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Natural Studies of Velocity Field of the Water Flow for the Big Namangan Channel

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ABSTRACT: This research paper presents the results of natural studies of the velocity field of the water flow in the sections (PK138-PK290 and PK290-PK508) of the Big Namangan Canal in various hydrological conditions (during the vegetation and non-vegetation seasons), carried out in 2018-2019. To study the velocity field of flow was used an acoustic doppler-profilograph SonTeke-S5 model.

KEY WORDS: acoustic doppler-profilograph, closure structure, alignments, intake structure, unsteady water flow, natural experiments,.

I. INTRODUCTION

The Big Namangan Canal begins in the upper pool of the Uchkurgan Hydroelectric Power Station on the river Naryn, with a total length of 126.6 km, with a head project flow rate of 61.9 m³/s, which passes from the territory of Kyrgyzstan 13.8 km to the territory of the Republic of Uzbekistan 112.8 km. The total area of irrigated land suspended from the canal is 38.0 thousand ha, including 6.0 thousand ha in the territory of Kyrgyzstan. The main structure of the Big Namangan Canal is located on the upper pool of the Uchkurgan Hydroelectric Power Station on the territory of the Kyrgyz Republic [1].

The structure of the water flow in the irrigation canal, namely, the field of its velocities at various water flow rates, is very important information for predicting the formation and development of hydraulic processes. Therefore, field studies of the flow structure on irrigation canals are particular interesting. The emergence in recent years of new technical means, namely, acoustic doppler-profilograph, allows to effectively conduct field studies to measure the hydraulic parameters of the flow from the large irrigation canals.

II. METHODS OF RESEARCH

The modern scientific instrument is a hardware-software complex, which includes the SonTeke-S5 acoustic doppler current velocity meter, as well as SonTeke-S5 and as well as RiverSurveyor Live software for equipment management, data collection and processing. The complex made it possible in dynamic mode, when the boat moves along the observation line, to obtain an almost instantaneous picture of the vertical distribution of speed and direction of flow with a resolution of 0.1-0.4 m (depending on depth), as well as the depth at the measurement point and distance traveled along the alignment line, and thus, automatically calculated the flow rate of water. The horizontal distance between the measurement points along the line depends on the speed of the alignment and where it is 1-2 m. Spatial positioning is provided by a GPS receiver of increased accuracy and an inertial system including a magnetic compass and linear and angular acceleration sensors (Fig. 1).

In 2018, observations were performed at two sections of the Big Namangan Canal PK138-PK290 and PK290-PK508, and in 2019 PK362 + 93-PK642 + 09. Thus, the results of the observations not only replenished the general information of field data, but also gave detailed information about the flow structure in the channel sections, which are critically

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important in hydrometric and economic terms. The length of section No. 1 along the axis of the channel is 15.2 km, and for section No. 2 is 21.8 km.

Fig. 1. Hardware-software complex SonTeke-S5

In each section, 16 measuring targets were planned. In order to provide greater spatial coverage at high water, when the channel forms are flooded, some sections are made in the form of broken lines. During the measurements, the sections of the alignment was passed successively from top to downstream.
To control the general parameters of the water flow in the channel at each site, the level bridge-type hydrological posts are operating (see Fig. 2).

Fig. 2. General view and position of the measuring alignments

Before and after the end of the process of observing the field velocities of flow, a watermark was measured in the corresponding section. In addition, the flow rate was determined in the input and closing sections of the site. In total, two series of observations of the velocity field of flow were carried out: May 20-27 and October 11-15, 2018; May 11-14 and November 22-30, 2019.

The results of natural experiments of level marks, flow rate and water flow rates at the observation sites are presented in Figs. 3-6.

