EUROPEAN JOURNAL OF LIFE SAFETY AND STABILITY (EJLSS)
ISSN 2660-9630
www.ejlss.indexedresearch.org Special Issue, 2022 ||

"Challenges and Innovative Solutions of Life Safety in Ensuring Sustainability in Economic Sectors"

Forecasting the Processes of Siltation of Flood Reservoirs

Asror Yangiev
Doctor of technical science, professor, National research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers", Tashkent, Uzbekistan

Dilmurat Adjimuratov
PhD, National research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers", Tashkent, Uzbekistan

Sherzod Panjiev
PhD student, National research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers", Tashkent, Uzbekistan

Abstract: *The article presents the results of field research conducted in Kasansay, Rezaksay and Jiydalisay flood reservoirs in Namangan region (Uzbekistan). The floods in the reservoirs are causing a lot of problems, and there are disturbances in the discharge and discharge facilities during the accidental floods. At the same time, a large amount of mud and sediments accumulated in the reservoirs. Clearing of flood reservoirs from mud and sediments will need to be considered on the basis of calculations. At present, it is necessary to determine the useful volume of flood reservoirs and consider the issue of targeted use of flood reservoirs in the future, given the loss of useful volume. The main purpose of the study is to forecast the amount of sludge in the flood reservoirs on the basis of natural observations and make recommendations for their removal. In the article, the results of the calculations using empirical formulas for predicting the amount of turbid sediments in Kasansay, Rezaksay and Jiydalisay flood reservoirs up to 2025-2030 years are also presented, and it is noted that at present their useless volumes are full of turbid sediments. Preliminary recommendations Ufor assessing the safety of flood reservoirs have been developed. It has been observed that the useless volumes of the above-mentioned flood reservoirs are now filled with mud and sediments and will increase in the future. Observations show that the particle size of sedimentary deposits is characterized by a decrease in the direction of the dam from the entrance to the floodplain. That is, in the upper storks, deposits consisting mainly of rock and sand particles collapse. In addition, the article provides information on initial recommendations for assessing the safety of flood reservoirs.*

Keywords: *flood reservoir, water discharge facility, sediments, useless size, suspended and primitive sediments, flood reservoir safety.*

Date of Submission: 15-4-2022 ***Date of Acceptance: 18-5-2022***

---

1. Introduction

As a result of global climate change on our planet, the rate of occurrence of natural hazards in nature is increasing. Floods are an example of such kind of natural phenomena. In particular, floods and other dangerous natural phenomena have been frequent in Central Asia, including the Republic

of Uzbekistan, over the past decade as a result of climate change. As a result, short-term floods lasting tens of minutes or hours damage bridges, roads, canals, fields and hydraulic structures in flood reservoirs. Floods are mainly caused by the accidental occurrence of accelerated precipitation, as a result of which the constant flow of rivers is combined with the flow of floods, causing great dangers in the short and long term. Most of the major floods in the country occur in mountainous and foothill areas. Therefore, one of the most pressing issues is to conduct field research on existing floodplains and to study their technical condition and develop recommendations for their reliable and safe operation. The following is information on floodplains where field research has been conducted [2; 3; 5; 7;]. The process of accumulation of solid flow in the upper reaches of the floodplain consists of complex physical and hydraulic conditions, which depend on hydrological, topographic, hydraulic, hydraulic, operational and a number of other factors. Currently, there are no technically and economically effective measures to clean mudflows from muddy sediments. In general, it is practically impossible to completely remove the deposits in the upper basin from the zone of floodreservoirs. However, if appropriate measures are not taken to reduce their amount, such hydropower plants may become completely unusable after several years of use. In addition to determining the size of sedimentary deposits in the upper basin, it is important to study the characteristics of their location in relation to the topographic conditions of the upper basin. The parameters of the sedimentary deposits in the floodplain reservoirs, which have been in use for several years, differ sharply from the design calculations. [9; 10; 12; 13]. Therefore, one of the urgent issues is to conduct field research on existing reservoirs and study their technical condition and develop recommendations for reliable and safe operation.

