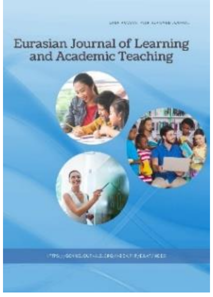

Optimization of the Channel Head Settling Tanks to Guarantee the Water of Pumping Stations

PhD, Norkulov Behzod Eshmirzaevich	National Research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers.
Assistant, Kurbonov Azizali Ilkhomovich	Karshi Institute of Irrigation and Agrotechnologies of the National Research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers
PhD, Zhamolov Farkhod Norkulovich	Bukhara Institute of Natural Resources Management of the National Research University of Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

ABSTRACT

The article discusses and analyzes various types of sedimentation tanks, studies the dynamics of sediment changes and their deposition location in the supply section of the CMC. The paper presents the results of field studies. Recommendations are given to establish the location of the sump in the channel of the supply channel. And also on the basis of full-scale data, the design parameters of the sump are proposed, which allow to improve the operating conditions of the supply channels of pumping stations.

Keywords: River, canal, sediments, sediments, elements, structures, irrigation, particles

Introduction. The supply of the necessary amount of water for irrigation of agricultural crops in the world is one of the most important tasks. Particular attention is paid to the use of water supply systems by pumping stations to guarantee water consumers. The water needs of the national economy in Uzbekistan are growing year by year. Along with the requirement of guaranteed water availability, some of its branches impose certain conditions on the quality of the water used: its chemical composition or the content of solid mineral particles – sediments in it.

The use of suspended unsaturated waters in agriculture leads to siltation of all parts of the irrigation network, a decrease in their capacity, and sometimes to their failure. If we take into account that such a vital waterway of Central Asia as the Amu Darya River carries more than 200 million tons of suspended and bottom sediments only in an average turbidity year, then the complexity of solving the problem of regulating solid runoff for practical purposes becomes obvious.

An effective measure to combat the harmful effects of water-borne sediments on irrigated agriculture is the installation of irrigation settling tanks. When designing water intake structures, it is necessary to answer questions about the planned placement of irrigation settling tanks, their constructive solution and operating modes. Particular attention is paid to the problem of calculating the alluvial regime of irrigation sedimentation tanks, which is explained by its significant significance both at the design stage and at the stage of operational operation of sedimentation tanks. The solution to this problem implements the basic idea of the settling tank device – to ensure the planned percentage of flow clarification to a value equal to or not exceeding the transporting capacity of the channel following the settling tank.

The research method. The study of the results of field studies on the site of the Karshi main canal, the assessment of the state of the riverbed, the establishment of the location of the settling tank in the channel of the supply channel is the method of investigation of this work.

Results and discussions: In this study, it was established that the Amu Darya River is that it flows in exceptionally easily eroded soils. The instability of the riverbed of the Amu Darya river, due to constant erosion and build-up of the banks, creates exceptional difficulties for the stable operation of water intake structures, as a result of which there are significant fluctuations in water flow, including in the supply channels.

In terms of the amount of sediment transported by water flow, the Amu Darya River ranks first in the world. Thus, according to the data, the average annual turbidity of water in the middle reaches of the Amu Darya River ranges from 3 to 3.7 kg/ m^3, and the maximum can reach 20 kg/ m^3.

Currently, in order to ensure the receipt of the required water flow into the ante-chamber of pumping station No. 1, the incoming sediments are removed from the supply part of the channel by a hydromechanical method, which cannot meet the requirements of the operation of the KMK. In order to prevent sediment from entering the next stages of the cascade, it is proposed to arrange a settling tank in which it is supposed to delay all sediments with a diameter larger than 0.0015 mm, while preventing the deposition of small useful sediments that can be transported to irrigated lands.

It should be noted that in irrigation practice, sedimentation tanks located in the head of the channels and in-system sedimentation tanks are used. The first ones are arranged in the head of the system on the supply section of the main channel and provide for the deposition of some of the largest fractions of sediment that cannot be transported down the main channels. In intra-system sedimentation tanks arranged in various areas below the channels, the flow is clarified a second time so that the remaining sediments can be transported by water flows of irrigation channels to irrigated fields. In this type of settling tanks, there are more opportunities to maintain the desired filling depths, supports and speeds with the help of regulators located above and at the end of the settling tank.

Studies of the transporting capacity of the Amu Darya irrigation systems located in the middle reaches of the river have shown that head settling tanks on large irrigation systems cannot ensure that the on-farm network is not accessible to channels of the same order. Here it is necessary to set up in-system settling tanks. It was shown that during the entire irrigation period, 30% of the total flow of suspended sediment entering the system can be transported into the on-farm network, of which 20% will go to the fields, and 10% will be deposited in the on-farm network. At the same time, about 70% of sediments should be retained in the sedimentation tanks. Sedimentation tanks on irrigation systems in the lower reaches of the Amu Darya River, are mainly expanded and deepened head sections of channels on which continuous removal of sedimentary sediments is carried out by a hydro-mechanical method. The length of the head settling tanks is 1000 - 2500 m, and the intra–system ones are 400-1500 m.