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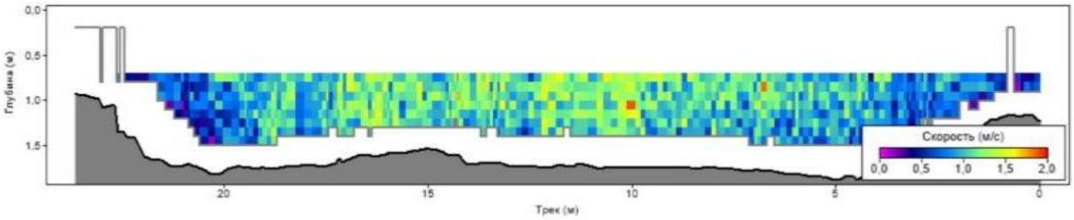

Fig. 3. The head section of the Big Namangan Canal, PK138. The maximum flow depth is 1.87 meters, the maximum flow rate is 2.1 m/s, and the water discharge is 27.901 m^3/s.

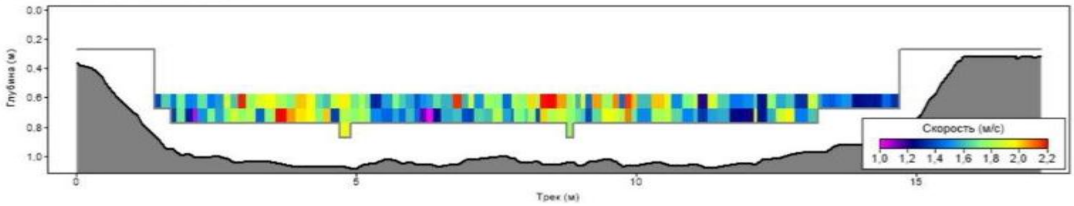

Fig. 4. Picket PK451 of the Big Namangan Canal. The maximum flow depth is 1.05 meters, the maximum flow rate is 2.2 m/s, the water discharge is 19.641 m^3 /s.

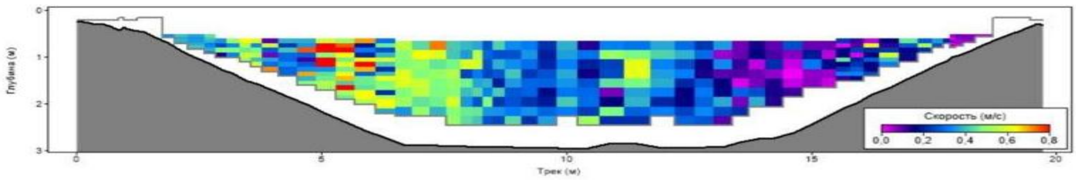

Fig. 5. Picket PK597 + 89 of the Big Namangan Canal. The maximum flow depth is 2.94 meters, the maximum flow rate is 0.8 m/s, and the water discharge is 9.942 m^3/s.

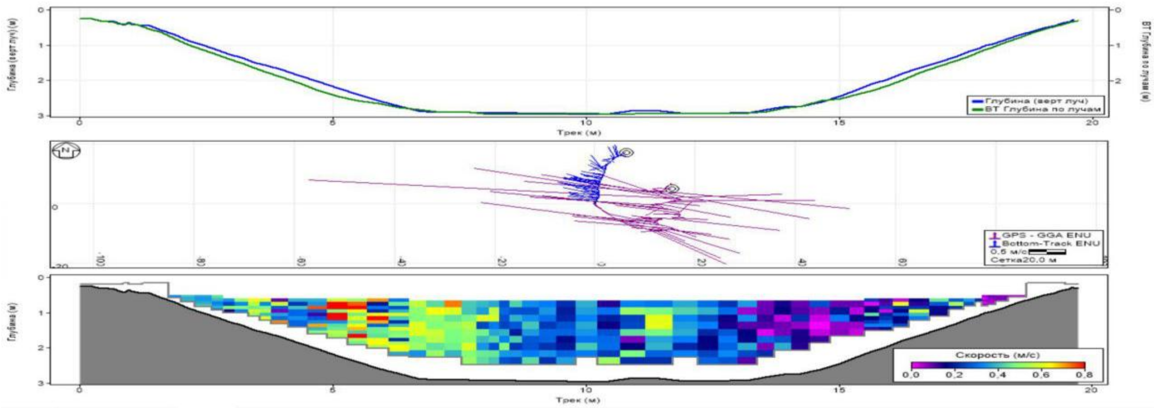

Fig. 6. Picket PK362 + 93 of the Big Namangan Canal. The maximum flow depth is 2.6 meters, the average flow rate vector is 0.5 0.8 m/s, and the water discharge is 10.65 m^3/s.