2. Materials and Methods

The studies were conducted on the basis of nature observation data analysis and theoretical processing of the research results. Large amounts of sludge are accumulating in the basins of rivers and reservoirs built in river basins. The constant flow of rivers, combined with the flow of floods, poses great dangers quickly and in the short term, that is, it leads to the accumulation of large amounts of sludge in the basins of rivers and floodplains built in river basins. The main purpose of the study is to predict the amount of sediments in flood reservoirs. To achieve this goal, the following tasks are required: field research, collection of data on perennial floods, determination of the fractional composition of sludge. The research was conducted in 2021 in the Kosonsoy, Rezaksay and Jiydalisay flood reservoirs in Namangan region. Therefore, the studies were conducted based on nature observation data analysis and theoretical processing methods of the research results.

3. Results and discussions

The largest flood centers in Namangan region are the rivers in the mountainous areas of the region. Therefore, the reservoirs located in the basins of these rivers are often damaged by floods. That is, it is caused by the accumulation of large amounts of turbid sediments in the basins of water and flood reservoirs built in river basins.

A review of the current technical condition of all hydrotechnical structures in the Kosonsoy flood reservoir revealed that the volume of the basin was muddy in 2014 and amounted to 16 million m3. Currently, it is necessary to determine the amount of sediments in the flood reservoir [17; 18; 19,20].

Considering the current technical condition of all hydraulic structures in the Rezaksoy reservoir, the volume of muddy sediments in the basin in 2014 amounted to 15.4 million m3.

According to the observations made at the Jidaliysoy floodplain, in 2014, the volume of turbidity detected by the Batiometric Center amounted to 9.6 million m3. At present, the accumulation of turbid sediments continues. The useful volume of the flood reservoir is filled with turbid sediments, which requires them to consider the treatment of muddy sediments on the basis of calculations. It is

now necessary to calculate the useful volume from the flood reservoir and to consider the targeted use of the flood reservoir in the future, taking into account the loss of useful volume.

In Namangan region, monitoring was carried out on 104 cases of floods registered in 2017-2020:

- In 2017, -18 cases, 12 of which were observed in May;
- In 2018, -22 cases, 18 of which were observed in June;
- In 2019 - 34 cases, 23 of which were observed in May;
- In 2020 - 30 cases, 22 of which were observed in May.

The following is the data on the consumption and number of floods in the foothills of Namangan region in 2017-2020.(Figure 1).

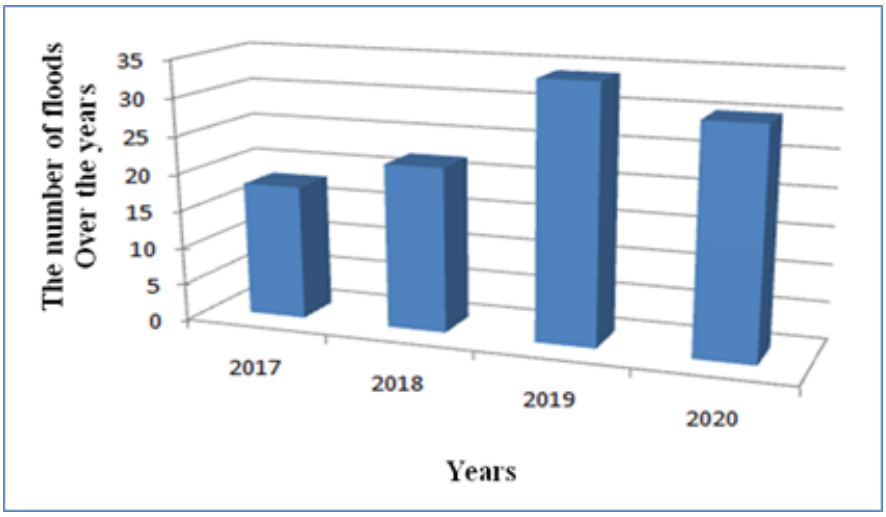

Figure 1. Consumption and number of floods in the river basins of Namangan region in 2017-2020.

Observations show that the floodplain in Namangan region received 2 times more floods in 2019 than in 2017. As a result, the floodplain basin continues to be filled with turbid sediments. The main reason for the filling of sediments is the acceleration of floods.

The results of the study of the characteristics of turbid sedimentary deposits in the reservoirs studied above show that the solid flow

More than 90% consists of soils with particles d <0.05 mm. Such soil particles mixed with water have a sharp effect on the physical and mechanical properties of the flow. In particular, the relatively high viscosity and specific gravity of the flow relative to fresh water create complex hydraulic conditions in the process of transforming floods and mudflows in high basins. According to the observations in the flood-reservoirs, the turbid stream falling into the upper basin moves towards the dam along the deep ravine. However, towards the dam, the turbid flow particles are sorted and sink.

