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IMPROVEMENT OF THE METHODS OF DETERMINING THE VOLUME OF TURBIDITY OF THE CHERVO RESERVOIR

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Abstract:
Issues of changes in indicators of the decrease of the useful volume of water reservoirs have been widely studied in scientific literature, and now, as one of the problems of water reservoirs, special attention is paid to the effects of filling the water reservoir with muddy sediments, subsidence, subsidence, and washing. In the article, the above-mentioned cases are analyzed, suggestions are made on the issue of methods of determining the cases resulting from the decrease of the useful volume of the Charvoq reservoir, as well as methods of calculating the volume of turbidity.

Keywords: Reservoirs, water storage, banks, wet, maximum depth, runoff, turbidity, flatness, useful volume, subsidence, sloughs, water saturation, gravity, compressive strength.

How to Use This Template

The issues of changing the indicators of decreasing the useful volume of reservoirs in different territories have been widely studied in the scientific literature, currently special attention is paid to the prevention of situations such as burials resulting from the impact of small faults, washouts, subsidence and washouts on coastal slopes flooded with reservoir water, as one of the problems of reservoirs. The article analyzes the above circumstances and provides suggestions for the rapid identification of emerging areas of the coast, as well as for the implementation of measures to prevent coastal landslides.

1.Introduction

The operation of existing hydrotechnical structures in our republic depends on effective and safe use of water reservoirs, their timely technical inspection, timely repair, restoration and reconstruction. This places great responsibility on the

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organizations that use hydrotechnical facilities and requires improvement of the operation of water reservoirs.

2. Materials and Methods

The Materials and Methods should be described with sufficient details to allow others to replicate and build on the published results. Please note that the publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. New methods and protocols should be described in detail while well-established methods can be briefly described and appropriately cited.

3.Results

20-30 years of inflow and outflow water consumption data (daily or ten-day) for the river (or channel) supplying Chervok reservoir were studied. The calculation of the volume of turbid sediments of the reservoir was carried out in the table in the following order:

1.Table

T/r	**Year**	**Water level max.m**	**Water level Min. m**	**Size Wl project according to million m^3**	**Enter ∑Wkmillion m^3**	**Exit ∑Wch million m^3**	**∑Wk - ∑Wch million m^3**	**Blur size ΔWmillion m^3**	**General water ingress My timemillion m^3**	**The blurred part of the useful volume is ΔWf million m^3**
1	1	2	3	4	5	6	7	8	9	10
2	2018	862.11	838.00	1043.35	4975.43	5816.36	840.93	202.42	19298.94	461.53
3	2019	858.23	838.68	1111.91	5059.90	5788.63	728.73	383.18	32007.85	1076.75
4	2020	863.25	843.33	999.21	5713.30	6183.82	470.52	528.69	59631.76	1453.9
5	2021	848.36	836.00	701.75	5223.75	5576.60	352.85	648.9	124920	1535.2

4.Discussion

The annual maximum and minimum water level values of the reservoir from at least 4 years of data were found and entered in columns 1 and 2. By finding the water reservoir volume Wd for these years under the project (monthly value), it is entered in the 3rd column, in the 4th and

5th columns, the input and output water consumption data are entered for the selected year (monthly total). The difference between input and output water consumption is written in column 6 (∑Wk - ∑Wch).

5.Conclusions

Determining the amount of turbidity between the maximum (highest) and minimum (lowest) water levels of the water reservoir observed during any year is carried out by the following formula:

$\Delta W = W_l - (\sum W_k - \sum W_{ch}) = 1043.35 - 840.93 = 202.42$ million m^3 (1)

where: Wl is the volume of the reservoir along the design line between these water levels, mln.m^3;

$\sum W_k - \sum W_{ch}$ - the sum of inflow and outflow components during the time when the water balance level changed between these water levels, mln.m^3.

