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Dynamics of the hydraulic and alluvial regime of the lower reaches of the Amudarya after the commissioning of the Takhiatash and Tuyamuyun hydrosystems

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Abstract. The article presents data on changes in the main hydraulic parameters of the flow in the hydrological sections of the Amudarya river located in the zone of influence of the Takhiatash and Tuyamuyun reservoirs. It has been established that in recent years an acute water shortage has been observed in the lower reaches of the river during the growing season. In dry years for the Amudarya River, the Takhiatash hydroelectric complex becomes the last section, in some periods there are even no sanitary passes through the hydroelectric complex in the prescribed manner, and as a result, a tense situation is created in the Amudarya delta below the Takhiatash hydroelectric complex. Analysis of the hydrological regime of the river showed that in the lower reaches of the Amudarya on the territory of the Kharezmi region and Karakalpakstan, the water regime of the river is very different from the domestic one. The low-water period on the river practically begins in September, as there is a large flow of water in September and October. The waters coming from the upper reaches of the river are retained to fill the Tuyamuyun reservoir. At the same time, the end of the low-water period is actually shifted to the beginning of March, since in March, the work of the water accumulated in the reservoir begins and its supply for flushing irrigation begins. The flood waters entering the Tuyamuyun reservoir are either fully accumulated (if the reservoirs are not filled up to the normal retention level of the NRL) or are very strongly transformed (if the reservoir is filled up to the NRL). Analysis of the dynamics of sediment runoff showed that the amplitudes of fluctuations in sediment runoff over periods have a very wide range of changes. In the initial period of operation of the hydroelectric complex, the sediment runoff mode almost repeats the household mode, that is, the largest runoff occurs during the dry season, but with the lowest solid runoff values on average 3 and 8 (at the Samanbai station) times. For 7 years from 1975 to 1981, the annual flow at the Kipchak gauging station amounted to 41.722 thousand tons, that is, 32% of the annual household regime. The largest annual flow at the Kipchak and Samanbai gauging stations took place in the high-water year 1978 and amounted to 66329 and 57971 thousand tons соответственно. The smallest amount of annual runoff at gauging stations was observed in dry 1981 and amounted to 25074 and 3943 thousand tons. The study of the sediment runoff regime of the Amudarya river during the period of joint operation of the Takhiatash and Tuyamuyun hydrosystems showed that the amount of solid runoff entering the



zone of influence of the Takhiatash hydroelectric complex significantly decreased due to a sharp decrease in water discharge under the influence of regulation and low water. At the same time, as the analysis of field studies has shown, despite their relatively small number, accumulation of sediments is observed in the pays of the hydroelectric complex, that is, silting occurs. The amount of sediment siltation in the area of the Takhiatash hydroelectric complex varies depending on the water content of the year and the operating mode of the Takhiatash hydroelectric complex. Analysis of the alluvial regime shows that during the period of operation of the hydroelectric complex, depending on the hydrological regime of the river and the regime of the water level in front of the dam, the clarification of the flow occurs in April, May, June and August. The seasonally average clarification of the flow within the upper pool ranges from 10 to 40%, and in some months, at levels close to the NSP, reaches 90%, that is, the upper pool of the node turns into a kind of settling tank. The composition of suspended sediments of the Amudarya varies both in time and along the length of the river, but particles smaller than 0.25 mm remain predominant. Particles larger than 0.25 mm are found only in the upper areas and in an amount of no more than 3 - 4%. During the flood period, along the entire length of the river, the percentage of fines content increases in comparison with the low-water period.

1. Introduction

The Amudarya is the largest in terms of water intake and water content river in Central Asia, formed by the confluence of the Pyanj and Vakhsh rivers. Its total length from the confluence with the Vakhsh River is 1415 km. Taking into account the morphological and geographical features, the Amudarya river basin is divided into three sections: the upper course (above the gauging station Kelif - the border between Turkmenistan and Uzbekistan); middle streams (between gauging station Kelif and Tuyamuyun); and the lower course (below Tuyamuyun).

In the Amudarya basin, there are two large river reservoirs of seasonal regulation - the Nurek reservoir on the Vakhsh river and the Tuyamuyun reservoir in the lower reaches of the Amudarya river and a dozen intra-basin and intra-system reservoirs.

