Assessment of the influence of river sediments in the Sokhsoy river

Aybek Arifjanov[1], *Islombek* Akhmedov[2*], *Isroil* Umarov[2], and *Aleksandr* Kazadayev[2]

[1]Tashkent Institute of Irrigation and Agricultural Mechanization Engineers National Research University, (TIIAME NRU), Uzbekistan
[2]Namangan engineering-construction institute, Islom Karimov avenue, 12, Namangan, Uzbekistan

Abstract. The paper is devoted to carrying out targeted scientific research activities aimed at the development of new methods and technologies to accurately determine the consumption of bottom sediments and reduce their negative impact on hydraulic structures. One of the urgent tasks is to carry out scientific research aimed at the development of scientifically based measures aimed at reducing the negative impact of river sediments on hydrotechnical structures built in the bed of the river in the foothills. At present, measures are being taken in the Republic of Uzbekistan to identify the factors affecting the consumption of bottom sediments and to develop new methods of existing hydraulic calculations that provide opportunities for improvement. This article focuses on the protection of the Kokan reservoir from turbid sediments and provides an accurate estimate of the sediments that flow into the reservoir.

1 Introduction

One of the important issues is the improvement of calculation methods and technologies for the assessment of processes in the river bed and prediction of bed deformation. In this regard, special attention is paid to the scientific research works aimed at improving the technologies for preventing silting of hydrotechnical structures in the river bed and canal. In the management and regulation of the amount of river sediments, researches were conducted in natural field conditions in the upper reaches of the Kukan hydroelectric system [1, 2, 3]. From this point of view, the Kokan hydroelectric plant can be considered as a laboratory in its own natural field conditions. Because water flows from this reservoir in certain months of the year. The rest of the time, the river is in a state without water. That is, at this time, it is possible to see, observe and measure the changes that have occurred at the bottom of the riverbed [4, 5, 6].

2 Methods and materials

In order to regulate river sediments, settling tanks were built in the Kukan hydroelectric system. However, over the years, due to the processes that have occurred along the river, the

* Corresponding author: i.axmedov0588@gmail.com

flow's turbidity transfer capabilities have changed dramatically, and a large amount of turbid discharges are coming to the hydroelectric network. Current clarifiers are not capable of regulating these turbid discharges. As a result, the danger of silting up the Kukan hydroelectric station and the channels receiving water from it is increasing year by year. In order to reduce the negative consequences of this, it is advisable to carry out measures in the upper part of the Kukan hydroponic, that is, in the upper part of the Kokan hydroponic. According to its location, the project of the pacifier located along the river can be implemented. Since the impurities in the river water consist of stones and gravel, if the area of the clarifier is expanded and the water depth is designed to be small, the work of the mechanisms in cleaning the clarifier will be easier [7, 8, 9].

In order to reduce the high volume of the hydrowell and the silting of the channels, it is recommended to implement a project of a filter that traps large fractional discharges in the bed of the water-carrying channel. It is known from the conducted studies that the slope of the river bed is high, and the river sediments reach the hydrowell with the flow of water.

This article is aimed at protecting the Kokan hydroelectric reservoir from turbid sediments, for which we will change the hydraulic parameters of the existing riverbed [10, 11, 12].

We will see if a filter 2-2,5 km long and 0,5-1 km wide can hold large river sediments in the Sokh stream bed, which supplies water to the Kokan hydroelectric system. The refinery we are planning to design will cover an area of 20-25 hectares (200000-250000 m^2).

For this, the slope of the bottom of the stream is lowered by 1,2 m from the previous level, and as a result, it is possible to reduce the water speed and extinguish the flow energy due to the reduction of the slope of the clarifier. 20-25 million m^3 of gravel sediments can be retained in the area of the resulting sedimentation tank. In one year, the amount of sediments cleaned in the Kokan hydroelectric plant is 11 mln. m^3 is the volume. There are many difficulties in removing the sediments (gravel) buried in the area of the hydrowell, therefore, if Kukan is built outside the hydrowell, that is, in the Sokh riverbed, it is considered convenient for the local population to use the sediments there. As a result, the negative consequences to the hydrogel due to improper use are avoided. Nowadays, as a result of taking gravel directly from the inner part of the hydrowell, i.e., from the upper part, due to the load from heavy trucks, there may be cases of hydrowell concrete covers breaking into unusable condition [13, 14, 15].

3 Results and discussion

Based on the conducted research, data on hydraulic parameters and the amount of turbidity were collected. Proposals were developed based on the obtained results [16, 17, 18].

The following table shows the parameters of the watershed in the upper part of the Kokan hydroelectric system.