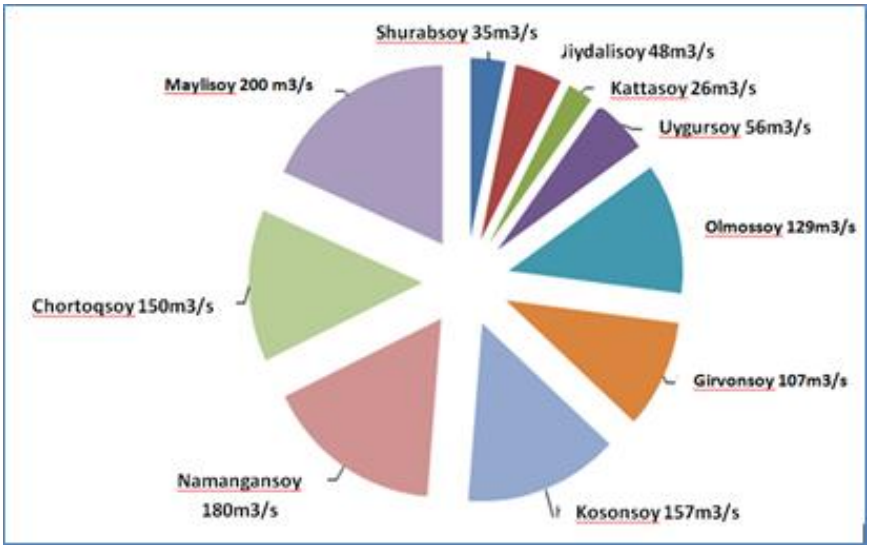

Figure 2. Maximum amount of floods in the sources of flood reservoirs in Namangan region.

The processes of solid flow accumulation in the upper reaches of the mudflow reservoir complex consist of complex physical-hydraulic conditions and depend on hydrological, topographic, hydraulic, hydro-technical, operational and a number of other factors. Currently, there are no technically and economically effective measures to clean the reservoirs from muddy sediments. In general, it is practically impossible to completely remove the deposits in the upper basin from the flood zone. However, if appropriate measures are not taken to reduce their amount, such hydropower plants may become completely unusable after several years of use.

In addition to determining the size of turbid sedimentary deposits in the upper basin, it is important to study the characteristics of their location in relation to the topographic conditions of the upper basin in solving the problem. Parameters of turbid sediments in floodplain reservoirs, which have been in use for several years, differ sharply from the design calculations. According to the results of the research, the total volume of muddy-sedimentary deposits in these flood reservoirs can be determined as follows. [1; 4; 13; 14]:

$W = R*n*K$, м3; (1)

where:

n – is the period of operation, year;

R- is the perennial average amount of turbid sediments falling into the upper basin (determined on the basis of analysis of several years of hydrological data);

K - is the coefficient taking into account wind erosion, siltation from the shoreline to the reservoir (K=1,01-1,04).

According to the analysis of the mechanical structure of sludge deposits, the average percentage for particle diameters and their weight is as follows: d > 0,5 mm- 0,1 % ; d= 0,25-0,5 mm - 0,79%; d = 0,1-0,25 mm - 2,33%; d= 0,05-0,1 mm- 53,22%; d= 0,01-0,05 mm - 13,46%; d= 0,005-0,1 mm - 8,92%; d< 0,005 mm - 21,18%; dўp= 0,05 mm.

An analysis of the literature [16,17,18] shows that the size of the particles of turbid sedimentary deposits in the upper basins is characterized by a decrease in the direction of the dam from the entrance to the floodplain.Deposits composed mainly of rock and sand particles were found in the upper storks. However, the relationship between the sedimentation processes of turbid sediments in flood reservoirs and their formation processes under the influence of flood currents has not been fully studied.The Kasonsay, Rezaksay and Jiydalisay flood reservoirs have been used to calculate the amount of turbid sediments for 2025-2030 using the above empirical formula. It can be seen that

the useless volumes of the Kasansay, Rezaksay and Jiydalisay reservoirs are now filled with muddy sediments and will increase in the future(1). [Figures 4,5,6].

