

THE ROLE OF THE WATER SUPPLY SYSTEM IN ENSURING THE SAFETY OF LIFE

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Abstract:

The article presents the results of a study on the reliability of water supply systems in the city of Samarkand. The reasons for failures of the linear part of the pipelines of water supply systems such as mechanical damage, corrosion damage and seam breaks affecting their reliability are listed.

Keywords: water supply system, water supply networks, network reliability.

Introduction

The main water consumers in the city of Samarkand are the population, industrial enterprises, organizations, institutions, and public and communal facilities. In addition, water is partially spent on watering the city's green spaces, fire protection and other city needs. The city's buildings are mixed: multi-storey, single-storey and individual with private plots. Multi-storey buildings are located mainly in the western part of the city in the areas along Gagarin and Narpay streets, Sogdiana microdistrict, microdistricts "A" and "B", as well as in the southwestern part of the city – the residential area "Sattepo". These neighbourhoods are mostly built up with 6-9-storey buildings. These residential areas (approximately 35% of the population) receive water on schedule for 8 hours (4 hours in the morning and evening). The reason for this is the

difficult terrain and the great remoteness of the water collection points. Regarding water intakes, the dictating points are located at a distance of 16-18 km, and geodesically they are 70-100 m higher. Another important reason is the high water withdrawals on the main lines by private houses for watering gardens and vegetable gardens. This leads to a significant decrease in network pressure. The central part of the city has buildings 4-5 storeys high, but most of the city's territory is built up with one- and two-storey individual houses [1,2,3]. Most water supply networks were built in the 60s of the last century. Table 1 shows data on water supply networks.

Table 1. Information on water supply system in Samarkand

№	Street name (Old name)	diameter mm	Length km	material pipes	year of construction
1	Akhunbabayeva	200/500	1,5/1,5	Vr/ steel	1939
2	Arutyunova	400	0,7	vr	1959
3	Bazhova	100	0,9	a/t	1956
4	M.Gorky Boulevard	250-800	2	Vr/ steel	1939/1979
5	Revival	250	1,25	vr	1940
6	Voykova	100	0,4	a/t	1950
7	Thieves	150	0,7	a/t	1955
8	Gagarin	400	4	vr	1956
9	Griboyedov's	150	0,85	steel	1987
10	Dybenko	200	1,15	vr	1961
11	D.Zakirova	150	0,9	vr	1989
12	Dobrolyubova	200	1	vr	1968
13	Factory	100	0,5	a/t	1959
14	Z.Kosmodemyanskaya	200	0,9	vr	1950
15	Isaeva	200	0,9	vr	1952
16	Krasnovostochnaya	200	0,95	vr	1960
17	Cavalry	100	0,3	a/t	1957
18	Kurchatov	500	2,2	steel	1986
19	Krenkel	200	1	vr	1966
20	K. Marx	250/100	3,6	Vr-a/t	1952
21	The Communist Party	200	1,9	vr	1970

According to [4], "Reliability is the property of an object to perform specified functions while maintaining the values of established performance indicators in time

within specified limits corresponding to specified modes and conditions of use." A failure is an event that results in a malfunction of a system or element. The reliability of an object includes the following properties: reliability, durability and maintainability, as well as efficiency. Depending on the cause, failures can be constructive, productive and operational. Structural failures are caused by imperfections in the structure of the object (incorrectly selected material, loads, etc.). Production failures occur as a result of imperfections or violations of the established manufacturing or repair process of the object. Operational - failures resulting from violations of the rules and (or) conditions of operation of the facility.

The reasons for the failure of the water pipes may be mechanical and corrosion damage, as well as ruptures of welding seams. Mechanical damage occurs due to improper or negligent construction and installation of water pipelines, design errors, the presence of landslides and subsidence of soils. The occurrence of these injuries is accidental. Corrosion damage is most damaging to steel pipes, which can form through cracks - fistulas. Seam breaks occur when pipelines deflect during soil sedimentation, which is caused by defects in the base of the pipes; at temperature stresses that occur in the pipeline in the autumn-winter period, if the temperature during the construction of the pipeline significantly differed from the temperature during the specified period.

Valve failures occur much more often than failures of the pipes themselves. Failures of the linear part of pipelines – 40 %; at the same time, damage to welds accounts for 20 %, corrosion - 28 % and mechanical damage – 52 %. Valve failures account for 60% of all failures, while valve failures account for more than 66% of this type of failure.