The simplest type of settling tank is a single-chamber sedimentary basin, which is usually a widened and deepened section of the channel, the flow velocities in which should not exceed 0.2- 0.5 m/ s. The transverse outline of the sump is traditionally assumed to be rectangular or trapezoidal, and in the longitudinal direction its bottom is given either a positive or negative slope.

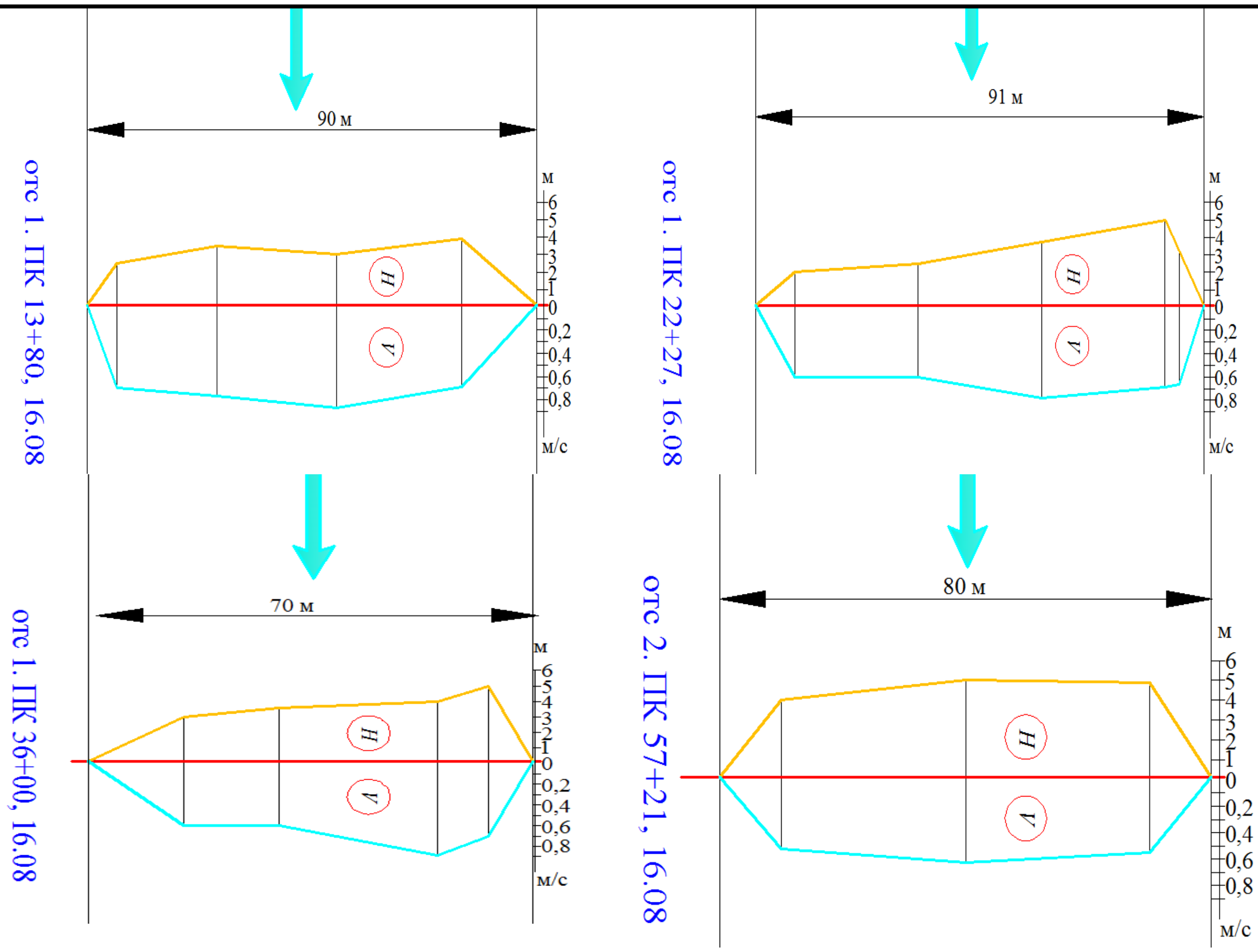

Fig-1. Change in the speed of flow and depth of water in the channel bed in PK.

The most unfavorable conditions were used as the initial data for the calculation of the settling tank in order to ensure the operation of the cascade hydraulic structures, including pumping stations, in particular, this concerns water flow and the weighted average turbidity of the flow. As for the sediments that should be detained in the sump, in accordance with the Terms of Reference, "all sediments coming from the river stream, with the exception of a fraction of 0.0015 mm and smaller, should be detained in the sump." Thus, the following parameters were taken into account in the calculations:

The average flow rate entering the sump Q = 120 m^3/s. The depth of the sump H = 7.42 m. The average velocity of water flow in the sump ϑ = 0.25 m/s. The weighted average turbidity at the inlet to the sump is ρ_0 = 3.6 kg/m^3. The diameter of the smallest fraction to be retained in the sump is D = 0.05 mm. The hydraulic size of the smallest fraction to be retained in the sump is ω = 0.00178 m/sec.