The flow regime of the Amudarya is studied and controlled by 16 – 20 hydrological posts and stations, starting from the Termez post and ending with posts on the estuarine branches: Akdarya, Kipchakdarya, Kazakdarya. The expenditure regime is studied by seven first-class skeletons. Three of them are above the Tuyamuyun gorge and four below. The latter include (downstream) posts: Tuyamuyun, Kipchak (after 1974), Chatly (before 1973), Samanbai (after 1973) and Kyzyljar. The posts of Kerki (in the middle reaches) and Chatly, organized in 1910, have the greatest length of observation of the flow regime of the Amudarya.

In the last century, large structures for irrigation and energy use were built in the riverbed and in its floodplain. Naturally, all these structures have a dramatic effect on the flow dynamics, which contributes to a change in the channel morphometry.

In this regard, significant changes have occurred in the hydraulic and sediment regime of the river [1, 2]. To ensure the safety of the constructed structures, it is required to perform predictive calculations of channel processes in the river bed, taking into account the influence of hydraulic and hydropower structures on the flow dynamics [3–8]. Regulating the channel, the river, taking into account the flow dynamics in connection with the construction of hydrotechnical and hydropower many scientists were engaged in structures [9–12].

The results of many researchers of channel processes have shown that very often in high-water years they most fully reflected the relationship and dynamics between the morphological elements of the flow and the hydraulic parameters of the Amudarya river flow. After the construction of structures or water intake in the river bed, this connection is sharply disrupted [13–16]. Especially the change in the hydrological and alluvial regime of the river sharply complicates the operation of the head structures of the pumping station inlet canals with damless water intake, which poses a real threat to the guaranteed water intake [17–21]. A sharp change in the river bed regime can lead to an increase in the intensity of channel processes, a decrease in the useful volume of reservoirs and the throughput of

the channels of machine canals. The intake of an excessive amount of sediment in the front chambers of pumping stations contributes to an increase in abrasive wear of the pumping units of the pumping stations and the turbines of the hydroelectric power station. To solve the above problems, it is first of all necessary to have information on the dynamics of the hydrological and alluvial regime of the river. Despite the fact that numerous studies have been carried out in this direction, due to the complexity of the problem of taking into account the influence of the constructed structures on the dynamics of the hydrological and alluvial regime of the river, its solution has not been brought to its logical conclusion [5, 7], [22–27].

Based on the foregoing, the study of the dynamics of the hydraulic and alluvial regime of the lower reaches of the Amudarya after the commissioning of the Takhiatash and Tyuyamuyun hydrosystems, which affect the course and direction of channel processes in conditions of regulated river flow, is defined as the main goal of this scientific work. To achieve the set goal of this work, the following research objectives are defined:

- analysis of the dynamics of the average annual water discharge with regulated flow in gauging stations located in the lower reaches of the Amudarya and under the influence of the Takhiatash and Tyuyamuyun hydroelectric complexes;
- analysis of water flow in hydroelectric stations, which are influenced by the above-mentioned reservoirs;
- study of the dynamics of bottom and suspended sediments of the Amudarya river before and after the construction of dams; establishing a functional relationship between hydraulic turbidity and average flow turbidity;

2. Methods

Analysis and study of the dynamics of the main parameters of the water flow of the river before and after the commissioning of hydroelectric complexes in its channel, analysis of the dynamics of the fractional composition of suspended and bottom sediments and their hydraulic size are the method for studying this work.

3. Results and Discussion

The Chatly post, located below the Takhiatash gorge and water intakes into the Suenli and Kyzketken canals, covered the regime of the Amudarya water discharge into the Aral Sea. In 1973, due to the completion of construction 3 km upstream of the Takhiatash Dam, it was closed. However, according to channel calculations, the Samanbai post, opened instead of it at a distance of 14 km from the dam, falls into the zone of intense erosion of the downstream of the hydroelectric complex. The Kichak post (48 km upstream of the dam), converted in 1973 into a first grade post, falls into the siltation zone of the headwater.