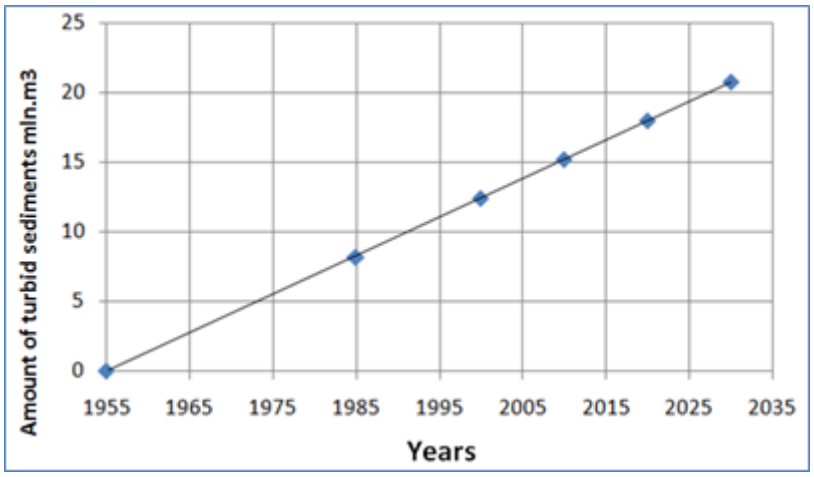

Figure 3. Graph of changes in the amount of turbid sediments in the Kasansay flood reservoir.

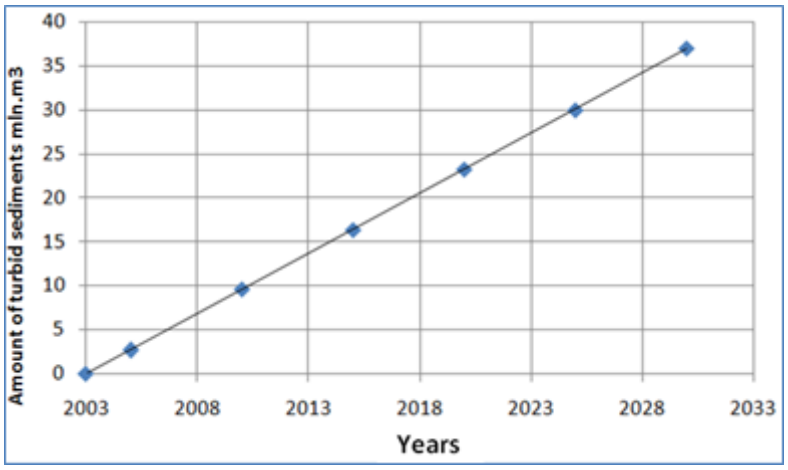

Figure 4. Graph of changes in the amount of turbid sediments in the Rezaksay flood reservoir.

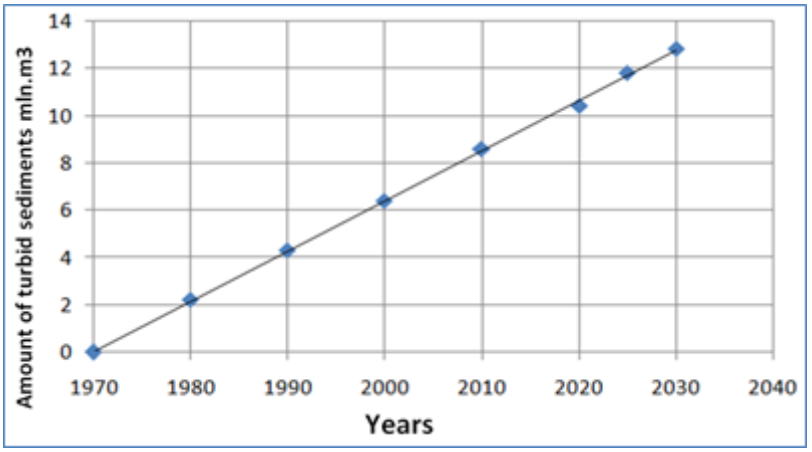

Figure 5. Graph of changes in the amount of turbid sediments in the Jiydalisay flood reservoir.

Therefore, it is necessary to take constructive and operational measures to reduce the amount of sludge and to remove them as a result of continuing field monitoring of the above reservoirs. [6; 11; 21].

As a result of the research, initially developed recommendations for assessing the safety of flood reservoirs are presented.