Table 1. Existing parameters of the Sokh stream bed.

b, m	h, m	m	N	i	L, m
100	1.1	1.5	0.03	0.0015	2000

We calculate the hydraulic parameters of the channel based on the above table and evaluate the carrying capacity of the flow in the channel:

ω- section surface in motion:

$$\omega = (b + m*h)*h = (100 + 1.5*1.1)*1.1 = 111.82\ m^2$$

χ – wettability perimeter:

$$\chi = b + 2*h\sqrt{1 + m^2} = 100 + 2.2*1.8 = 103.96\ m$$

R- hydraulic radius:

$$R = \frac{\omega}{\chi} = \frac{111.82}{103.96} = 1.07\ m$$

C- Shezi coefficient:

$$C = \frac{1}{n}\sqrt[6]{R} = \frac{1}{0.03}\sqrt[6]{1.07} = 28.9\sqrt{m}/s$$

We determine the flow rate according to the determined parameters:

$$\vartheta = C \cdot \sqrt{R \cdot i} = 28.9 \cdot \sqrt{1.07 \cdot 0.0015} = 1.15 m/s$$

The speed of the flow obtained as a result of calculations (1.15 m/s) is high, and at this speed, washing occurs in the lower part of the structure, and the ground of the river is washed away and poses a threat to the Kukan hydroelectric system. In order to regulate this process, the following proposals are recommended [19]:

(1) work should be done to reduce the slope of the river;

(2) it is necessary to carry out the work of enlarging the cross-section of the core.

Based on the above proposals, using the Uzan as a quencher, we accept the parameters of the Uzan-quencher as follows based on the conducted research [20, 21].

The following table (Table 2) shows the results of the hydraulic calculation of the proposed extender.

Table 2. Hydraulic parameters of stretcher.

B, m	h, m	M	n	i	L, m
500	0.8	1.5	0.03	0.0006	2000

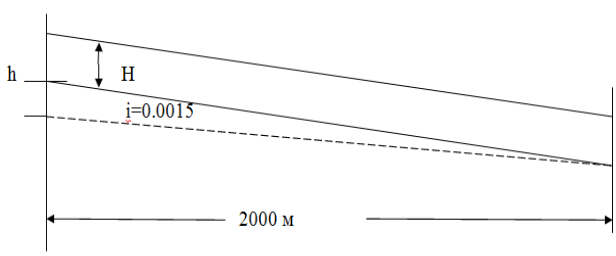

Fig. 1. Uzan - the scheme of the bottom of the cooler.

Based on the proposed parameters, we determine the hydraulic parameters of the stream:

ω- cross-sectional area in motion:

$$\omega = (b + mh)h = (500 + 1.5 \cdot 0.8) \cdot 0.8 = 400{,}96 m^2$$

χ – wettability perimeter:

$$\chi = b + 2h\sqrt{1 + m^2} = 500 + 2 \cdot 0.8\sqrt{1 + 1{,}5^2} = 502{,}88 m$$

R- hydraulic radius:

$$R = \frac{\omega}{\chi} = \frac{400{,}96}{502{,}88} = 0{,}8м$$

C- Shezi coefficient:

$$C = \frac{1}{n}R^{1/6} = \frac{1}{0.03}\sqrt[6]{0{,}79} = 32{,}04\sqrt{m}/s$$

We determine the flow rate according to the specified parameters:

$$\vartheta = C \cdot \sqrt{R \cdot i} = 32{,}04 \cdot \sqrt{0.79 \cdot 0{,}0006} = 0.7 m/s$$

As can be seen from these calculations, it is possible to reduce the turbidity of the water flow by changing the parameters of the channel. A change in the flow cross-section leads to a change in the flow velocity, resulting in a decrease in the carrying capacity of the flow.

To determine the amount of turbidity, we calculate the carrying capacity of the current in the current state [1/3].

$$S_1 = \alpha_1 \frac{{\vartheta_1}^3}{gR_1\bar{W}} = 0,2\frac{1,15^3}{10 * 1,07 * 0,029} = 0,88кг/m^3$$

$\alpha - 0,18 \div 0,25$ changes to:

$\bar{W}$ - average hydraulic quantity, (mm/s) [6].

Based on the above suggestions, the carrying capacity of the stream is:

$$S_2 = \alpha_2 \frac{{\vartheta_2}^3}{gR_2\bar{W}} = 0,2\frac{0,7^3}{10 * 0,80 * 0,029} = 0,3kg/m^3$$

The amount of turbidity remaining in the inductor can be determined by the difference in the amount of turbidity of the flow.

$$S_0 = S_1 - S_2 = 0,88 - 0,3 = 0,58kg/m^3$$

Assuming that the maximum possible water consumption in the average Sox river is 140 m3/s, the volume of turbidity remaining in the clarifier is –V

$$Q_m = 140 * 0,58 = 81,2kg/s$$

$$V = 90 * 81,2 * 60 * 60 * 24 = 420940,8m^3$$

4 Conclusion

As a result of the above calculations, it is shown that the amount of turbidity remaining in the clarifier is 420940.8 m^3. This will reduce the amount of cleaning work in the Kukan cooler by the same amount.

If we estimate the average cost of cleaning 1 m3 of turbidity as 0,2 cent, then according to the initial calculations it will be 8400$ saving is achieved. It should also be noted that these calculations are based on baseline data for the highest water consumption and turbidity levels. These values change as water consumption changes and the amount of turbidity changes.

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