If we take the value of the average long-term discharge at the Kerki post for 20 years (1958 - 1978) about 1900 m³/s, then the time interval, with a water content above the average, can be considered five years: 1958, 1959, 1966., 1969, 1973 The most abundant were 1958 and 1969. In 1969, the average annual discharge at the Kerki post was 2990 m³/s and at the Chatly post - 2240 m³/s.

In the most shallow years, 1962, 1963, 1965, 1971, 1974 and 1977, the average annual discharge at the Kerki post decreased to 1500 - 1400 m³/s, and at the Samanbai (Chatly) post - even to 219 m³/s (1974). In 1974 and 1977, as well as subsequent dry years for all irrigation systems receiving Amudarya water, proportional water apportioning was introduced for the period of vegetation irrigation. For this, by decision of the government in Urgench, a special headquarters was organized from the leading workers of the water management bodies. In accordance with the decree of the government of the USSR in 1987, it was decided to create the Amudarya basin administration for inter-republican distribution of water resources ("Amudarya" Water Management Agency). Subsequently, the Amudarya Administration for Water Management was renamed into the Amudarya Basin Water Management Association and was entrusted with the tasks of operational management of water resources and their distribution among the republics.

The passage of flood peaks lays the foundation for the reformation of the river bed. With an increase in flow rates at the beginning of the peak, the erosion of the head parts of the ducts and branches, corresponding to their death, increases. The annual maximum discharge of the river most often occurs in July, less often in June and August. Its largest value was recorded in 1969 at the stations: Tuyamuyun - 9480 m³/s and Chatly – 6930 m³/s.

The minimum water discharge in the Amudarya is observed in the second half of the autumn-winter low – water period, most often in the middle - end of January, since in February – March the river begins to recharge with melt and rainwater. However, after the construction of the Nurek and Tuyamuyun reservoirs (after 1980), the regime of the river along its length and in time changed dramatically. In subsequent years, seasonal regulation of the runoff is carried out with sharp fluctuations in the volumes of reservoirs from dead to their maximum filling.

Figure 1 shows the data on changes in the average annual water discharge in the lower reaches of the Amudarya for 20 years (1980 – 1999) at the gauging stations: Darganata, Tuyamuyun, Kipchak and Samanbai with a regulated flow of the Amudarya river.

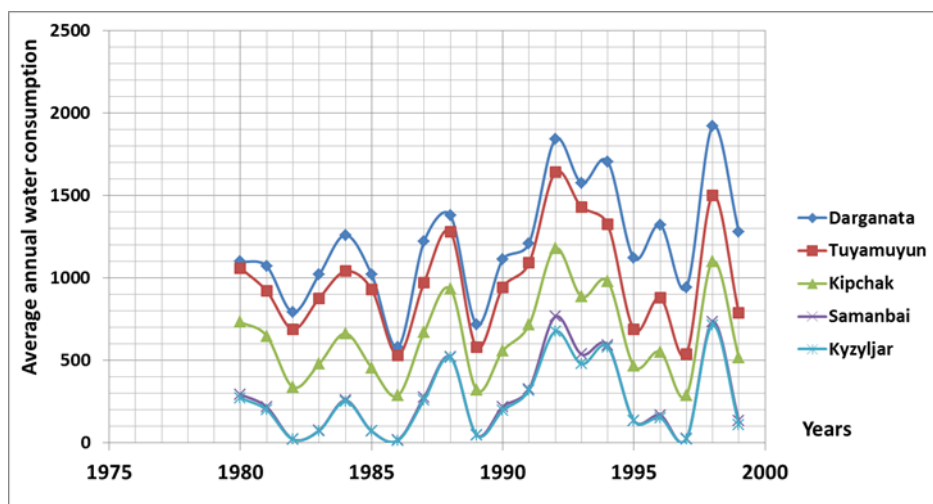


Figure 1. Change in the average annual water discharge along the length of the Amudarya river with regulated flow (1980 - 1999).

Figures 1 and 2 show the daily changes in water discharge along the length of the river at the Kipchak and Samanbai gauging stations under the conditions of the drifted pits of the Takhiatash hydroelectric complex (Figure 1 and 2 are given in the appendices). Analysis of long-term changes in the water regime of the Amudarya river in time and along the length of the river shows that as the water moves down, especially in dry years, there is a sharp decrease in river runoff starting from the post below the Takhiatash hydroelectric complex.

