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DEVELOPMENT OF THE INFORMATION SYSTEM FOR ANALYSIS THE PARAMETERS OF THE LOADING OF HYDRAULIC STRUCTURES

Hydraulic structures are designed not only for the use of water resources, but also for the fight against water elements. They must have a significant margin of safety, resistance to cyclic loads during floods, flood waters for long periods of time, since their destruction can lead to significant damage to the environment, the national economy, economic damage and even human casualties. The impact of the harmful effects of flood waters is observed in 27 percent of the country's territory (165 thousand sq. Km.), where almost a third of the population lives. The population of the mountainous and foothill regions of the Carpathians suffers the most from floods, where the area of half of the reclaimed slopes is affected by landslide processes. There is practically no territory of the state where the negative impact of floods is not felt from time to time (a significant increase in the water content of the river within the annual cycle, occurs irregularly; forms during heavy rains or during a thaw).

The longer the flood waters last, the longer the dam or dam is subject to destruction. The constant pressure exerted on hydraulic structures by water can lead to water leakage through dams and underground currents, leads to leaching and subsidence of the bottom of a hydraulic dam or dam, and this threatens its stability. The consequence of such softening can be a breakthrough of the dam, which entails negative consequences. The increase in the frequency and intensity of destructive floods and floods on mountain rivers prompts an analysis of the state of hydraulic structures. Therefore, it is proposed to develop an information system for analyzing the parameters of the loading of hydraulic structures (dams and dams), which will make it possible to formulate recommendations for the design of new ones and prevent the destruction of existing ones. The development of the information system was carried out in the Borland C ++ Builder software environment with the support of groundwater filtration and dynamic loads.

Keywords: meat comminutor, meat, screw, serve, rheological properties.

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РОЗРОБКА ІНФОРМАЦІЙНОЇ СИСТЕМИ АНАЛІЗУ ПАРАМЕТРІВ НАВАНТАЖЕНОСТІ ГІДРОСПОРУД

У роботі запропоновано розробку інформаційної системи аналізу параметрів навантаженості гідроспоруд (дамб і гребель), яка дозволить сформулювати рекомендації з проектування нових та запобігти руйнуванню існуючих.

Ключові слова: навантаженість гідроспоруд, дамба, гребля, фільтрація, інформаційна система.

Formulation of the problem

Safe and reliable operation of hydraulic structures is one of the important directions for ensuring the stable operation of power plants and preventing dangerous impact on the environment. Constant monitoring of the condition of hydraulic structures and preventive work is carried out by the personnel of the hydrotechnical services of power plants. In order to establish additional control over the technical condition, the authors of the work have developed an information system for analyzing the workload of hydraulic structures. It was found that the fight against the consequences of filtration is specifically aimed at reducing water losses from the headwater, at reducing back pressure, at reducing the velocities of the filtration flow and the arrival of the front and crest of the wave after the breakthrough of the hydraulic structure depends on the distance at which the residential areas are located.

Analysis of the latest sources

In works [1, 2] it was established that calculations must be carried out for two groups of limiting states: calculations of the total strength and stability of the structure-base system, the total filtration strength of structures, the strength of individual elements of structures, the destruction of which leads to the termination of the operation of structures; calculations of individual structural elements, on which the strength or stability of structures as a whole depends and calculations of the foundations for local strength; calculations to limit displacements and deformations, formation or opening of cracks, violation of local filtration strength or strength of individual elements of structures,

which are not considered the limit states of the first group [3].

KINPRO-SYSTEM [4]. contains innovative and cost-effective technologies for the protection of existing hydraulic structures and hydraulic structures under development. Sealing with Aquaconstruct the KINPRO-Nano-System method is a natural method for the construction of lakes, ponds, sedimentation tanks, reservoirs, pools of wet biotopes.

Existing soil does not need to be removed. The Aquaconstruct components are applied to the soil and then mixed. As a result, the "KINPRO" technology increases the physical and mechanical parameters, improves the waterproofing properties and protection against erosion of the treated and compacted soil. Mycorrhiza is offered due to the increased tolerance compared to salinization and waterlogging, advantages in the reclamation of flood-damaged areas and when used in biological strengthening of dams and banks [5–8]. Advantages of mycorrhiza in strengthening dams and banks: it has been proven that growth rates have been improved when planting greenery on dams and banks; strengthening of coastal ramparts and protection against erosion by rapid germination and the formation of the root system; increasing plant resistance to drought, waterlogging and salinization; self-regeneration of the biological system.