To assess the malfunctions in the operation of the Samarkand water supply networks, an analysis of more than 1,000 malfunctions was carried out, which showed that more than half of them are steel and cast iron pipes that makeup 1/3 of the entire length of the pipeline networks, with 40% associated with seam rupture and 54% with soil deformation. Weld failures are the most frequent (20% of all faults); faults (22%) and holes (18%) occupy the second and third places.

The causes of malfunctions on pipelines were seam ruptures, which in most cases (79%) is a hydraulic shock, and the cause of through holes is corrosion of the pipe material (85%). At the same time, soil deformation was the main cause of faults (73%) and cracks (57%) in pipelines.

The analysis of damages associated with hydraulic shock showed that accidents of this type mainly occur on pipelines of small (up to 300mm) diameter, i.e. where cast iron and steel pipes are laid. According to the data, accidents on large-diameter pipes (more than 1000 mm) occur less frequently than on medium-diameter pipes used in the

Samarkand water distribution system. Nevertheless, accidents on large-diameter pipes cause greater damage to the safety of water supply systems. Damage to road surfaces, erosion of volumetric pits, damage to nearby engineering communications, and large water losses create additional difficulties in locating damaged areas and lead to disruption of water supply. As a rule, the operational terms of restoration of such pipelines are not maintained [5].

Of the damages associated with corrosion of the pipe material, the main part falls on steel pipes laid more than 20 years ago (Fig. 8) (the largest number of damages per 1 km of pipeline).

It should be noted that the pipelines laid in the period 2000-2015 are less durable, which, apparently, is due to both the quality of the material and the working conditions. Statistical data on accidents on polyethylene pipes are insufficient, therefore they are not considered in this analysis. Over the past five years, five cases of damage have been known to occur in the coupling couplings (polyethylene–metal) [3].

Improving the efficiency, reliability and quality of operation of municipal water supply systems and structures and at the same time, the reliability of their operation can be achieved by carrying out several targeted measures. Of the main activities at this level, the following can be distinguished:

- a) Carrying out certification and inventory of facilities, communications and water supply equipment;
- b) Assessment and control of reliability indicators of networks, individual structures and water supply equipment;
- c) Preparation, maintenance, correction and storage of technical and executive documentation of networks, individual structures and equipment;
- d) Carrying out measures to determine the actual technical condition of the water supply and distribution system, individual structures and equipment.