In recent years, an acute shortage of water has been observed in the lower reaches during the growing season. A sharp decrease in water consumption was observed in such dry years as 1982, 1986, 1989, 1997 and 2000 – 2002. During these years, the Takhiatash hydroelectric complex became the last section for the Amudarya river, in some periods there were even no sanitary passes through the hydroelectric complex in the prescribed manner (Fig. 2). Thus, a tense situation was created in the delta of the Amudarya river below the Takhiatash hydroelectric complex.

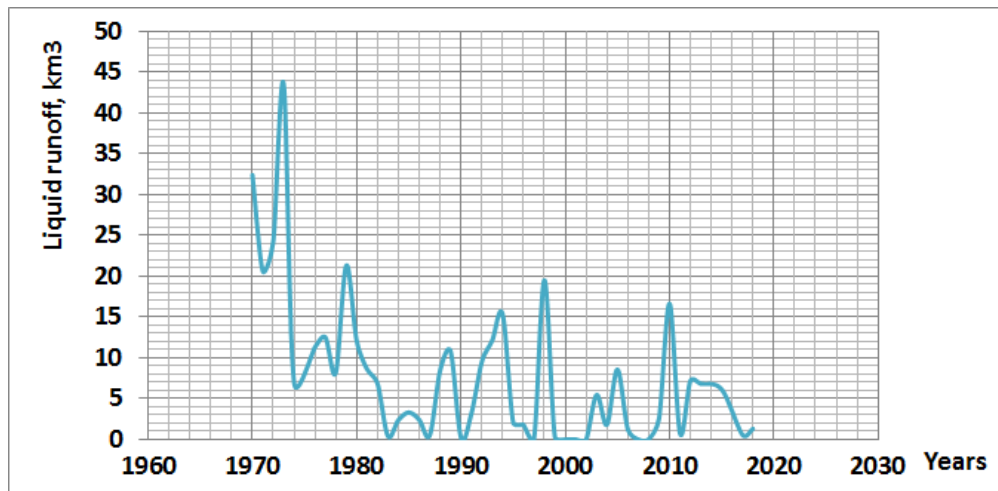


Figure 2. Average annual water flow of the Amudarya river at the Samanbai gauging station.

Consequently, in the lower reaches of the Amudarya through the territory of the Khorezm region and Karakalpakstan, the water regime of the river is very different from the domestic one. The low-water period on the river practically begins in September, as there is more water consumption in September and October, coming from the upper sections of the river and delayed to fill the Tuyamuyun reservoir. At the same time, the end of the low-water period is actually shifted to the beginning of March, since in March it begins with the processing of water accumulated in the reservoir and its supply for flushing irrigation. The flood waters entering the Tuyamuyun reservoir are either fully accumulated (if the reservoir is not filled up to the normal retaining level – NRL) or are very strongly transformed (if the reservoir is filled up to the NRL). The flow rate is least of all subject to change at the beginning of the spring low – water wave, which, in order to weaken siltation, is passed through the Tuyamuyun reservoir at levels close to the level of the dead volume – DVL.

Solid runoff regime. The water regime of the river has a great influence on the regime of its sediments and the channel process associated with the latter regime. The commissioning of the Takhiatash (1974) and Tuyamuyun (1982) hydroelectric complexes on the Amudarya river brought tangible changes to the sediment regime in its lower reaches. Changes in the amount of sediment transported by the river, their regime largely influenced the formation of the river channel in the basins of the Takhiatash hydroelectric complex.

The river sediment runoff regime and channel processes in the zone of influence of the Takhiatash hydroelectric complex were studied by the SANIIRI staff in the initial period of operation (1974 - 1991). and during the years of joint operation of the Takhiatash and Tuyamuyun hydroelectric complexes (1982 - 2000). For a comparative analysis of the obtained research results, the UGMS data were used at the Kipchak, Nietbaytas and Samanbai hydrological stations, as well as at the Chatly post for the period (1939 - 1959), representing the everyday state of the solid river flow in the lower reaches.