Construction companies of Ukraine, such as: "Minstroy", "Eurasia" propose in advance to protect the population, cities, hydraulic structures from floods and floods, using PVC sheet piles as a building element.

A sheet pile fence is a solid sheet pile wall formed by plastic sheet piles by vibration, hammering or indentation. In order to strengthen the banks from erosion near Ivano-Frankivsk, in the village Ugryniv, Tysmenytsya district, Ukrainian-Romanian enterprise "Iteko" began to produce modular dams. The first trial batch of modular dams has already been produced at an enterprise like Romanian.

Now experts are collecting orders and determining the number of modular dams required for the region, which are used during floods and floods. We are talking about modular metal structures with rubber connecting gaskets.

Each section of the dam weighs 110 kg, has a height of 1.5 m and is designed for a water load of up to 3 tons. According to Romanian experts, 15 people lay out a 1 km-long dam in 8 hours [14].

The analysis showed that these protective structures are at the stage of development or design, and the developed information system will prevent the premature destruction of technical hydraulic structures and prevent flooding of residential areas or adjacent agricultural land.

The purpose of the work is to ensure the ecological safety of the environment by monitoring the parameters of hydraulic structures.

Presentation of the main material

When designing hydraulic structures, it is necessary to take into account the following loads and effects: the influence of the filtration rate and pressure; water-physical and thermal properties of soils; dynamic load NF effect of the breakthrough wave on hydraulic structures.

The influences described above will be taken into account in the development of an information system for analyzing the state of hydraulic structures using mathematical formulas and laws.

Calculation of the rate of filtration of groundwater using Darcy's law - the law of filtration of liquids and gases in a porous medium, where the main input parameters are the rate and coefficient of filtration and the pressure gradient.

Hydraulic gradient, pressure gradient - the value (dimensionless) of the pressure loss per unit length of the path of fluid movement. It characterizes the degree of resistance of the medium to the movement of water. In the dynamics of groundwater, the hydraulic gradient (piezometric slope) is proportional to the filtration rate and, depending on the geological structure and composition of rocks, varies mainly from hundredths to thousandths of a unit.

In hydraulic structures, the hydraulic head is the depth of the reservoir in front of the building, or the difference in water levels in front of the structure and behind it.

The filtration coefficient of rocks is the proportionality coefficient in the Darcy equation, the value of which depends on the threshold structure of the rock, density and viscosity of the filter fluid. It characterizes the degree of permeability (water permeability) of rocks, which depends on the size of interpore gaps in granular rocks and the width of cracks in rocks.

Rock filtration coefficient is a proportionality coefficient in the Darcy equation, the value of which depends on the rock structure, density and viscosity of the filter fluid. Characterizes the degree of permeability (water permeability) of rocks, which depends on the size of interpore gaps in granular rocks and the width of cracks in rocks.

The development of the information system was carried out in the Borland C ++ Builder software environment (Fig. 1).

For calculations, we will take the value of the loam corresponding to the rock: the size of the porous body is 0.0001 m, the filtration coefficient is 0.001 m/day [9]. The density of the liquid is 1000 kg/m3, the acceleration of gravity is 9.8066 m/s2, the pressure gradient is 3 m.

Loam can be found on the banks of the Seret River (Chertkov, Ternopil Region), as well as sections of the river where the bottom is covered with this soil.

Conversion of dimensions from m/day to m/s is taken into account in the text of the program.

