WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 6, June, 2023

STUDY OF THE RELIABILITY OF IRRIGATION CANALS AND THEIR PIPELINE WATER TRANSFER FACILITY

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The reliability of an object should be understood as its non-measurable description. However, it can be estimated based on the experience of using this or a similar object, using methods of mathematical statistics and probability theory.

Keywords : Irrigation channel, object, channels , the number of outputs.

Introduction

Reliability theory is a new branch of science that studies the general laws that must be followed during the design, construction, assembly, testing and use of objects or their elements in order to achieve the highest efficiency.

Optional object, system design requires knowledge of reliability criteria and quantitative indicators, criteria analysis methods.

Creating a reliable system, structure and devices is the main task of reliability theory. This theory can be said to be general for all technical equipment. However, their specific characteristics should be taken into account when developing measures to predict and increase the reliability of hydrotechnical structures.

Modern irrigation systems consist of a complex of dozens and hundreds of separate elements that perform very important tasks.

Reliability means the property of a technical object related to its ability to maintain the required functions over time in a given mode and conditions of use. Reliability is a complex property, generally characterized by many conceptual indicators such as integrity, durability, repairability, and good maintainability.

For this purpose, research was conducted on the operational reliability of irrigation canals in the Kasbi and Mirishkor districts of the Karshi Desert, and as a result of statistical data processing and analysis, relevant indicators were determined.

During the research, information on the technical condition of irrigation canals, breakdowns and repair-restoration works was processed, and the time of observations was equal to 21 years. Data for the initial period of operation are based on observations and data made by repair and restoration organizations, and for the last 7 years based on the results of research conducted by the department of "Hydraulics and Hydrostructures" in 2014...2021. done. The number of failures by years of use is presented in Table 1.

Table 1

Channel name	Years of use											
	1	3	5	7	9	11	13	15	17	19	20	21
	Number of resignations											
Mirishkor-Qamashi	8	7	5	4	2	3	-	1	3	4	6	5
Fazli-1	5	6	5	2	2	-	1	1	-	3	3	6
Fazli-2	10	7	5	5	3	2	3	2	3	4	3	8
UR - 6	9	7	6	6	4	3	2	3	2	5	7	9
Uzbekistan channel	8	6	4	4	3	2	3	2	4	4	8	7
Jami	40	31	27	15	13	10	8	10	12	19	24	32

As can be seen from the table, the number of layoffs is high in the first 5 years. This describes the period of adaptation of the new network during use. In the following years, the number of outages decreases and exhibits a certain permanent characteristic. This corresponds to the normal period of use. The distribution of types of damage, breakdowns and failures corresponding to the period of commissioning of irrigation canals and hydrotechnical structures in them was determined

In addition, there is an increase in the number of failures from the 9-10th year of the operational period, for which, among other reasons, it is possible to mention the corrosion and wear of the object.

The distribution of failures of irrigation channels and their structures by months of the year was studied and it was found that they have different values in the months. This situation is caused by climatic factors, for example, seasonal temperature changes, freezing-thawing processes, storage of irrigation canals and structures in winter and re-operation after storage in spring, and water to crops during the growing season. can be explained by the beginning of the period of giving. It was observed that layoffs occur less often in the post-vegetation period than at any other time. Such data were also recorded in the experiments conducted by some researchers for the channel channels in the Karshi desert [1].

The failure flow parameter, which is one of the most basic indicators in the reliability theory, is determined as follows for the irrigation canal and its elements (in 1 km length of the canal).

$$f(t) = \frac{n_i \cdot (\Delta t)}{L_c \cdot \Delta t} \qquad (1)$$

in this $n_i(\Delta t)$- $\Delta t$from the work of the irrigation network in the time interval
number of exits, units; L_c- channel length, km.

When determining this indicator, it is necessary to take into account the fact that the network of the channel will be operational during the season, as well as the possibility of suspending non-working parts of the channel. Based on this, coefficient of use of the irrigation network during the growing season $K_и$= 0.8 we accept.

In the first five years in the irrigation canal, the average parameter values of failure flow were found to be in the range of 0.59010-4...0.44010-4 1/(h0km). In the next decade of operation, the average parameter of the failure flow was within the limits of 0.29010-4 ...0.48010-4 1/(h0km), while it was noted that this value decreased significantly.