The Kipchak gauging station is located 51 km above the hydropower complex and belongs to the transit zone, the Nietbaytas gauging station is located 12 km above the dam and is in the zone of backwater influence. The Samanbai gauging station is located 14 km below the dam and belongs to the general erosion zone.

Figure 3 presents data on the monthly distribution of the mean long-term sediment runoff of the Amudarya River for the above gauging stations.

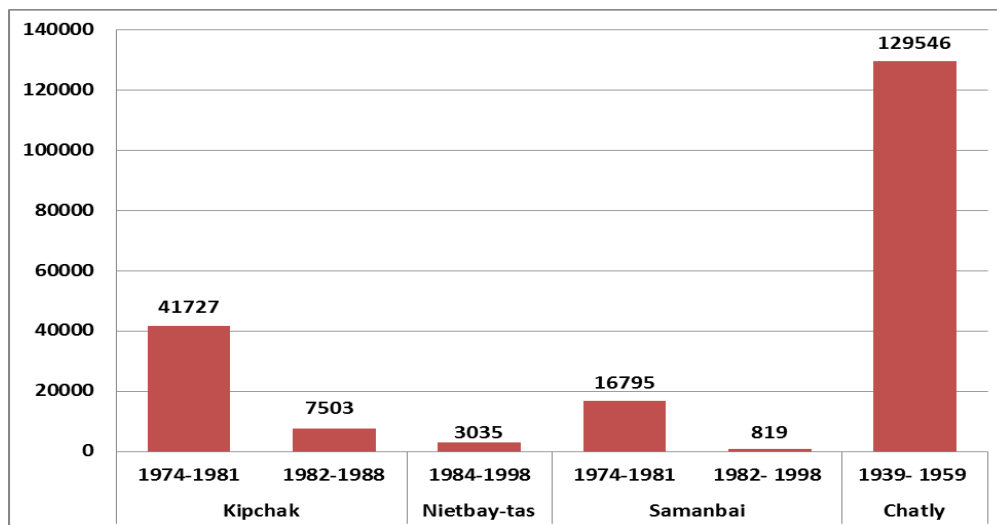


Figure 3. Average annual sediment runoff of the Amu Darya River at gauging stations Kipchak, Nietbay-tas, Samanbai and Chatly for various periods by months, thousand tons.

Figure 3 shows that the amplitude of fluctuations in sediment runoff over periods has a very wide range of changes. In the initial period of operation of the hydroelectric complex, the sediment runoff mode almost repeats the domestic mode, that is, the largest runoff occurs during the dry season, but with the lowest solid runoff on average 3 and 8 (at the Samanbai station) times. For 7 years from 1975 to 1981, the annual flow at the Kipchak gauging station amounted to 41,722 thousand tons, that is, 32% of the annual household regime. The largest annual runoff at the Kipchak and Samanbai gauging stations took place in the high-water year 1978 and amounted to 66329 and 57971 thousand tons, respectively. The smallest amount of annual runoff at gauging stations was 25074 and 3943 thousand tons and was observed in low – water 1981.

During the period of joint operation of hydroelectric complexes, the value of sediment runoff compared to the initial and everyday periods has significantly decreased. These ratios on average are: in the Kipchak section - 6 and 17 times, in Nietbay-tas – 43 and in the Samanbai section - 21 and 158 times. The passage of the largest runoffs, as in the previous periods, is observed during the growing season, but the exception is April, it no longer refers to the months of greatest runoff. In May - September, 6205 thousand tons passed through the Kipchak gauging station on average over 17 years. sediment load, that is, 83% of the annual runoff. For gauging stations Nietbay-tas and Samanbai this ratio is 81 and 76%, respectively.

The annual sediment runoff at the Samanbai gauging station, as well as at Nietbay-tas, depends on the operating mode of the hydroelectric complex. The maximum annual runoff at the gauging station was observed in the relatively high-water year 1988 and amounted to 4143 thousand tons, the minimum in the low-water year 1988 and amounted to 31 thousand tons. On average, over 17 years of joint operation of hydroelectric complexes, the annual sediment runoff at the Samanbai section amounted to 819 thousand tons, which is about 5% of the annual runoff of the initial period of operation and almost 1% of the annual runoff of the river's everyday regime. On average for the period from 1982 to 1998 at the Samanbai section, sediment runoff is 11% of the Kipchak section.

