
# Carrying out hydraulic calculation of the aquifer of pumping stations and work with sediments (in the example of the Ulugnor pumping station)

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**ABSTRACT**

In this article, further improvement of the working conditions of the water-carrying channel of the pumping station, development of irrigation and reclamation facilities. Analysis of design information, operating conditions and operation of the Ulognor pumping station, and based on this, development of scientifically based measures and recommendations for increasing the efficiency of the pumping station's operating mode.

**Keywords:** Pumping station, water source, main water receiving facility, water carrying channel, advance chamber.

## Introduction

At present, there are 4.2 thousand hectares of irrigated land in our republic, of which 2.3 thousand hectares are irrigated with pumped water. At present, 1688 pumping stations are included in the state budget. 35 of them are large pumping stations. These pumping stations were mainly built and put into operation in the 70-80s of the last century. Many pumping stations have lost efficiency due to years of inactivity. The reason for this is the operation of the pumping stations of our republic in difficult conditions, the presence of nanoparticles in the water of water intake sources and their lowering to the bottom of the canal, the change in hydraulic parameters in the aquifer of the aquifer. pumping station, as well as abrasive and cavitation erosion of water-bearing parts of pumping stations, moral and spiritual deterioration of equipment and equipment, leading to physical wear and tear.

## Analysis And Methodology Of The Literature

The technical condition of all hydraulic structures that are part of the pumping station was studied under the operating conditions of the pumping station.

On both sides of the coastline, large eddy zones form in large areas, and cases of accumulation of a large amount of sediment and islands have been observed.

Funnels appear on the surface of the water in the receiving chambers of the units on both sides, and in these cases, along with the flow of water into the units, air is sucked in from the bottom side of the pump (up to 5-10%). air flow). This situation causes the phenomenon of cavitation in the pumping units and reduces the energy efficiency (power, FIC) of the pumping units.

In order to avoid such a situation, it is recommended to install flow diverting devices (flow diverting walls) in the blade chamber to reduce the size of the vortex formed in the blade chamber and to evenly distribute water over all receiving chambers.

**Discussion**

Taking into account the very low capacity of the water supply channel of the object under consideration, reliable water intake from the river will be ensured by moving the main water intake facility 2 km upstream. It is required to carry out a hydraulic calculation of the designed water supply channel in such a way that it is effective for improving the operating mode of the pumping station.

The maximum calculated flow rate of water supplied to the canals is equal to the maximum ordinate on the water consumption graph, i.e. –7500 m3/s. It is known that in years of heavy rainfall, the canal system of pumping stations is also filled with water with excess water, so we consider this as a catastrophic water consumption. Thus, the catastrophic calculation of the water consumption of the channels of pumping stations:

$Q_{хис} = 1{,}15 \cdot Q_{max.} = 1{,}15*7{,}500 = 8{,}625$ м³/с

equals

2. We calculate the width of the bottom of the channels using the following formula

$b_к = \sqrt[3]{Q^2{}_{\max}} = \sqrt[3]{7{,}5^2_{max}} = \sqrt[3]{7{,}5^2_{max}} = 3{,}8$ м

Since the estimated width of the channel bottom is large, we adjust to the standard value, that is:

$b_к = 4{,}0$ м.

3. We accept the coefficient of roughness of the channels. Considering that the core of the channel is covered with concrete, we accept its roughness coefficient: n = 0.014.

4. We accept the slope coefficient of the channel walls. Since the channels pass through sand, sand and loam, their slope coefficient is taken equal to:

$m = 2{,}5$

5. We accept the slope coefficient of the bottom of the channels. Taking into account the terrain, the slope of the channels is taken as follows:

i = 0.0002

Taking into account the characteristics adopted for the channels, we calculate the hydraulic elements for different water depths in the channels according to the following calculation formulas.

- cross-sectional area of channels:

$$\omega_i = (b_k + mh_i)h_i \text{ ,м}^2;$$

- wetted perimeter of channels:

$$\chi_i = b_k + 2h\sqrt{1+m^2} \text{ ,м};$$

- hydraulic radius of channels:

$$R = \frac{\omega_i}{\chi_i} \text{, м};$$

- Chezy coefficient:

$$C_i = \frac{1}{n} R_i^{1/6}, \ \frac{\sqrt{м}}{с};$$

- water velocity in channels:

$$\upsilon_i = C_i \sqrt{R_i i}_k \text{, м/с};$$

- water flow in canals:

$$Q_i = \omega_i \upsilon_i \text{, м}^3/\text{с}.$$

We present the obtained and calculated hydraulic elements of the channels in Table 4.1. Based on the table, we construct the following working channel schedules: hk = f(Q), Rk= f(Q) and ( = f(Q) - Picture 3 shows the working channel schedules (Table 1).