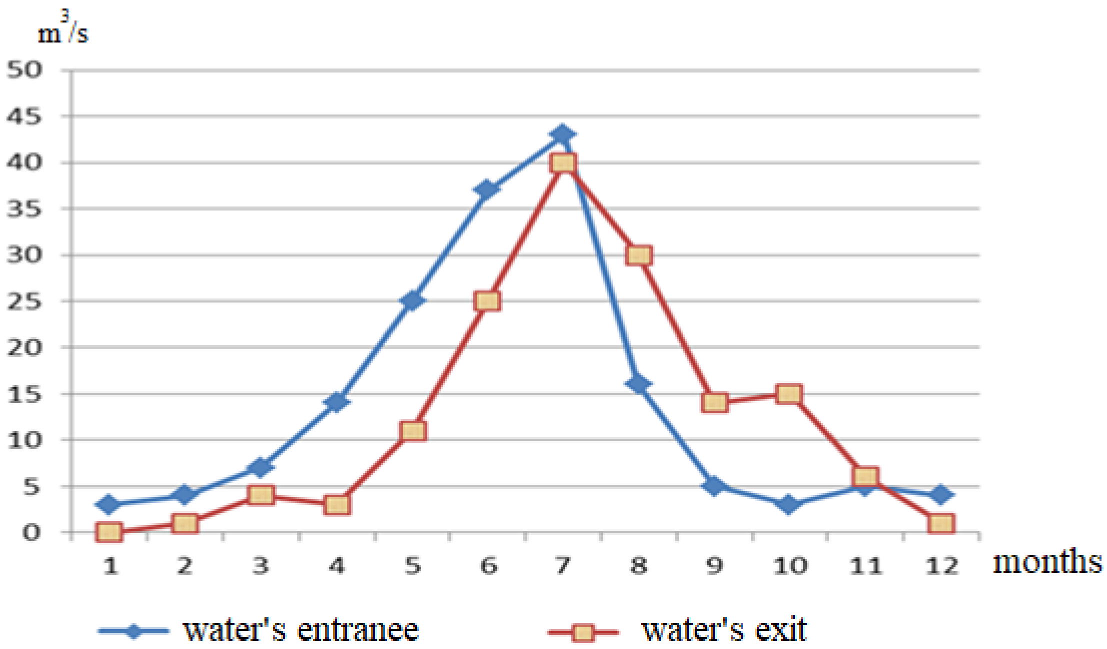

Figure 1. Diagram of water input and output observed in the reservoir during one year

Determined values are entered in column 7 for each year.

6.Patents

The total volume of the flow that was poured into the reservoir during the fiscal yearMy timevalues are entered in column 9. The blurred part of the useful part ΔWf is found from the following equation and written in the 10th column.

$$\Delta W_{useful} = \Delta W \cdot \frac{MSLsign - USLsign}{\text{water level}_{max} - \text{water level}_{min}} = 202{,}42 \cdot \frac{890-835}{862{,}11-838{,}00} = 461.53 \text{ million m}^3$$

Having found this volume for several selected years, draw a graph (Figure 1) on columns 9 and 10 of the table (according to the level function), a curve that aligns themit is possible to determine the amount of turbidity during the time of use of the reservoir.

By finding the volume of turbidity for several selected years, it is possible to determine the volume of turbidity during the period of use of the reservoir according to the graph below. For calculations, the years with the maximum change in water levels and with more reliable data were selected (Fig. 2).

Based on the calculation result and the conducted research

$$(2)\frac{\Delta W_{flow}}{\Delta W_0} = 0{,}023\left(\frac{\Delta W_{flow}}{W_0}\right)^{0{,}55}$$

The blurred part of the full volume of the reservoir:

$W_{total} = \Delta W_f + \Delta W_0$ (3)

where ΔW_f is the blurred part of the useful volume, mln.m³;

ΔW_0 – dead volume, million m³ (the dead volume of Chervok reservoir is 498 million m³).

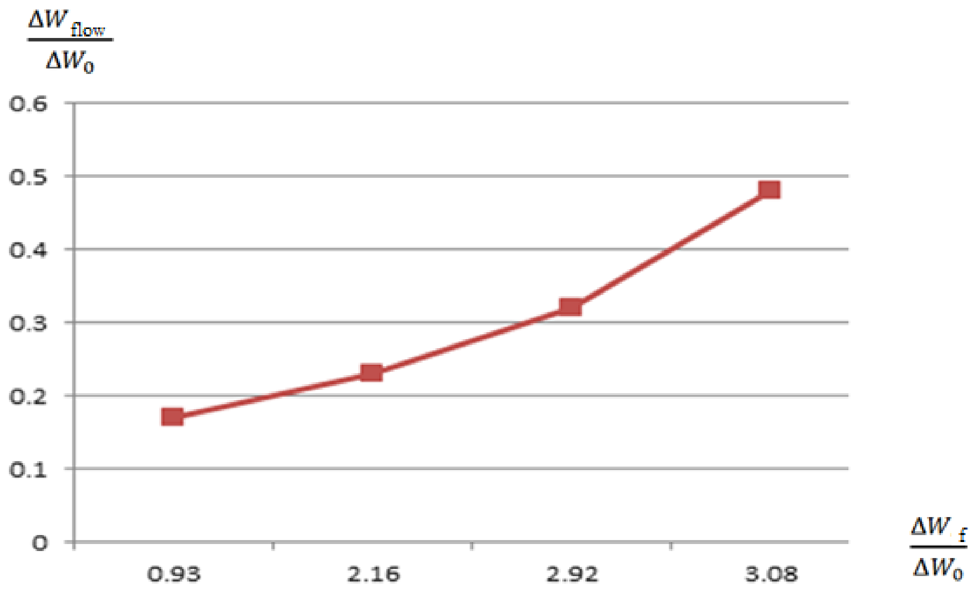

Figure 2. The graph of changes in the amount of turbidity in the Chervok reservois