Thus, the study of the sediment runoff regime of the Amudarya River during the period of joint operation of the Takhiatash and Tuyamuyun hydroelectric complexes showed that the amount of solid runoff entering the zone of influence of the Takhiatash hydroelectric complex significantly decreased due to a sharp decrease in water discharge under the influence of regulation and low water. At the same time, as the analysis of field studies has shown, despite their relatively small number, accumulation of sediments is observed in the ponds of the hydroelectric complex, that is, silting

occurs. The amount of sediment siltation in the area of the Takhiatash hydroelectric complex varies depending on the water content of the year and the operating mode of the Takhiatash hydroelectric complex.

Figure 3 shows the changes in the water level in front of the dam, the average long-term turbidity of the Chatla station, the average daily turbidity in the Kipchak section and in the water intake zone over time: 1978, 1980, 1983. Research data show that during the initial period of operation during the growing season in the water intake zone, the turbidity of the flow was less than the turbidity for the same months in the living conditions of the Kipchak post. Maximum average ten-day turbidity in the growing season $\rho = 0.77 \text{ kg/m}^3$ in 1977. With the commissioning of the Tuyamuyun hydroelectric complex (1982), the turbidity of the river in the Kipchak section decreased sharply due to the accumulation of sediments in the channel reservoir of this hydroelectric complex (Figure 3 is given in the Appendix).

From the analysis of the data of the sediment regime, it also follows that during the period of operation of the hydroelectric complex, depending on the hydrological regime of the river and the regime of the level in front of the dam, the clarification of the flow occurs in April, May, June and August. The seasonally average clarification of the stream within the upper pool ranges from 10 to 40%, and in some months, at levels close to the NRL, reaches up to 90%, that is, the upper pool of the node turns into a kind of settling tank.

The composition of suspended sediments of the Amudarya varies both in time and along the length of the river, but particles smaller than 0.25 mm remain predominant. Particles larger than 0.25 mm are found only in the upper areas and in an amount of no more than 3 - 4%. During the flood period along the entire length of the river, the percentage of fines content increases in comparison with the low-water period.

Fractional compositions of suspended sediments and bottom sediments of the Amudarya consist of the same fractions and differ only in the predominance of small and large particles. Average annual fractional composition of river sediments under domestic conditions (1971 – 1973) in the Chatly section and our data on the sediment composition in the water intake zone (Table 1).

Table 1. Average annual fractional composition of suspended sediment during the household period and after the construction of the water intake dam

Years	Turbidity $\rho, \text{ kg/m}^3$	Hydraulic size, mm/s							Values $W_{max}, \text{ mm/h}$
		> 32	32-20	20-12	12-2	2-0.2	0.2-0.02	<0.02	
Household period									
1952-1969	1.86	-	1.6	2.2	13.6	24.4	26.2	32.0	25.8
1971	1.70	0.10	3.54	9.64	35.2	14.9	28.5	3.12	28.5
1972	2.32	0.30	4.30	8.95	28.2	13.3	38.5	6.45	31.0
1973	2.20	0.10	2.34	6.40	46.0	14.4	19.8	10.96	33.0
Period at dam water intake									
1975	1.85	-	0.84	3.94	32.2	21.5	28.4	13.1	24.0
1976	3.36	-	1.37	1.80	6.10	31.8	51.8	7.13	23.4
1977	0.76	-	0.82	2.25	1.73	24.65	63.05	7.50	30.2
1978	2.55	-	0.62	3.14	12.65	29.30	49.38	4.91	32.8

As follows from the table 1 in the first years of operation of the Takhiatash hydroelectric complex, fine particles predominated in the sediment composition in front of the dam, since large ones were deposited at the beginning of the zone of the backwater curve. As the upstream silted up, the size of particles coming to the dam and entering the channels increased annually. For example, for the period from 1976 to 1978, the maximum hydraulic size of sediments increased from $W_{max} = 23.4 \text{ mm/c}$ to $W_{max} = 23.8 \text{ mm/c}$.