Based on the results, the average arithmetic values were 0.34010-4 1/(h0km), average square deviations (S=0.22010-4). The upper and lower values of the failure flow parameter were 0.25010-4 1/ (h0km) and 0.36010-4 1/(h0km), respectively. These values confirm the results obtained by the researcher R. Khojakulov for the canals in the area with similar conditions.

We determine the laws of the distribution of the probability of failure of the irrigation canal and its pipe alignment facilities and establish statistical and theoretical functions of the probability of failure on the basis of the performed calculations (Fig. 1).

In practice, the experience of operating the system shows that there are many sudden failures during the operation of the irrigation channel. It is generally found that failures like this obey an exponential distribution law [2].

$$P(t) = e^{-\lambda t} (2)$$

ISSN: 2776-0979, Volume 4, Issue 6, June, 2023

where $\lambda$is the parameter of the exponential distribution.
When the failure flow parameter obeys this law, changes over time occur less, i.e.

$$\lambda(t) = const \qquad (3)$$

When we establish the theoretical function of the probability of failure of the irrigation channel and the structures in it, the statistical function according to its appearance also obeys the exponential law.
We will check the compatibility of the above-mentioned theoretical and statistical distributions according to the Kolmogorov criterion. In this case, the maximum value of the modulus of the difference between the statistical and theoretical functions was taken as a measure of the difference [2].

$$D = \max\left|P^{*}(t)\text{-}P(t)\right| \qquad (4)$$

In our case, D = 0.172 it happened
We then proceed to determine the parameter of this exponential distribution:

$$\lambda = D\sqrt{n} = 0{,}172\sqrt{12} = 0{,}59 \qquad (5)$$

We use the table given in the literature related to these calculations [32; p.279] and λdetermine by the value of . $P(\lambda) = 0{,}857$ As a result, it means that the value of the maximum difference between the statistical and theoretical functions is not less than the actual one [3].
So, for our case, the conditions of the Kolmogorov matching criterion are fulfilled. The average downtime for a kilometer-long section of the irrigation canal was equal to:

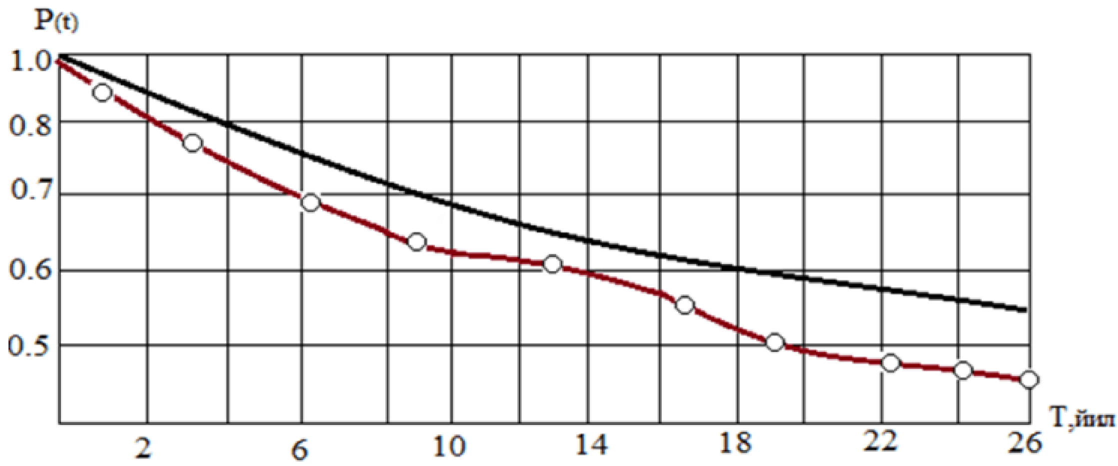
$$T_o = \frac{1}{f(t)} = \frac{1}{0{,}34\cdot10^{-4}} = 31427 \text{ ch} \quad (6)$$

In obtaining the value of the average time of operation without failure, the probability of failure and the probability of non-failure of the Irrigation canal under study for one kilometer were respectively determined as follows

$$P(t) = e^{-0{,}109t} \qquad (7)$$

$$Q(t) = 1 - e^{-0{,}109t} \qquad (8)$$

Based on the results of calculations, the following conclusions can be drawn:
During the start-up period of the irrigation channel and the pipeline water transfer facility in it (for us, this period is five to seven years), it was observed that the failure flow parameter is much larger than during the normal operation period, and this situation is explained by the uneven failure of the channel. However, it should be noted here that during normal operation, the failure flow parameter tends to a constant value, and this irrigation channel proves that the distribution law of the time of operation of the structures without failure is correctly adopted.



