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RESTORING FUNCTIONAL CAPACITY OF IRRIGATION SYSTEMS

The purpose. Determination of major factors of influence on operating conditions of channels of irrigation systems. **Methods.** Analytical, by results of on-site investigations. **Results.** Analysis is made of state of use of irrigation systems with the purpose of determination of their ability in security of water delivery for watering crops in modern conditions of climate fluctuations and economic activities. **Conclusions.** The integrated approach providing restoration and modernization of inter-economic and inter-farm irrigation systems with allowance for water- and power-saving techniques is necessary, as well as redesign of buildings of engineering infrastructure and pump-power equipment.

Key words: irrigation systems, functional capacity, use reliability.

The problem and its relevance. According to the findings of the Food and Agriculture Organization (FAO) under the UN, the strategic role of the agricultural sector in Ukraine is to transform it into one of the world's leading food producers [6]. Effective agrarian production, a significant increase in agricultural output is a priority of agrarian policy in Ukraine and will contribute to solving the problem of the global food crisis. Under conditions of climate change and management, the role of irrigation is significantly increased [6, 9].

Now the potential of irrigation systems in Ukraine is used only by one third. According to the results of the audit, the use of irrigated lands and inventory of infrastructure of inter-farm and in-house systems in 2014 was 482.4 thousand hectares of 2178, 3 thousand hectares (from the AR of Crimea), that is, only 22% of the available areas [3]. Significant deterioration of the technical condition of irrigation systems, especially their inter-farm network, significant physical deterioration of engineering infrastructure and energy equipment, insufficient number and weak updating of the park

of sprinkling machines. In addition, the technologies of growing crops and crop rotation are violated. All this leads to a deterioration of the ecological and reclamation state of irrigated land.

In modern conditions, in the absence of sufficient funding, the priority is not the construction of new ones, but the restoration and modernization of existing irrigation systems built at the end of the last century. Most of the objects of the engineering infrastructure of irrigation systems require reconstruction, technical re-equipment and modernization of pump equipment [3, 7, 10].

The purpose of the research is to identify the main factors enhancing the ability of irrigation systems to provide water supply for irrigation of crops in modern conditions of climate change and management.

Materials and methods. Experts of the IWPIM carry out works on the survey of objects of engineering infrastructure of irrigation systems, systematization of damage, development of new materials and technologies for increasing the operational reliability of hydraulic structures [5]. During 2011-2015, a survey was carried out on hydrotechnical structures of the Dnipro-Ingulets Canal Department, the Tisza River Basin Department of Water Resources, the Department of Kakhovka Main Channel, Interregional Water Administrations of Bakhchysaraysky, Irpinsky, Kakhovsky, Yakymivsky, Novotroitsky, Kilia, Kalanchatsky, Genichesk Water Departments farms, etc. Inspection of technical condition of water hydrotechnical construction allowed to reveal characteristic damage to reinforced concrete structures of hydraulic structures, to determine the reasons for their occurrence, to provide for planning of measures for their liquidation [4].

Research results. The estimation of the operational and technical condition of each object as a whole and its individual elements is given in particular, the reasons, which predetermine destructive processes, are analyzed. Specific recommendations were made on the use of technologies and materials to be used during repairs.

Of particular importance in the organization of repair and restoration works on reinforced concrete hydrotechnical structures is the use of a system of repair materials, different in their intended purpose. By their use, we can solve all the problems of

reconstruction and reconstruction of buildings, from the emergency elimination of active leaks in structures and ending with the restoration of the surface and geometric shape of structures, their aesthetic appearance. In this regard, the Institute developed and implemented technologies for the repair of concrete and reinforced concrete structures of irrigation systems using polymeric and polymer-cement composite materials [2, 5].

The analysis of modern water use indicates the changing conditions in the use of all elements of irrigation systems in comparison with the working regimes provided by design decisions, namely:

- changes in the conditions of operation of the inter-farm open irrigation network;
- changes in the structure of crop rotation used in irrigated lands in past years;
- significant physical deterioration of the objects of the engineering infrastructure of the inter-farm irrigation network and power-supply equipment due to insufficient volumes of repair works.

Inter- farm irrigation network is not always able to provide water supply to water distribution points in project volumes. On irrigating lands, the crop structure in general does not meet the requirements of a scientifically sound irrigation agriculture [1]. Most commodity producers are not sufficiently concerned with the maintenance of soil fertility and optimizing the irrigation regime of agricultural crops. The insufficient upgrading the park of the main agricultural machines and tools to them violates the technologically optimal timing of agricultural work, respectively, reducing production volumes on irrigated lands.

The research conducted by the specialists of the institute found that the main reasons for decreasing water velocity in the channels are:

- implementation of multi-tariff electricity accounting, which significantly changes the mode of operation of the channel (leads to the so-called "torn" mode of operation);
- intensive growth of the seaweed channel during periods of maximum water consumption in July-August;
- siltation of channels, which also reduces their throughput.

Changing traditional crop sets in crop rotation, where predominantly forage crops and perennial grasses predominated by 40%, led to an increase in the proportion of moisture-loving cereals and vegetable crops with the simultaneous period of maximum water use. The situation is complicated by the fact that farmers use modern high-quality varieties and hybrids that are characterized by increased sensitivity to environmental conditions and irrigation regimes and increase of irrigation rates in order to increase their productivity. At the same time it becomes extremely difficult to streamline the water use schedule and ensure that the required amount of water is fed to the water distribution point. This is evidenced by the consolidated data of water use of individual water management departments in the Kherson, Zaporozhye and Mykolaiv regions, where the average irrigation rate for corn irrigation for grain varies from 3500 to 4500 cubic meters per hectare, which is 115-125% of the design indicators.

The institute conducts research on optimization of modes of operation of intercompany channels in order to determine their ability to provide water supply for irrigating crops in modern conditions. An estimation of the technical state of the irrigation canal cladding has been carried out in order to determine their anti-filtering ability [8].

The technical condition of irrigation canals in the course of long-term operation significantly deteriorated (damaged concrete lining of channels and deformation seams, from the vegetation germination the integrity of the polyethylene film was damaged, etc.), filtration losses increased. As a result, the efficiency of the channel decreases, which requires the implementation of measures to restore anti-filtering properties of facing.

To improve the efficiency of the irrigation channels, minimize filtration losses, increase the efficiency of the channels specialists of the Institute proposed appropriate technologies of repair and renovation work using effective polymer composite materials, and technology for the installation of anti-filter screens [2]. Testing of new technologies shows a significant reduction in filtration losses of water from channels and improvement of the ecological and reclamation state of adjacent to the channel of territories.

Conclusions

The integrated approach providing restoration and modernization of inter-economic and inter-farm irrigation systems with allowance for water- and power-saving techniques is necessary, as well as redesign of buildings of engineering infrastructure and pump-power equipment.

Such studies will allow to scientifically substantiate the maximum possible areas of irrigation restoration taking into account the above factors of influence on the channel operation mode. Based on these studies, the water management will be able to justify optimal technical conditions for design organizations taking into account the necessary measures to optimize the operation of the inter-farm network to ensure uninterrupted water supply to water users.

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