During the research the spatial inhomogeneity of the flow velocity field, ideally, the flow parameters should be constant over time. However, under natural conditions, achieving such stationarity is almost impossible. Nevertheless, field data show that the water level during the measurements on the site significantly changed: a maximum of 24 cm (7.8%). It should also be noted that the differences in the value of water flow in the inlet and outlet sections of the sections are explained only by the non-stationary flow caused by the violation of the operating mode of the UchkurganHPP. Desk works on the processing of field measurements show that the largest differences between the values of water flow at the inlet and at the exit of the plot (5.7%) are observed in the second series of measurements at plot No. 1.

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At the same time, according to the data, 19,6 m^3/s flowed from the site at the Kizilravot pumping station (PK144 + 53), and the flow rate to the on-farm pump stations at the PK208 + 90 and PK238 + 27 sections was 5 m^3/s. Given these losses, the discrepancy between the inlet and outlet water discharge is reduced to 29%. Less favorable in this sense are data on water discharge in the same area for May 21. The total outflow from the section into the ducts should be 6 m^3/s, however, the difference between the inlet and outlet discharge gives only 3 m^3/s. Thus, the unsteadiness of the flow manifests itself in this case clearly quite - about 21%. In addition, it should be noted that two days passed between the measurements of discharge in the ducts and the experiment on the research area, during which the water level was intensively reduced, which means that the discharge in the ducts could slightly decrease. Thus, the above data and their analysis allow us to assume that during the study of the field velocity of the flow regime in the Big Namangan Canal in the sections under consideration it was rather close to the stationary state.

As mention above, the acoustic profilograph made it possible to obtain a three-dimensional picture of the flow field velocity with a representation of the analysis of the flow field velocity, averaged over depth, which is carried out by the software of the profiler during its operation. During measurements, the boat trajectory, as a rule, deviated somewhat from the intended line of the alignment in one direction or another, since it is very difficult to maintain a constant course on a small boat moving with low speed across a wide river with a strong current.

On average, for all the completed alignments in both series of observations, this deviation, measured along the normal to the alignment line, is 0.7 m, maximum 1.3 m. In addition, even after the transition to a two-dimensional picture (averaged over the depth of the flow velocity), the amount of data collected is still too large to adequately display. As already noted, the interval between the measurement points was only 1-2 m. Due to these circumstances, the following method was chosen to present the measurement results: reference points were set on the alignment line with a step of 20 m, in each of which the data obtained in the closest real measurement point. The results of the research, namely the depth of the water and the vectors of the averaged over the depth of the flow rate at the reference points of the measuring alignments are presented in Fig. 3 and 6.

It should be noted that in section No. 2 during measurements on May 24, alignment No. 12 could not be completely completed due to obstacles during boat movement. It is interesting to note that under the same hydrological conditions the field data turned out to be very close to each other.

During analyzing the results obtained by experiments, first of all, attention should be paid to the effect of separation of the flow from the right floodplain bank with the formation of a whirlpool zone at its sharp bend at the top of the forced bend. This effect is observed on the earthen sections of the canal, and the relationship between the size of this zone and the steepness of the bend of the coast is clearly visible. In section No. 2, where the upper wing of the forced bend is oriented relative to the left bank at an angle of more than 20° (counting in the direction of the channel), the length of the whirlpool zone is about 200 m. In section No. 1, where the corresponding angle is about 15 °, the size of the zone is approximately three times smaller. In the whirlpool zone, translational movement of the water mass is practically absent, which contributes to the accumulation of sediment transported by the stream. We also note that in section No. 2 the dynamic axis of the flow (the line of its highest velocities) shifts to the other (left) bank right after the top of the bend, which is not observed in section No. 1. Here, under vegetations conditions, the dynamic axis of the stream and in the lower wing of the compelled bend remains pressed to the right floodplain shore, as indicated by our two biennial observations. The displacement of the dynamic axis of the flow to the left appears only at a distance of 800 m from the top of the bend.