The fractional composition of bottom sediments is studied by many gauging stations of the UGMS. As one approaches the mouth of the Amu Darya, the content of fractions larger than 0.25 mm decreases, while those of small 0.05 mm increase. This leads to a decrease in the average size of sediments, which, according to the UGMS data, is 0.35 mm for kerki, 0.20 mm for Tuyamuyun, and 0.15 mm for Chatly (Samanbai). Fractions less than 0.01 mm are practically not involved in sediments in the main canal. Therefore, K.I.Rossinsky, I.A.Kuzmin, V.S.Lapshenkov, A.M. Mukhamedov, I.A.Buzunov and others consider for the Amudarya channel-forming fractions that determine the course of the channel process, particles larger than 0.01 - 0.08 mm.

Changes in the water regime of the Amudarya under the influence of hydraulic engineering measures of recent years have greatly changed the sediment regime of the river in its lower reaches. After the commissioning of the Takhiatash dam (1974); in its upper reach, intensive sedimentation began, causing the extension of the backwater zone. In this case, the products of coastal erosion in the downstream began to play the main role in the saturation of discharge flows with sediments. Below the dam of the Tyuyamuyun reservoir (after 1982), the erosion of the outlet river channel by the clarified waste waters did not lead to the restoration of the original turbidity even in the section of the wedging out of the backwater of the Takhiatash dam (although sedimentation of sediments in the section of this backwater continues). The existing methods for calculating the transporting capacity of the flow, the headwaters of hydrosystems and reservoirs, as well as the general erosion of river beds below the hydrosystems, are based on the application of the characteristics of the sediment composition in the form of a conventional value of the average hydraulic size (or average diameter) of particles.

To predict and calculate the average hydraulic size of suspended sediment in the area of the Takhiatash hydroelectric complex, the following formula can be used (Figure 4):

$$\bar{W} = 1.25 + \frac{1}{1.73\rho} \quad (3)$$

where ρ – average turbidity of the stream.

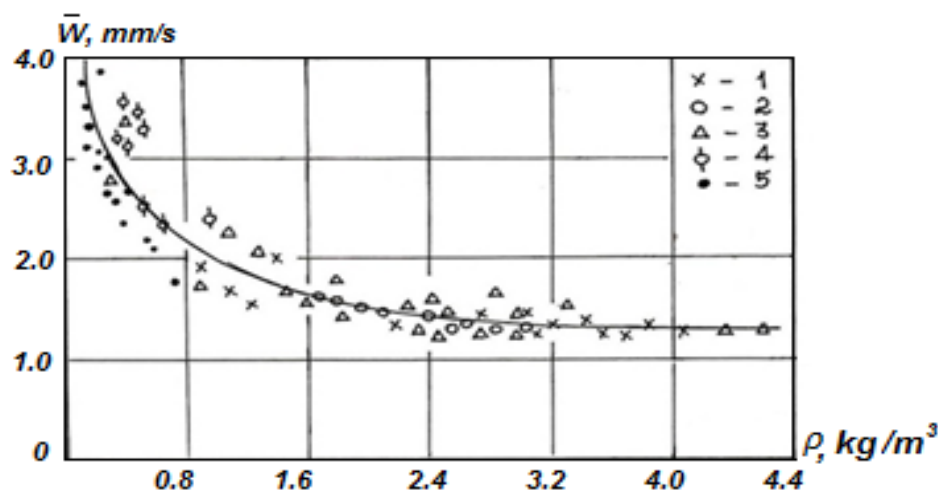


Figure 4. Graph of the dependence of the average hydraulic size (\bar{W}) on the average turbidity of the Amudarya river flow for the Takhiatash hydroelectric complex area: 1-points based on the materials of the Takhiatash hydrosystem design assignment; 2 - points of taking off the schedule of N.A. Tsvetkova for the Chatly post; 3-field data of the author in the section of the water intake in 1976-1978; 4 the same in 1999.

As the initial data, the study of the fractional composition of suspended sediments of the Amudarya river in the section of the water intake of the Kyzketken and Suenli canals [13, 14] and the materials of the design assignment of the Takhiatash hydroelectric complex were taken.

