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ASSESSMENT OF THE CAPACITY OF A REGULATED RIVER CHANNEL

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Annotation. *In this article, the change of hydraulic resistances for permanent and temporarily flowing parts of the lower Amudarya riverbed under adjusted conditions is studied. As a result of the study and analysis, the hydraulic parameters of the river and the formulas for calculating the elements of the flow were obtained. Through these received formulas, the water carrying capacity of the river was estimated for the conditions of the Amudarya water flow. Also, the obtained results were compared with the designed water carrying capacity of the river bed in the lower reaches of Amudarya, and it is based on the fact that the water carrying capacity has decreased by 25-30%.*

Key words: *regulated river bed, roughness coefficient, throughput.*

Аннотация. *В данной статье изучено изменение гидравлического сопротивления на постоянной и временно действующей части русла реки Амударья в условиях зарегулированного стока. В результате исследования и анализа были получены формулы расчета для гидравлических параметры реки и элементов стока. На основе полученным формулам была оценена водопропускная способность реки Амударьи для условий зарегулированного стока воды. Также полученные результаты сравнивались с проектной водоносностью русла реки в нижнем течении Амударьи, исходя из того, что водопропускная способность снизилась на 25-30%.*

Ключевые слова: *зарегулированного русла, коэффициента шероховатость, пропускная способности.*

Annotatsiya. *Ushbu maqolada Amudaryoning quyi oqimidagi o'zanini rostlangan sharoitidagi doimiy va vaqtincha oqadigan qismlari uchun gidravlik qarshiliklarning o'zgarishi o'rganilgan. O'rganish va tahlillar natijasida daryoning gidravlik parametrlari va oqimning elementlarini hisoblash formulalari olingan. Ushbu olingan formulalar orqali Amudaryoning suv oqimi rostlangan sharoiti uchun daryoning suv o'tkazish qobiliyati baholangan. Shuningdek olingan natijalar Amudaryoning quyi oqimidagi daryo o'zanining loyihaviy suv o'tkazish qobiliyati bilan solishtirilgan va hozirda suv o'tkazish qobiliyati 25-30 % ga qisqargani asoslangan.*

Kalit so'zlar: *Rostlangan o'zan, g'adir-budurlik koeffitsiyenti, suv o'tkazish qobiliyati.*

Introduction. Under conditions of regulated water flow, a constant flow of water is discharged into the lower pool of the structure and as a result of a long passage of a smaller (small) flow, a new channel is formed in the river [3]. The width of the new channel is usually smaller than the width of the regulated channel. Thus, the total width of the regulated channel is divided into two parts. The first part is constantly flowing, while the second part is flowing only during the flood, i.e. the second part of the width works periodically. On the periodically working part, the width, due to the long absence of flow, becomes overgrown with vegetation, increasing the roughness of the channel (Fig. 1).

Thus, in the part of the width where water constantly flows, its own roughness of the channel is formed and in the part of the periodically working width - its own roughness. The roughness of the channel on the periodically working part is usually greater than in the part of the constantly operating channel. The value of the roughness coefficient for the permanently active part of the width is determined by the formula that we obtained based on the processing of data from the hydraulic sections of the Amu Darya River:

$$n = \frac{0,025}{Q^{0,35}} \quad (1)$$

The value of the roughness coefficient for the periodically acting part of the width is taken in accordance with the state of the channel according to the XVI scale of roughness of river channels and floodplains [1].

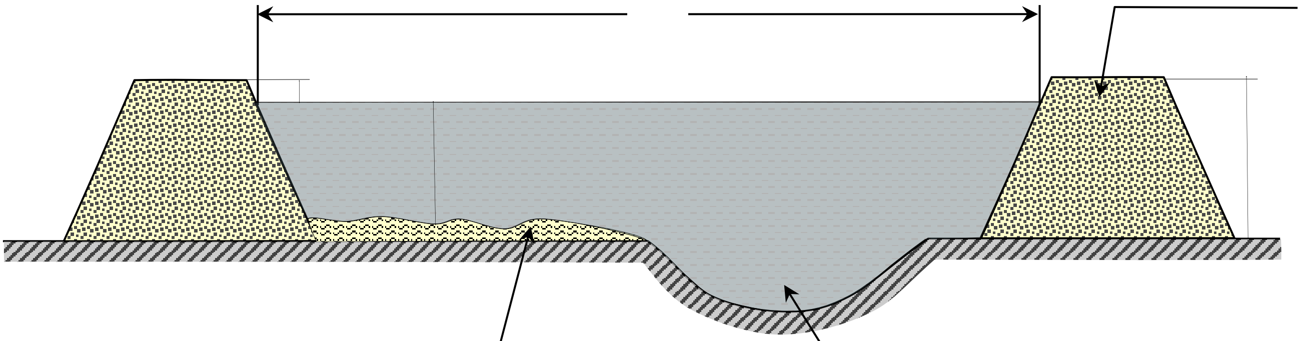

Figure 1. Cross-section of the regulated riverbed.

As the survey of the regulated section of the river showed, the width of the permanently active channel is 1/3 of the full width of the regulated channel.

According to this, the roughness coefficient over the entire width of the regulated riverbed will be [4]:

$$n_0 = \frac{1}{3} n_{\text{р}} + \frac{2}{3} n_n = \frac{n_{\text{р}} + 2n_n}{3} \quad (2)$$

The maximum filling depth of a regulated riverbed is determined by the formula:

$$H = H_{\text{д}} - H_{\text{з}} \quad (3)$$

H_{∂} – High damm, м;

H_3 – reserve above maximum water level, m.