III. RESULTS

Let us further consider the features of the velocity field during the vegetation season over the large river forms available in the sections. In both sections, directly below the channel form, on the left bank there is a quiet-water zone with very low flow rates, but with rather significant depths. As the results of measurements show, during the growing season in section No. 1, the velocity field above the channel form is fairly uniform in both magnitude and direction. This means that sediment entering the riverbed form, as well as being withdrawn by the stream from the sidewalk itself, transits along it and then is deposited in the low-water zone: just at the entrance to the flumes of water intake No. 1. A completely different picture is observed in section No. 2. In the central part of the side stream, a noticeable deceleration of the flow occurs, which means accumulation of channel sediments.

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Then, in its lower part, the flow accelerates again, while its velocity vectors are clearly oriented in the direction of the right bank. Consequently, sediment entering the stream from the lower part of the side stream falls into the region of high flow velocities located in the upper wing and at the top of the compelled bend, and then they are probably deposited downstream in the right-bank whirlpool. Thus, the entrance to the bucket of water intake No. 2 is outside the area of significant accumulation of channel sediments. In general, the results obtained are agree well with those of the main ones.

In general, the results obtained are agree well with the characteristic features and peculiarities of the flow velocity field in the channel sections. So, the conducted field studies have provided a lot of information about the main hydraulic parameters of the water flow in the Big Namangan Canal.

IV. CONCLUSION

The results of natural experiments show that the section of channel No. 2 is currently quite favorable for its smooth operation, which cannot be said about intake No. 1. Here, the main negative factors are the sharp changes in the water horizon due to violation of the operating mode of the Uchkurgan HPP which lead to unsteady movement of water flow in the channel. As a result of this technogenic impact on this section of the channel, has been appeared a very complicated hydraulic and economic situation.

REFERENCES

[1]. Makhmudov I.E. «Improving the management and use of water resources in the middle reaches of the Syrdarya basin (Chirchik-Akhangaran-Keles irrigation district)» // Republican Scientific and Technical Conference, May 1-2, 2015 Tashkent.

[2]. Kazakov E.A. Hydraulic modeling of transient water movement in the downstream of the Uch Kurgan Hydroelectric Station. IJARSET. Scientific and technical journal. India 2020 №7. 14137-14140 p.

[3]. Mahmudov I.E., Kazakov E.A., Gulomov O.G. Operating conditions and reliability parameters of hydraulic structures on the Big Namangan canal. Agro science. 2020 №4.

[4]. Kazakov E.A., Yakubov G.M. Research and assessment of the state of water resources of the Greater Namangan Canal. Architectural construction design. Scientific and practical journal. Tashkent 2019 №4. 213-217 p.

[5]. Kazakov E.A., Sadiev U.A. Hydraulic model of water supply regulation at fluctuations in the water level in the main canals. Agro ilm. 2020 number 1. 107-108 p.

[6]. Kazakov E.A., Petrov A.A. Automatic water level stabilization systems with discrete controllers. Sibak. XXVIII International Scientific and Practical Conference. "Questions of technical and physical and mathematical sciences in the light of modern research." Novosibirsk 2020.

[7]. Mahmudov I.E., Kazakov E.A. Experimental study of the velocity field of water flow movement of the Greater Namangan Canal. Current problems of earthquake resistance of buildings and structures. Collection of materials of the Republican scientific-practical conference. Tashkent 2020 March 18-19.249-254 p.

[8]. Makhmudov I.E., Kazakov E.A., Kuloov O.Y., Sadiev U.A. Hydraulic model of regulation of water level fluctuations in the Great Namangan Canal. TAYI 2020, 2. 9-13 p.

[9]. Kazakov E.A. Hydraulic model of regulation of water level fluctuations in the Big Namangan Canal. International Scientific Agricultural Journal. Russia, Volgograd 2018 No. 3. 67-71 p.