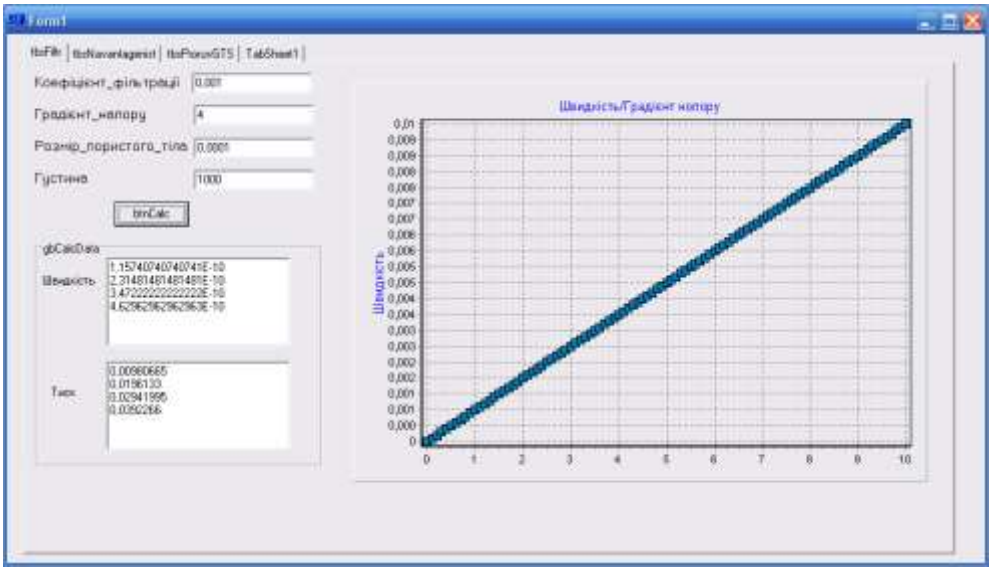

Fig. 1. Information system window for calculating filtration rate and pressure

Figure 1 shows one of the windows of the information system (IS). This IS window calculates the filtration rate, pressure drop, reflects the dependence of some values on another: namely: filtration rate on the pressure gradient.

The text of the program is written in such a way that the calculation of the filtration rate and pressure drop is carried out up to the value entered for the pressure gradient, therefore, we obtain the values of filtration rates 1.1574 * 10-4.6297 m/s, and for pressure 0.0098-0.039 Pa.

The results obtained above (Fig. 1) allow us to conclude that the filtration rate and pressure increase with the pressure gradient. An increase in the rate of filtration of groundwater, with prolonged precipitation, leads to the fact that the filtration flow, with an increase in gravitational forces, comes to the surface, causing landslides, suffusion.

The constant pressure exerted on hydraulic structures by water can lead to leakage of water through dams and underground currents, leading to leaching and subsidence of the bottom of the dam or dam, and this threatens its stability. The consequence of such softening can be a dam breakthrough, which entails negative consequences.

The runoff of groundwater in the form of silt leads to an increase in the level of rivers, the creation of additional pressure on hydraulic structures, since in addition to groundwater, everything that it washes in its path gets into the rivers.

The phenomena described above can be attributed to both anthropogenic and natural causes of the occurrence of flood waters [6].

Thus, the fight against the effects of filtration is specifically aimed at reducing water losses from the headwater, at reducing back pressure, at reducing the velocities of the filtration flow.

A priori, it can be argued that with the same head on the dam, the filtration under the structure and its consequences will be the smaller, the larger the filtration path, that is, the length of the filtration circuit.

The lengthening of the filtration paths is created by a device in front of the dam of a waterproof covering, called dull, and under the gloomy and construction - vertical obstacles in the form of sheet pile walls in soft soils, or in the form of cement, bitumen and other curtains in rocky foundations.

A similar filtration process occurs on the banks of the channel or valleys, which are adjacent to retaining structures. The fight against this phenomenon is also carried out mainly by lengthening the filtration paths.

Therefore, in order to reasonably determine the dimensions of the anti-seepage elements of the dam and to fully account for the flow in the section of the hydroelectric complex, it is necessary to be able to calculate the values of the main parameters of the filtration flow: its speed, flow rate and pressure.

The volume of the reservoir is approximately determined by the obelisk formula [15, 16], if we assume that the average depth of the flow behind the reservoir is equal to half of its maximum depth. The relevance of calculating the effect of flow rates and water pressure on the volume of a reservoir lies in the fact that when designing, at the initial stages of construction of dams and reservoirs, it is advisable to take into account the water consumption in certain periods, namely: low-water periods, floods, floods, since the discrepancy between the volume of the reservoir and the water flow rates, pressure leads to the creation of a dynamic load and a dam break, and this, in turn, to flooding.