The capacity of a regulated channel is determined by the formula:

$$Q = \frac{B \cdot H^{5/3} \cdot i^{1/2}}{n_0} \quad (4)$$

In order to demonstrate the applicability of new hydromorphological dependencies, we will calculate the hydraulic parameters of the flow and estimate the channel capacity using formulas obtained by us by processing and analyzing natural data in the lower reaches of the Amu Darya River for conditions of regulated water flow.

We will perform the calculation for two examples.

Example 1. For hydraulic calculation of river beds:

It is necessary to establish the width of the channel, average and maximum depths, the radius of curvature of the channel and other parameters of the river beds for the following data of the Amu Darya River:

-estimated water flow, Q=3000 m^3/s;

-water surface slope i=0,00010;

-average diameter of bottom sediments d=0,10 mm.

Based on these data, we determine:

1. The width of the channel using the formula:

$$B = 10\left(\frac{Q}{\sqrt{gi}}\right)^{0,37} d^{0,075} = 10\left(\frac{3000}{\sqrt{9,81 \cdot 0,0001}}\right)^{0,37} 0,0001^{0,075} = 350 \text{ m.}$$

2. Average flow depth according to formula [5]:

$$H = 200\left(\frac{Q}{\sqrt{gi}}\right)^{0,15} d^{0,625} = 200\left(\frac{3000}{\sqrt{9,81 \cdot 0,0001}}\right)^{0,15} 0,0001^{0,625} = 3,5 \text{ m.}$$

3. The average flow velocity over the cross-section according to the formula:

$$V = \frac{Q}{\omega} = \frac{Q}{B \cdot H} = \frac{3000}{350 \cdot 3,5} = 2,45 \text{ m/s.}$$

4. The radius of curvature of the geometric axis of the flow on a curved section of a regulated river bed according to the formula:

$$R = 150\frac{Q^{0,35} \cdot d^{0,125}}{(\sqrt{gi})^{0,35}} = 150\frac{3000^{0,35} \cdot 0,0001^{0,125}}{(\sqrt{9,81 \cdot 0,0001})^{0,35}} = 2627,5 \text{ m.}$$

Example 2. To assess the capacity of river beds:

It is necessary to establish the actual capacity of river beds with the following data for the Amu Darya River.

- Width of the regulated channel B=600 m.
- Height of the dam – $H_д$=5 m;
- Slope of the water surface i = 0,00014;

The calculation is carried out in the following sequence

1. We find the roughness coefficient for the permanently acting part of the channel width using the formula [2]:

$$n_p = \frac{0,025}{Q^{0,35}} = \frac{0,025}{3500^{0,35}} = 0,014$$

For preliminary calculations we take Q=3500 m^3/s

2. The roughness coefficient for the periodically acting part of the width is taken from the book "Hydraulics" [1] for channels with a calm current:

$$n_n = 0,03$$

3. The overall roughness of the regulated channel is determined using formula (2):

$$n_0 = \frac{n_p + 2n_n}{3} = \frac{0,014 + 2 \cdot 0,03}{3} \approx 0,025$$

4. The maximum filling depth of the channel is established according to formula (3):

$$H = H_д - H_з = 5,0 - 0,5 = 4,5 \text{ м.}$$

$H_д$=5 m - dam height

$H_З$=0,5 m – headroom above maximum water level

5. In fact, the capacity of a regulated river bed is determined by formula (4):

$$Q_ф = \frac{B \cdot H^{5/3} \cdot i^{1/2}}{n_0} = \frac{600 \cdot 4,5^{5/3} \cdot (0,00014)^{1/2}}{0,025} = 3500 \text{ m}^3\text{/s.}$$

The initial throughput is set according to formula (4):

$$Q_{п} = \frac{B \cdot H^{5/3} \cdot i^{1/2}}{n_p} = \frac{600 \cdot 4,5^{5/3} \cdot (0,00014)^{1/2}}{0,018} = 4800 \text{ m}^3/\text{s}.$$

Actual throughput $Q_ф$ = 3500 m^3/s.

Design capacity Q_n = 4800 m^3/s.

Conclusion. Thus, the actual capacity of the regulated river bed is 25-30% less than the design capacity due to the increase in the roughness coefficient on the periodically operating part of the bed width. The decrease in the actual capacity must be taken into account when discharging water through the discharge structures of reservoirs during the passage of a flood along the Amu Darya River bed.

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RECOMMENDATIONS FOR IMPROVING THE CAPACITY OF THE AMUDARYA RIVER CHANNEL BETWEEN THE TUYAMUYUN-TAHIATASH HYDRAULIC STRUCTURES

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Abstract. This article presents the research work on improving the water carrying capacity of the Amudarya riverbed from the Tuyamoyin reservoir hydro unit to the Takhyatosh hydro unit. In the course of the research, the current state of protective and corrective structures in the considered river section was studied and analyzed. According to the results of the study, measures were developed for the restoration and repair of protective and corrective structures in Amudarya.

Key words: water flow, water carrying capacity of the river bed, adjusted river bed, water reservoir.

Аннотация. В данной статье представлены научно-исследовательские работы по улучшению пропускной способности русла реки Амударья от гидроузла Тюямуюнского водохранилища до Тахиаташского гидроузла. В ходе исследований было изучено и