During the year it is observed that various amounts of water flow into the reservoir. Taking into account the occurrence of floods in the reservoir basin and its tributaries in May-August, the main turbid discharges are poured into the reservoir during these months. The amount of suspended discharge begins to increase from April, reaches a maximum value in June, and then begins to decrease until September.

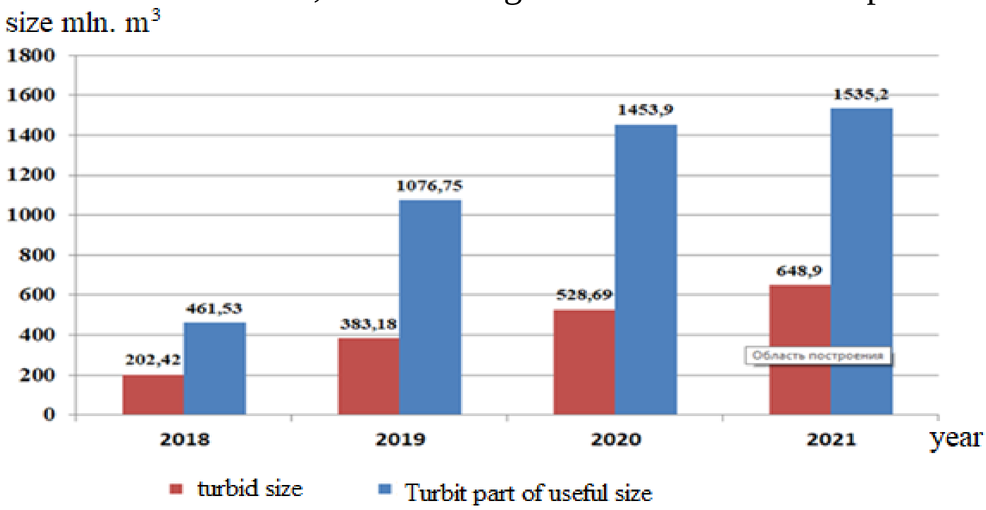

Figure 3. Changes in the volume of turbidity in the reservoir

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In October, the amount of suspended discharge reaches the minimum value. The maximum value of the suspended liquid corresponds to the month of June. According to the long-term average monthly data, 28.4% of suspended runoff occurred in June (Figure 4).

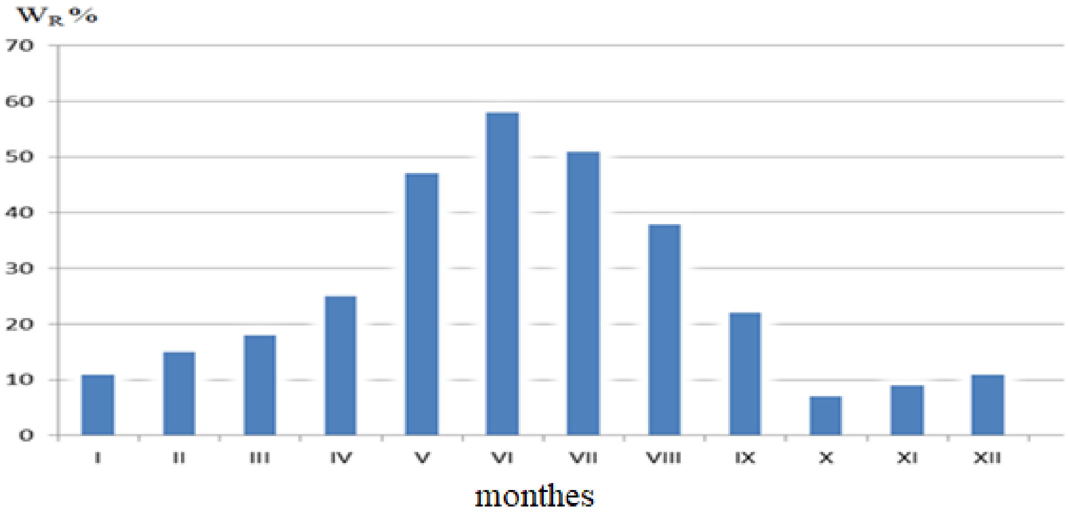

Figure 4. Annual distribution of the average multi-year discharge in the reservoir

The results of observations on determining the amount of turbid sediments during the operation of the livestock reservoir are presented in Table 2, and the graph of changes in the amount of turbid sediments in the reservoir is presented in Fig. 5.