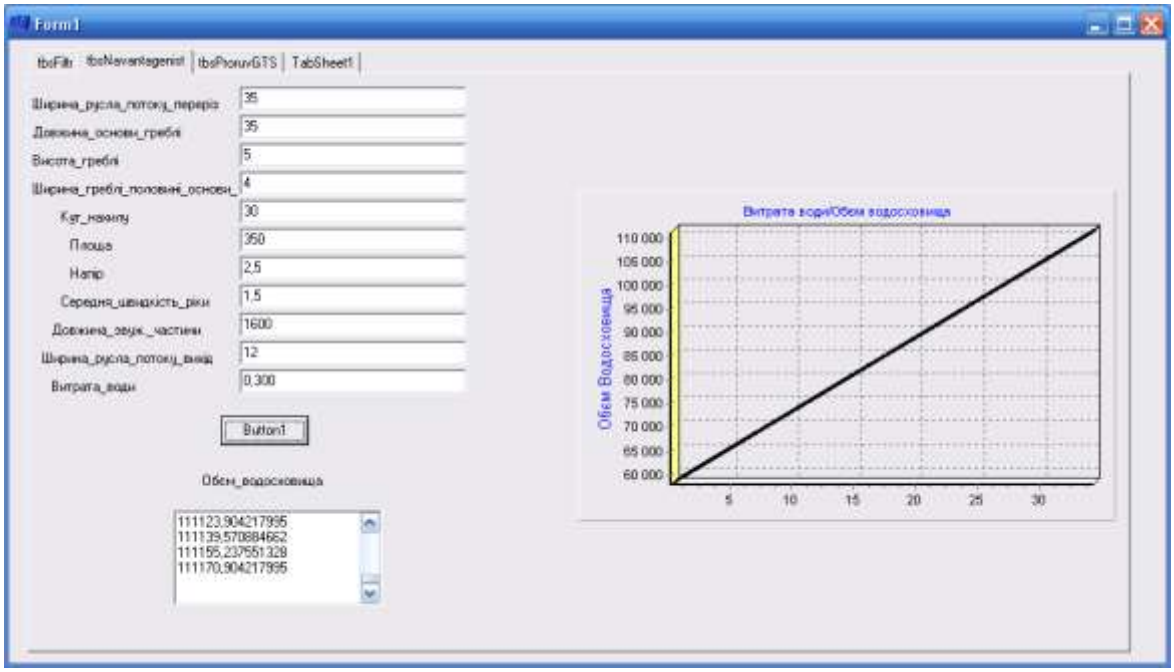

Fig. 2. Information window for calculating the effect of water discharge on the reservoir volume

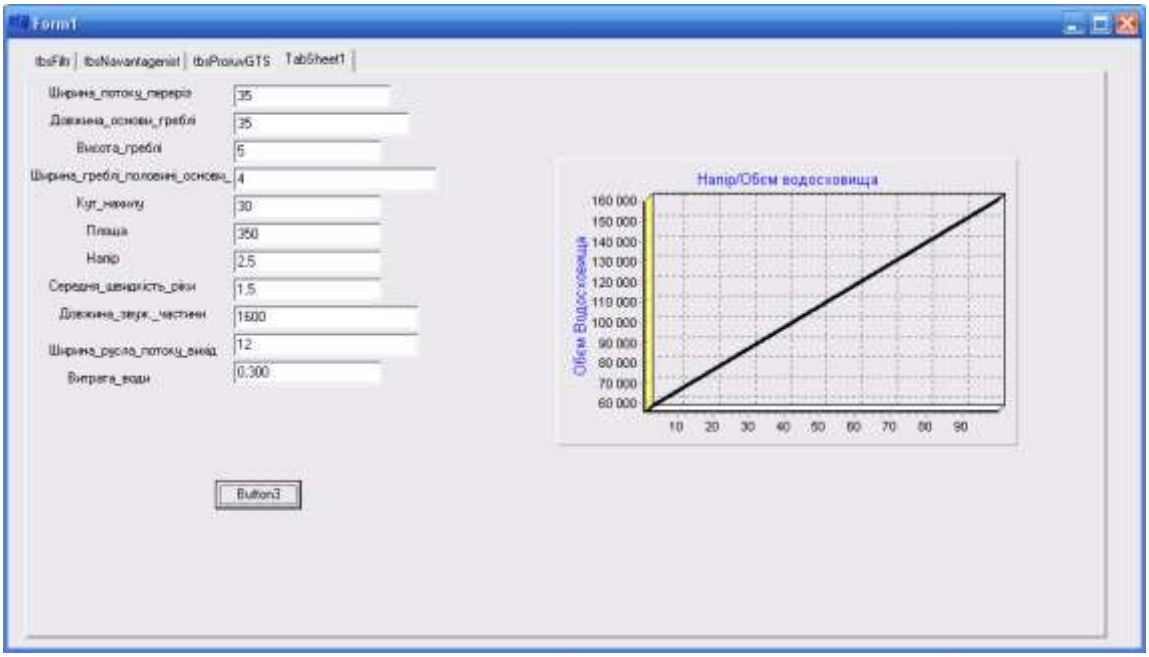

Fig. 3. General view of the window of the influence of water pressure on the volume of the reservoir

The graphs of the dependence of the reservoir volume on discharge (Fig. 2) and water pressure (Fig. 3) are linear (the higher the water flow rate and pressure, the more the reservoir volume grows). Flood waters occurring earlier in the selected area.

The text of the program (for calculating the effect of water discharge on the volume of the reservoir) is written in such a way that the volume of the reservoir depends on the influence of the water discharge, pressure, and the length of the dam base.