4. Conclusion

As a result of analysis of the main characteristics of the hydrological and sediment flow regime, the following was established:

1. In recent years, an acute shortage of water has been observed in the lower reaches during the growing season. A sharp decrease in water discharge was observed in such dry years as 1982, 1986, 1989, 1997 and 2000 – 2002, 2020. During these years, for the Amudarya river, the Takhiatash hydroelectric complex became the last section, in some periods there were even no sanitary passes through the hydroelectric complex in the prescribed manner, and as a result, a tense situation is created in the Amudarya delta below the Takhiatash hydroelectric complex;

2. In the lower reaches of the Amudarya on the territory of the Khorezm region and Karakalpakia, the water regime of the river is very different from the everyday one. The low-water period in the river practically begins in September, since more water flows in September and October, coming from the upper sections of the river, are delayed to fill the Tuyamuyun reservoir. At the same time, the end of the low-water period is actually shifted to the beginning of March, since in March, the drainage of water accumulated in the reservoir begins and its supply for flushing irrigation. The flood waters entering the Tuyamuyun reservoir are either fully accumulated (if the reservoirs are not filled up to the normal back-up level of the NRL) or are very strongly transformed (if the reservoir is filled up to the NRL). The least changes are observed in the flow rates at the beginning of the spring low-water wave, which are passed through the Tuyamuyun reservoir at levels close to DVL in order to weaken siltation;

3. Analysis of the dynamics of sediment runoff showed that the amplitude of fluctuations in sediment runoff over periods has a very wide range of variation. In the initial period of operation of the hydroelectric complex, the sediment runoff mode almost repeats the household mode, that is, the largest runoff occurs during the dry season, but with the lowest solid runoff values on average 3 and 8 (at the Samanbai station) times. For 7 years from 1975 to 1981, the annual flow at the Kipchak gauging station amounted to 41.722 thousand tons, that is, 32% of the annual household regime. The largest annual flow at the Kipchak and Samanbai gauging stations took place in the high-water year 1978 and amounted to 66329 and 57971 thousand tons respectively. The smallest amount of annual runoff at gauging stations was observed in dry 1981 and amounted to 25074 and 3943 thousand tons;

4. During the period of joint operation of hydroelectric complexes, the value of sediment runoff compared to the initial and normal periods significantly decreased. These ratios on average are: in the Kipchak section - 6 and 17, Nietbaytas – 43 and in the Samanbai section - 21 and 158 times. The passage of the largest flows, as in the previous periods, was observed during the growing season, but the exception is April, it no longer refers to the months of the highest flows. During the months of May - September, 6205 thousand tons passed through the Kipchak gauging station on average over 17 years. sediment load, that is, 83% of the annual runoff. For gauging stations Nietbaytas and Samanbai this ratio is 81 and 76%, respectively;

5. The study of the sediment runoff regime of the Amudarya River during the period of joint operation of the Takhiatash and Tuyamuyun hydroelectric complexes showed that the amount of solid runoff entering the zone of influence of the Takhiatash hydroelectric complex significantly decreased due to a sharp decrease in water discharge under the influence of regulation and low water. At the same time, as the analysis of field studies has shown, despite their relatively small number, accumulation of sediments is observed in the ponds of the hydroelectric complex, that is, siltation occurs. The amount of sediment siltation in the area of the Takhiatash hydroelectric complex varies depending on the water content of the year and the operating mode of the Takhiatash hydroelectric complex.

6. The analysis of the sediment regime shows that during the period of operation of the hydroelectric complex, depending on the hydrological regime of the river and the regime of the level in front of the dam, the clarification of the flow occurs in April, May, June and August. The seasonally average clarification of the stream within the upper pool ranges from 10 to 40%, and in some months,

at levels close to the NSP, reaches 90%, that is, the upper pool of the node turns into a kind of settling tank.

7. The composition of suspended sediments of the Amudarya varies both in time and along the length of the river, but particles smaller than 0.25 mm remain predominant. Particles larger than 0.25 mm are found only in the upper areas and in an amount of no more than 3 – 4%. During the flood period, along the entire length of the river, the percentage of fines content increases in comparison with low water.

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