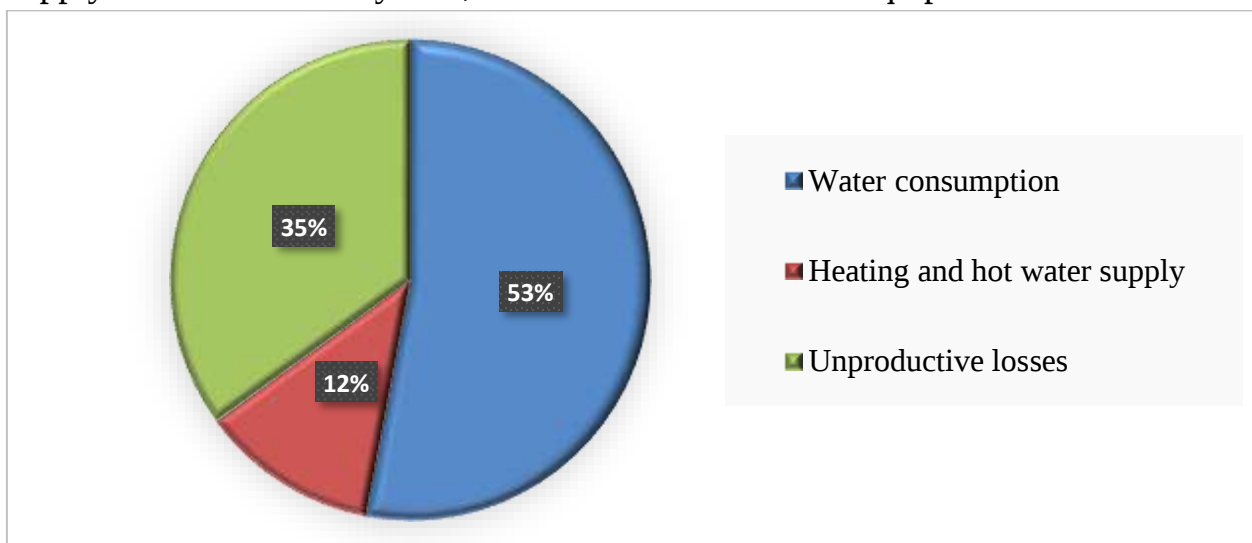


Fig. 1. Water consumption in the city of Samarkand

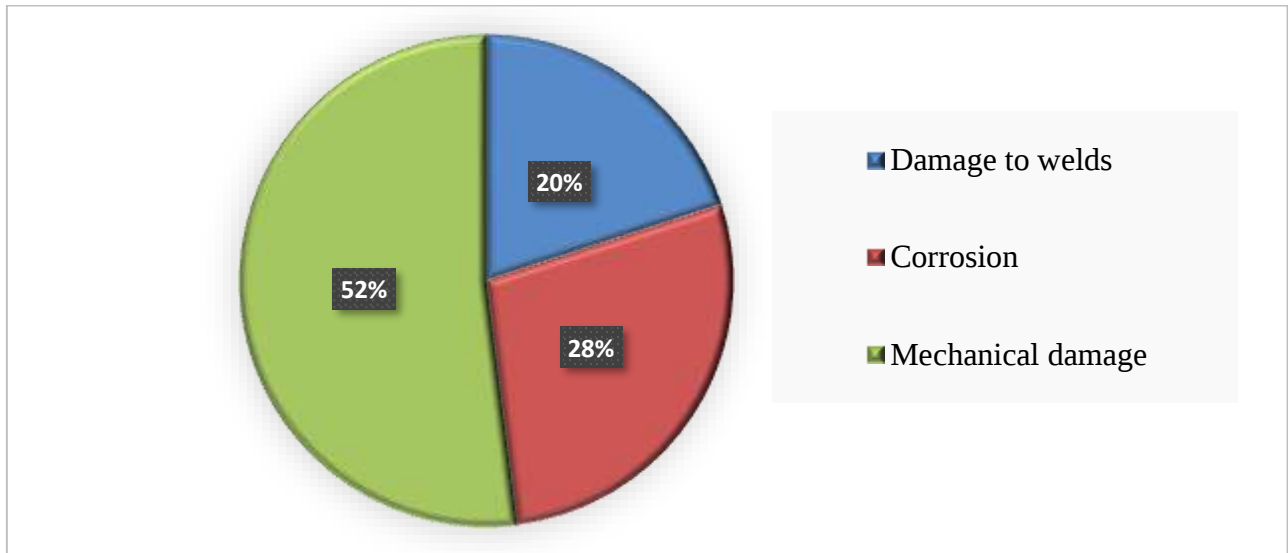


Fig. 2. Failures of the linear part of pipelines

Ensuring the reliability of the water supply system, as well as other queuing systems, is one of the main tasks in their design. The system must be designed and built so that during operation it performs its functions with a given degree of continuity. Since the function of water supply systems is to supply water to consumers by a given consumption regime, the operational state of the system meets these conditions. If, as a result of any reason, the quality of the water supply to the facility decreases below the permissible limit, then there is a "failure" of the system. The reliability of water supply systems is achieved by structural redundancy of individual elements of the system, etc. by the parallel inclusion of several interchangeable elements or by "temporary" redundancy.

Thus, ensuring the reliability of the water supply system, as well as other queuing systems, is one of the main tasks in their design. The system must be designed and built so that during operation it performs its functions with a given degree of continuity. System redundancy refers to the use of certain means and capabilities in order to ensure the operability of an object in case of failure; Taking into account the influence of random factors on the reliability of water supply systems. Accidental environmental influences (climate, season, meteorological conditions, etc.), deviations from the normal water consumption regime within the system itself (the inclusion of an unforeseen amount of fire equipment due to an increase in the level of fire danger of objects;

The mathematical support of the system includes the necessary programs for hydraulic modelling using the EPANET 2 program. The transfer of calculations to a computer makes it possible to take into account the multivariate of design solutions

for the water supply system in an interactive mode and make its final choice through additional informal analysis.

The use of criteria for the reliability of water supply makes it possible to determine the faulty supply of water in the water supply system, and thereby increase the efficiency and reliability of water supply to consumers.

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