Reservoirs are considered to be in working (normal) condition (or in good technical and safe condition) when the following indicators are provided:

- ✓ the structures have the maximum (catastrophic) water consumption according to the project, are not damaged, broken, cracked, do not sink;
- ✓ dams can withstand the water pressure (pressure) provided for in the project, the pressure slope cover is not damaged, does not swell, the pressureless slope is not damaged, there are no signs of water leakage;
- ✓ no clogging in the upper reaches, no washing and sludge in the lower and upper reaches with minimal and maximum (catastrophic) water flow;
- ✓ the parts of the inlet and outlet channels that are connected to the inlet are not damaged, and the maximum amount of water used in the project (without discharge, washing, washing, washing);
- ✓ hydromechanical equipment (valves, their lifts, etc.) are not corroded, do not rot, do not deform, the joints are intact, impermeable, the lifts are lubricated and easy and quick to operate..

The following indicators are considered a decrease in safety in reservoirs:

- ➢ the dams can hold the water pressure (pressure) provided in the project, the pressure slopes or the slopes are broken, swollen, the pressure slopes are broken, there are signs of water leakage;
- ➢ the channels of the water supply and drainage canals are eroded or submerged in the mud, the lining of the dam and the parts adjacent to the dams are damaged, broken, but the parts connected to the structure are not damaged;
- ➢ hydromechanics (locks, their lifts, etc.) have been subjected to a number of corrosions, the seals have been demolished and the water supply has been damaged, and the lifts have not been lubricated.

The following indicators are considered unsatisfactory in reservoirs:

- ✓ According to the project, the most catastrophic (catastrophic) water flow in the project will not be able to easily pass, damaged, broken, cracked, sunken, dumping, discharging, drainage and drainage structures, ice, etc;
- ✓ the dams can withstand the water pressure (pressure) provided in the project, the pressure slope cover is broken, swollen, the pressureless slope is broken, wet spot, water leakage, leakage, holes, concrete signs in the griffin;
- ✓ washing and sludge in the upper and lower reaches, with the lowest and maximum (catastrophic) water flow in the lower and upper reaches;

The following factors are critical to the safety of reservoirs:

- ➢ the level of safety of the reservoir associated with the transition from partial disability to full disability as a result of the emergence of conditions for the development of processes that reduce the strength and durability of structures and soil, exceeding the permissible indicators of safety criteria;
- ➢ after this case, the boundary condition that determines the depletion of the reservoir facilities in terms of inadmissibility or inexpediency of the facility in accordance with its function.

5. Conclusion

The results of field research in Kasansay, Rezaksay and Jiydalisay reservoirs in Namangan region revealed the following:

1. The Kosonsoy, Rezaksoy and Jiydalisoy reservoirs are prone to flooding, and there are disturbances in the discharge and drainage facilities due to the accidental flooding, which is caused by the accumulation of large amounts of sludge. Observations show that the floodplain received 2 times more floods in 2019 than in 2017. As a result, the floodplain basin continues to be filled with turbid sediments.
2. According to the analysis of the mechanical composition of sedimentary deposits, the average percentage by particle diameters and their weight is as follows: d > 0,5 mm - 0,1 % ; d= 0,25-0,5 mm - 0,79%; d = 0,1-0,25 mm - 2,33%; d= 0,05-0,1 mm- 53,22%; d= 0,01-0,05 mm-13,46%; d= 0,005-0,1 mm - 8,92%; d< 0,005 mm - 21,18%; dўp= 0,05 mm.
3. Particle size of muddy-sedimentary deposits in the upper basins is characterized by a decrease in the direction of the dam from the entrance to the floodplain. In the upper storks it was found that deposits consisting mainly of stone and sand particles were formed.
4. Using empirical formulas in the Kosonsoy, Rezaksoy and Jiydalisoy reservoirs, estimates of the amount of turbid sediments for 2025-2030 were calculated. Calculations show that the useless water volumes of the Kosonsoy, Rezaksay and Jiydalisay reservoirs are now filled with muddy sediments and will increase in the future.
5. Preliminary recommendations for assessing the safety of flood reservoirs have been developed.
6. The obtained results will be used to determine the amount of sludge and sediments in the forecasted Kosonsoy, Rezaksoy and Jiydalisoy reservoirs for 2025-2030 in the determination of their operating modes and the development of schedules and technologies for the removal of sludge.