A separate issue is the assessment of the impact of the breakthrough wave on hydraulic structures (Fig. 4).

The influence of the wave on dams, dams can be as follows: impact of the wave front in the GTS; long-term hydraulic pressure on the elements of hydraulic structures (supports) erosion of soil between the supports (general erosion) and erosion of supports (local erosion), destruction of regulatory structures and earth embankments; impacts of large floating objects on supports; the formation of congestion of floating objects and the formation of flow constraints, creates an additional backwater [17].

From the results obtained, it can be concluded that the arrival of the front and crest of the wave after the breakthrough of the hydraulic structure depends on the distance at which the residential zones are located. With the distance of objects from 1 m to 6 m, the flooding time will be respectively 0.08-1 h.

A breakthrough wave when moving along the riverbed causes colossal damage to the national economy. First of all, it poses a serious danger to the population as a result of the sudden flooding of residential buildings and

office buildings. Therefore, the issue of timely prediction of the consequences of the impact of the breakout and flooding wave is extremely important.

Thus, an information system has been developed for analyzing the parameters of the loading of hydraulic structures, which will make it possible to formulate and prevent the destruction of existing hydraulic structures in order to protect the population from the catastrophic consequences of flood waters, floods.

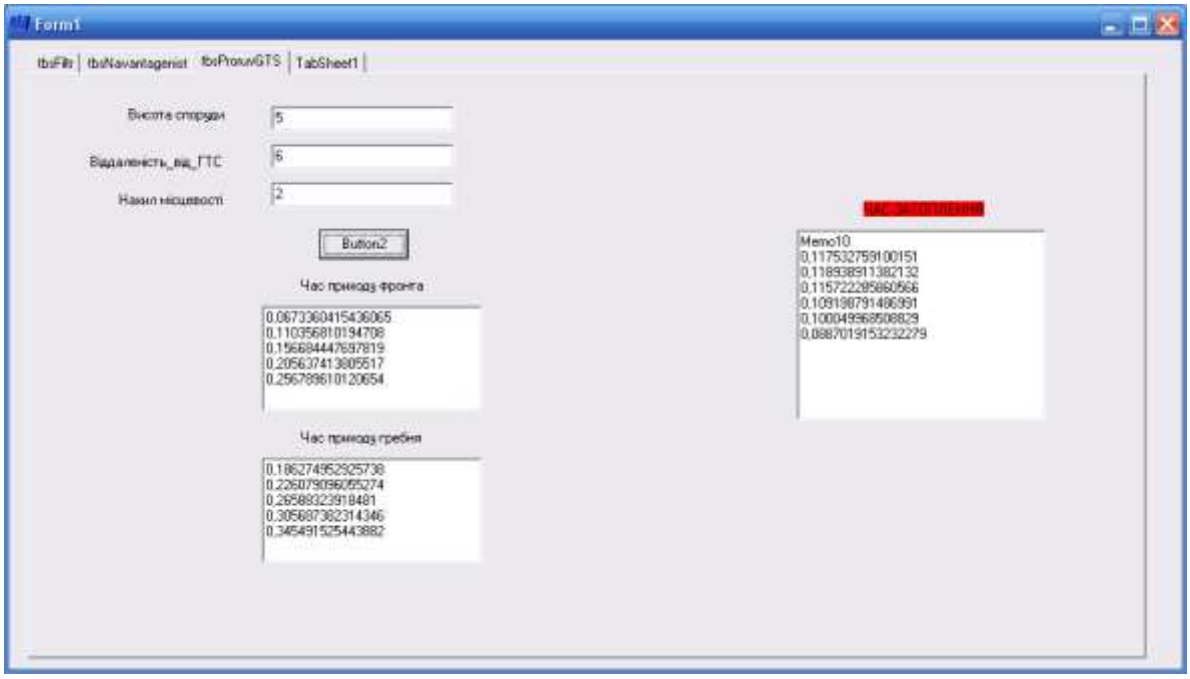

Fig. 4. Dam break time

Conclusions

The technical article presents the existing methods for calculating the loading of hydraulic structures, analyzes the existing protection systems for hydraulic structures, discloses a set of works that will maintain the working condition of hydraulic structures, which will allow in more detail when designing hydraulic structures to take into account the water-physical and thermal properties of the soil.

The developed information system makes it possible to substantiate the influence of the parameters of the water-physical properties of soils during the construction of hydraulic structures, the dependence of flow rates and water pressure on the volume of reservoirs, in order to prevent the breakthrough of dams and leakage of dams, are successfully operated, and the formulation of appropriate recommendations for the design of new hydraulic structures.

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