**Table 1**

**Hydraulic characteristics of the water supply channel of the pumping station**

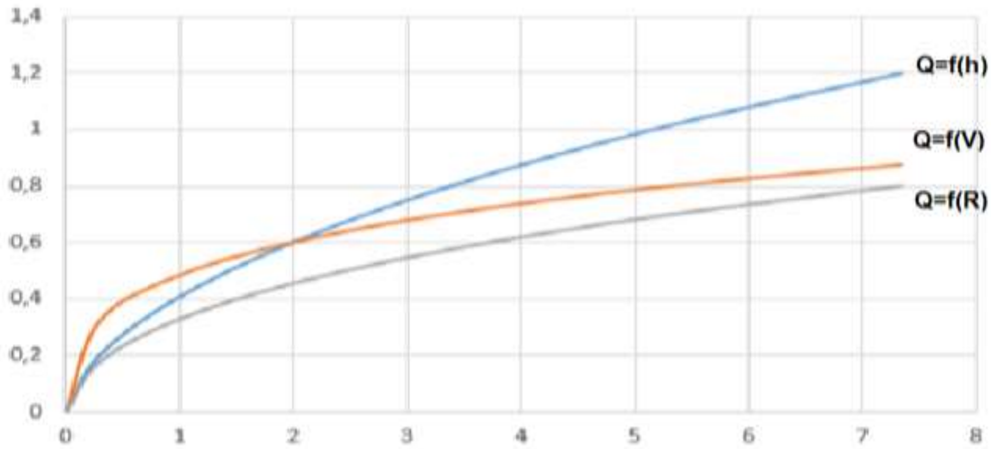
| № | *hk м* | *bk м* | *m* | *n* | *i* | *ω, м²* | *χ, м* | *R, м* | *C* | *ϑ, м/с* | *Q, м³/с* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 4,0 | 2,5 | 0,014 | 0,0002 | 0 | 4 | 0 | 0 | 0 | 0 |
| 2 | 0,2 | | | | | 0,9 | 5,077 | 0,177 | 53,5 | 0,31 | 0,28 |
| 3 | 0,4 | | | | | 2 | 6,16 | 0,324 | 59,17 | 0,47 | 0,94 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0,6 | | | | | 3,3 | 7,24 | 0,456 | 62,64 | 0,59 | 1,95 |
| 5 | 0,8 | | | | | 4,8 | 8,32 | 0,577 | 65,14 | 0,7 | 3,36 |
| 6 | 1 | | | | | 6,5 | 9,4 | 0,69 | 67,12 | 0,79 | 5,135 |
| 7 | 1,2 | | | | | 8,4 | 10,48 | 0,80 | 68,8 | 0,9 | 7,500 |

The minimum mile on the water consumption graph is Qmin. and the maximum value is equal to Qmax. we obtain the following hydraulic elements corresponding to the water flow and necessary for further calculations: hmax; hmin? thmax; min. To do this, water flow - from the abscissa, we draw auxiliary lines parallel to the y-axis, and continue until the intersection with the graphs R = f(Q) and θ = f(Q). The necessary elements for calculations are the dimensions at the intersection points - hmax; hmin? thmax; calculated (Pic. 1).

**Table 2**
**The depth of water in the channels and the corresponding speed**

| Water depth, m | | | Water speed, m/s | | |
|---|---|---|---|---|---|
| Minimalistic | Maximum | disaster | Minimalistic | Maximum | disaster |
| 0,60 | 1,2 | 1,3 | 0,60 | 0,9 | 0,98 |




Picture. Working graphics of the channel

Thus, the values obtained from the graph of the depth and speed of water are entered in the table.

Since the channels are filled with concrete, their walls and bottom are not washed out, so we check them only to ensure that they are not covered with dirt. Checking channels for non-burrowing. According to the non-burrowing condition, the minimum speed in the channels must be equal to or greater than the critical speed at which no deepening is allowed, i.e.

$$\vartheta_{мин} \geq \vartheta_{кўм}. \qquad (7)$$

where: $\vartheta_{мин}$= 0,43 м/с– minimum water velocity in the channels

(from the graph$\vartheta = f(Q)$(Pic 3) or from Table 5);

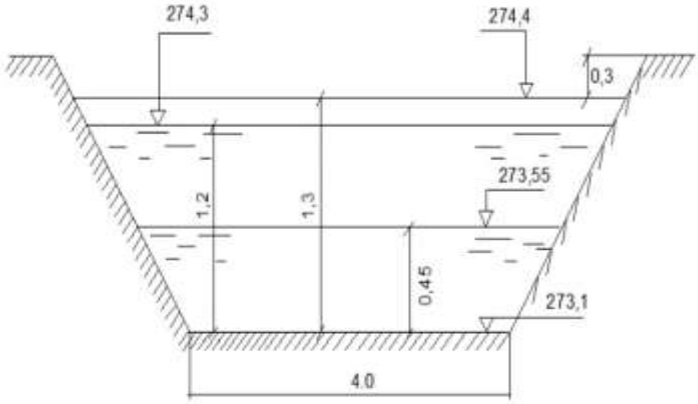
thko'm is the speed without penetration, calculated by the following formula:

$$\vartheta_{кўм} = 0{,}5 \cdot \sqrt{R_{\min}} = 0{,}5 \cdot \sqrt{0.48}\sqrt{0.48} = 0{,}34 \text{ м/с} \qquad (8)$$

where: Rmin is the hydraulic radius, determined (at Q = Qmin), Rmin = 0.48 m

So, 0.60≥0.34 - the channels will not be buried in clay.

Based on hydraulic calculations, we construct a cross section of the water supply channel (Pic 2).




Picture 2. Cross section of the water supply channel

**Conclusion**

It is known that nanoparticles are constantly sitting in the aquifer of pumping stations receiving water from the Karadarya River. Here is the first step in solving this problem, a hydraulic calculation of the water supply channel was performed.

To improve the technical condition of the water pipeline channel, it is necessary to reduce the amount of cross flow (circulation), making the channel bends smooth and smooth, and to reduce the process of washing the channel in these sections, it is necessary to protect these sections with a concrete coating.

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