Amount of turbidity in the reservoir

Table 2.

Year	Turbid sediments obtained on the basis of observations, mln.m^3	Average annual million m^3
1975	139.0	10.7
1980	192.5	9.8
1985	241.5	8.4
1990	283.5	7.2
1995	319.5	7.1
2000	355.0	6.4
2005	387.0	9.1
2010	432.5	5.9
2015	462.0	6.8
2020	528.7	7.7

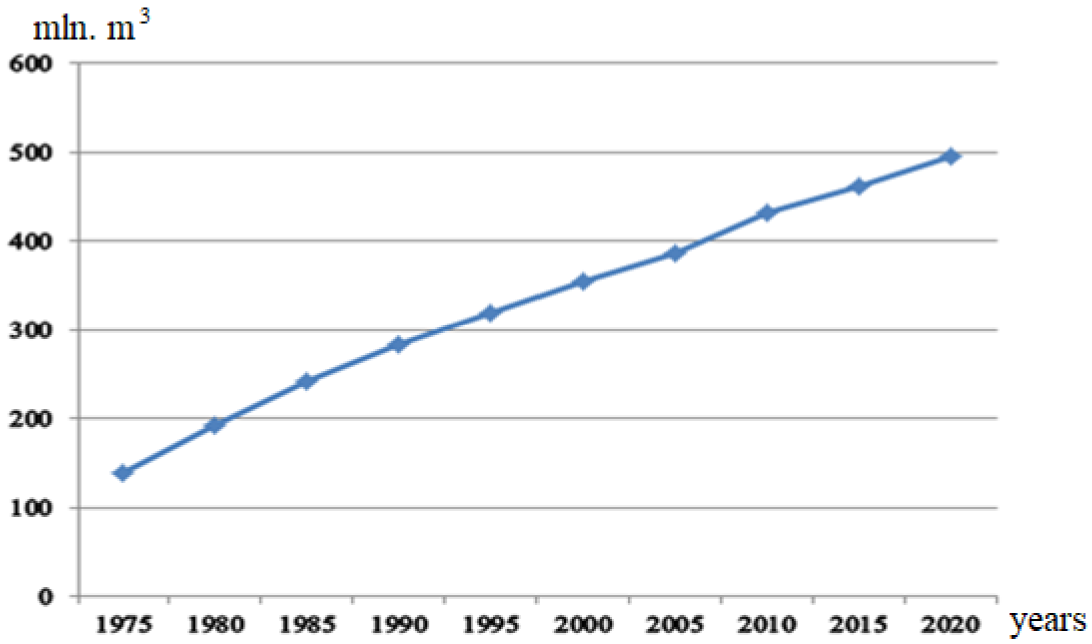

Figure 5. The graph of changes in the amount of turbidity in the Chervok reservoir

Appendix A

According to the project forecast, the amount of turbidity-sediments of the Chervok reservoir should be 6.8 million m^3 per year on average. According to the conducted studies, this situation corresponds only to the observations of 1975-1986. According to the conducted studies, the amount of turbidity in the Charvoq reservoir has accelerated in recent years compared to the project forecast. According to the design calculation of the Chervok reservoir, the volume of dead water (1.2 million cubic meters^3) indicated that the payback period for muddy sediments is equal to 21 years. According to the monitoring data of the water reservoir in 2010, it was determined that the amount of muddy sediments during the operation of the water reservoir in 1977-2010 was on average 7.91 million m^3 per year.

Appendix B

According to the conducted studies, the amount of turbidity in the Charvoq reservoir has accelerated in recent years compared to the project forecast. According to the project, the term of filling the dead water volume of the Charvoq reservoir with muddy sediments is 20 years. During the operation of the water reservoir, several observations were made to determine the volume of silted water, and according to the data of the observation carried out in 1997, the amount of turbid sediments during the years of operation of the water reservoir in 1983-1997 was 11.80 million m^3, according to the observations made in 2004, the volume of muddy sediments was and it was determined that it was 19.33 million m^3. From the analysis of the theoretical and experimental studies conducted on the determination of the amount of turbidity during the operation of the Chervok reservoir, it was found that

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