Weighted average hydraulic size of sediment ϑ_0=0.00706 m/s. The granulometric composition of sediments entering the channel was adopted according to the recommendations.

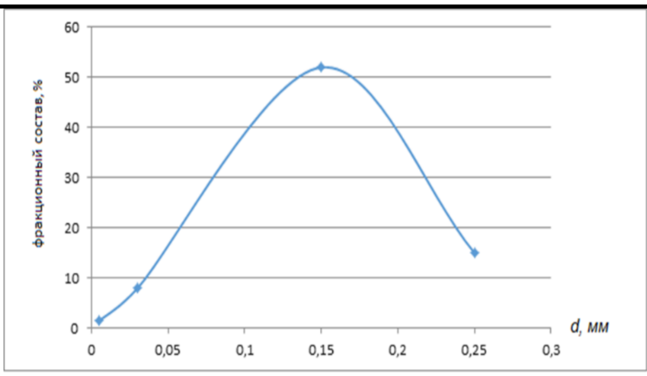

Fig 2. Average annual composition of suspended sediments of the Amu Darya River at the head of the KMC

Based on the information received about the granulometric composition of sediments entering the channel with river water and the hydraulic characteristics of the channel, it is possible to determine the length of the sump beforehand by assigning the water velocity in it.

Taking into account the recommendations, we take the width of the sump equal to the design width of the channel and ϑ = 0.25 m/s. For a rectangular section of the sump and at a water flow rate of 0.25 m/sec - the length of the sump, which ensures the retention of sediments of the smallest fraction (diameter 0.05 mm), for which there is information about its content, is:

$L = H\ V/\omega = 7.42 \times 0.25/0.00178 = 1042$ m,

Here: L is the length of the sump, V is the average velocity of water flow in the sump.

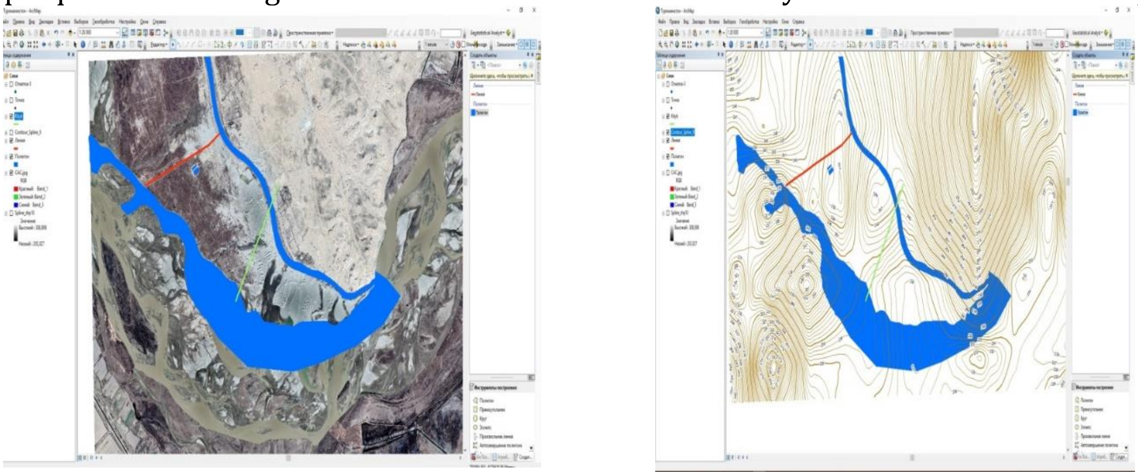

Fig-3. Location of a new type of settling tank in the channel of the KMK channel.

One of the most important characteristics from the point of view of operation is the siltation time of the sump. Taking into account the weighted average turbidity of the water entering the sump, as well as the need for continuous water supply to pumping station No. 1, it is possible to determine the probable duration of siltation of the sump. Having calculated ω/V and H/L according to the recommendations, we find the probability of precipitation of the calculated fraction P = 98%, i.e. at least 98% of sediments with a diameter of 0.05 mm and larger will be retained in the sump. Taking into account the unevenness of the velocity distribution plot in the horizontal plane, as well as the trapezoidal cross–section of the sump, the siltation time of the sump can be reduced by 15-20% and amount to about 15 months. Nevertheless, the device of two parallel chambers of settling tanks allows you to stably supply clarified water for a sufficiently long time and, at the same time, clean the silted chamber.

Conclusions and recommendations. The analysis of the results of field studies made it possible to draw the following conclusions:

1. The dynamics of changes in the speed and depth of the flow, as well as the capacity of the

supply channels of pumping stations are analyzed;

2. New layout schemes of the route and settling tanks of the supply channels of pumping stations are recommended;

3. Based on the field data, the design parameters of the sump are proposed, which allow to improve the operating conditions of the supply channels of pumping stations.

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