References

1. About the centralised inspection and an estimation of a technical condition of hydraulic engineering constructions in Republic Uzbekistan. Tashkent, Publ, 03.10.2001.№ 03-4-245.
2. Asarin A.E., Semenkov V.M. Design flood and dam safety. Hydraulic construction. № 8. 1992. Pp. 55-57.
3. Bakiyev, M., Khalimbetov, A., Matkarimov, O.// Flow spreading behind a combined dam with a through part of tetrahedrons on foothill rivers E3S Web of Conferences, 2021, 264, 03037
4. Choriev, J., Muratov, A., Yangiev, A., Muratov, O., Karshiev, R. Design method for reinforced concrete structure durability with the use of safety coefficient by service life period. IOP Conference Series: Materials Science and Engineering 883(1),012024 2020
5. Designer is manual. Hydraulic structures. Revised by Nedriga V.P.1983.
6. Khalimbetov, A., Bakiev, M., Shukurova, S., Choriev, J., Khayitov, K.// Study of submountain river flow patterns constrained by a combined dam IOP Conference Series: Earth and Environmental Sciencethis link is disabled, 2020, 614(1), 012053
7. Law of the Republic of Uzbekistan «On the safety of hydraulic structures».
8. M. Bakiev, U. Kaxxarov, A. Jakhonov, and O. Matkarimov, “Kinematic characteristics of the flow, in the compression region, with bilateral symmetric restriction by floodplain dams,” in IOP Conference Series: Materials Science and Engineering, 2020, vol. 869, no. 7, doi: 10.1088/1757-899X/869/7/072017.
9. Malik L.K., Extreme situations, related with hydraulic structure. Hydraulic construction. № 12. 2009. Pp. 10-16.
10. Muhammedov A.M. Operation of low-pressure hydro systems in rivers, transporting sediment (at the example of Central Asia). Science. Tashkent, 1976. 237 p.

11. Mirtskhulava S.E. // Reliability of hydromeliorative constructions. Moscow, Publ, 1974. 366 p.
12. Rustem E., Yestaev K., Abdimomynova M., Abduvalova A., Tassybayev A.// Study of new designs of spillway channels with artificial roughness. Periodicals of Engineering and Natural Sciences. Vol 10, No 1 (2022)
13. RAG-7-065 "Development of measures for scientifically based technical and technological modernization of water reservoirs to ensure efficient, reliable and safe operation" Tashkent-2014. P. 98
14. U. Khusankhudzaev, O. Kadirov, and A. Jakhonov, "Results of full-scale and laboratory studies of the spillway of HPP No. 2," in E3S Web of Conferences, 2021, vol. 264, doi: 10.1051/e3sconf/202126403028.
15. Yangiev, A.A., Bakiev, M.R., Muratov, O.A., Choriev, J.M., Djabbarova, S. Service life of hydraulic structure reinforced concrete elements according to protective layer carbonization criteria Journal of Physics: Conference Series 1425(1).
16. Yangiev, A., Omarova, G., Yunusova, F., Adjimuratov, D., Risalieva, A.// The study results of the filtration process in the ground dams body and its chemical effect on piezometers/E3S Web of Conferences, 2021, 264, 03014
17. Yangiev, A., Gapparov, F., Adjimuratov, D., Panjiev, S. // Safety and risk categories of water reservoir hydrosystems/ IOP Conference Series: Materials
18. Yangiev, A., Adjimuradov, D., Panjiev, S., Karshiev, R.// Results and analysis of field research in flood reservoirs in Kashkadarya region// E3S Web of Conferences, 2021, 264, 03033
19. Shukurova, S., Khalimbetov, A., Xayitov, X.// Deflection of the dynamic axes of flow contracted by combined dam with tetrahedron through-flow partю IOP Conference Series: Materials Science and Engineering, 2020, 883(1), 012175
20. Yangiev A.A., Panjiev SH., Adjimuratov D.S. //Recommendations for the analysis of safety and assessment of the formation of sludge in flood reservoirs. Journal of Irrigation and Melioration. Tashkent 2021. №1 (23). Pp. 29-33
21. Yangiev, A., Gapparov, F., Adjimuratov, D.// Filtration process in earth fill dam body and its chemical effect on piezometers / E3S Web of Conferences, 2019, 97, 05032