Point date result	A_1	A_2	A_3	A_4	A_5	A_6
Mg/l	160	152	120	80	55	40

DISCUSSION

When predicting the size and duration of Advance chamber blurring, it is possible to calculate forebay based on different operating modes.

When $H_{nu} > H_c \quad and \quad H_{ku} > H_c$

When it reaches the joint surface, the sedimentation process of cloudy discharge is observed and their volume is determined as follows (5,6).

$$\Delta W_{Cho'k} = 1.2\rho W_{pr}\varepsilon A \qquad (5)$$

Here: $$A = \frac{H_{nu}-H_C}{H_{nu}-H_{ku}} \qquad (6)$$

The following expression is used to determine the height of the water level, the sediments in the forebay fall to the lower bef, and the volume of these sediments (7)

$$\Delta W_{yuv} = 1{,}2\rho_{yuk}\left|W_{pr}(1-A) + W_c - W_{ox}\right| \qquad [7]$$

where: W_{pr}-levels change from $H_{nu} to\ H_C$ (load) - loading due to muddy flow, kg/m^3

We use the following expression (8) to determine the load in washing turbid sediments:

$$\rho_{yuk} = \frac{B_p^1 \mu(H\sum cho'k - H_{ku}}{1{,}2\ iQ_p^1} \qquad [8]$$

where: m is sediment washing speed, mm/sec; $\sum cho'k - H_{ku}$sediment mark based on the design volume graph; Q_p^1 −-average monthly water flow, m3/s; The width of the furrow corresponding to B_p^1-Q_p^1, m.

If:

$$H_{nu} < H_c > H_{ku} \quad (9)$$

When the values are in the state, the sediments washed by the stream are removed to the lower bef, and its volume is determined by the following formula (10):

$$\Delta W_{yu} = 1{,}2\rho_{yuk} W_P^1 \quad (10)$$

Here, $W_P^1 = Q_P^1 \frac{H_C - H_{KU}}{\mu}$ if $W_P^1 > W_{pr}$ is accepted for calculation. The width of the front camera is determined by this formula (11):

$$B_P^1 = \frac{Q_P^1}{V_P H_P} \quad [11]$$

Here $v_p = 1{,}0 \div 1{,}2 \frac{m}{c}$ $H_P -$ The depth of the vanguard is m.

It is necessary to take into account the seasonal change of the channel and the amount of muddy sediments before the accounting period when calculating the volume of silting of the water intake section and the vane chamber.

CONCLUSION

In June and July, in the field practice, work was carried out on receiving water at the PK-1512+01 KFK and SShK1 irrigation pumping station and calculating sedimentary sand and turbidity in the vane chamber. It was studied that the construction with flow-directing walls is effective in achieving equal distribution of velocities and preventing the formation of air bubbles in water intake units. In forebay 108 mg/l was taken in June, and 120 mg/l in July, sedimentation of turbidity and sand particles was observed in measurement locations A1 and A6.

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