----o---- - statistics; ----------- - theoretical

1 . Irrigation channel failure probability function

Based on the theory of reliability, irrigation canals and their hydrotechnical structures, in particular, pipe water transfer structures, are among the systems that will be restored, therefore, failure elimination is continuous. We have adopted the complex index-readiness coefficient as a reliability index [3]:($К_т$)

$$K_{\mathrm{t}} = \frac{T_o}{T_o + \mathrm{T}_{\text{ўрт}}}, \qquad (9)$$

where $T_{\text{ўрт}}$- the average recovery time;

T_0- the average downtime, which is defined as:

$$T_o = \int_0^\infty t\, f(t)\, dt (10)$$

where is $f(t)$ –the density of the failure probability distribution.

Based on the calculations, the time distribution density and function of the failure detection of irrigation canals are presented in Fig. 2. It was found that the failure detection time and failure delivery time obey the Lognormal distribution law. Calculations and determination of the distribution law were performed on the basis of the methodology and program developed at the National University of Water Management and Natural Resources of Ukraine [1] .

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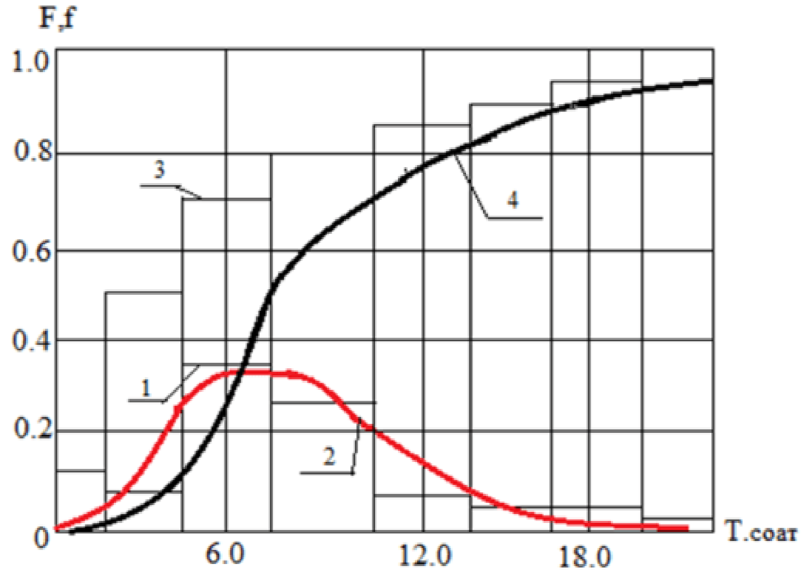

1 – empirical density of distribution; 2 – theoretical density of lognormal distribution; 3 – empirical distribution function; 4 – theoretical function of lognormal distribution when the parameters are m=5.6 hours.

2 - picture. Distribution of the time of detection of failure of irrigation canals density and function

Availability coefficient of the entire network according to the calculations $К_т$ = 0,86equal to and it was noted that it is lower than the value recommended by academician SE Mirskhulava [2]. As a result, according to these calculations, the reserve entry was not planned in the initial project . Proposals for the implementation of additional measures in the pipe water transmission facilities of the Kamashi-Mirishkor concrete irrigation channel served as the basis for the construction of additional equipment and devices

Summary

The performed activities made it possible to improve the research object's performance, water carrying capacity, reliability indicators of the facilities at the required level, and increase the reliability of the irrigation canal and its facilities by 3-4% according to preliminary calculations, and water increases the availability by 5-7%. The conducted calculations emphasize that the readiness coefficient is related to the average duration of failure elimination.

In short, the obtained results make it possible to determine the elements that do not satisfy the requirements during the period of use or to determine the periodicity of restoration and repair works.

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