pISSN:2349-5707 Volume:12,Issue 12,December-2025 eISSN:2349-5715

WASTEWATER SYSTEM PROBLEMS, ANALYSIS AND MODERNIZATION STRATEGIES (ON THE EXAMPLE OF THE CITY OF SAMARKAND)

Norkulov Bahodir Musulmonovich

Samarkand State University of Architecture and Construction, associate professor

norqulov.baxodir@samdaqu.edu.uz

Artikboyev Khusniddin Bakriddinovich

Samarkand State University of Architecture and Construction, teacher

artiqboyev.xusniddin@samdaqu.edu.uz

Gaffarov Bohodir Hamza ugli

Samarkand State University of Architecture and Construction, basic doctoral student

bahodirgofforov788@gmail.com

Abstract: Information is provided on the state of the wastewater disposal system of the city of Samarkand and its reliable operation. Information is provided on the history of the wastewater disposal system, development prospects, modernization of the wastewater disposal and treatment system, introduction of new repair methods, and widespread use of modern computer technologies and geoinformation systems.

Keywords: Wastewater drainage network, network repair method, treatment facilities, temperature.

The wastewater disposal system of Samarkand is an important component of the city's infrastructure, and its reliability and efficiency are of direct importance for the ecological state of the city and the health of the population. Samarkand is located in a hot and dry sharply continental zone. According to meteorological station observations over the past 10 years, the average annual temperature is 14.8°C, the absolute minimum is 15.2°C, and the absolute maximum is +41.4°C. The coldest month is January, the average monthly temperature is -2.6°C, the hottest month is July, the average monthly temperature is 26.6°C. The average soil surface temperature is +17.8°C, and the maximum reaches +69°C. According to long-term observations, the average annual amount of precipitation is 380 mm. The distribution of precipitation throughout the year is very uneven, most of it (about 84%) falls on the period from November to April. High air temperatures cause low relative humidity values, which in the cool season (October to April) are 60-74%, and in the summer it drops to 43%. Today , according to the Samarkand Water Supply JSC, out of the 585 thousand population, 90% are connected to the city sewage system. The number of people not connected to the sewage system is about 60 thousand people, and they use systems such as toilets and septic tanks of questionable standards that are available on their plots. There are 3 wastewater treatment plants in Samarkand. The first is the city wastewater treatment plant ZOS, with a capacity of 140-165 thousand m^3/cc, and two smaller ones are the KOS "Geofizika", with a capacity of 3500 m^3/cc, and the KOS "Farhod" with treatment facilities in the Kurgans. The treated wastewater is discharged into the Zarafshan River through the Siyob water collector and the Akdarya River. The total length of wastewater collectors and networks is more than 527 km, consisting of courtyard, street pipes, canals, side and main collectors. The diameter of the primary networks is 150 mm, the secondary collectors are 300-500, and in the final sections 600-1200 mm. Approximately 50% of the existing networks in the city are 300-500 mm pipes. Due to the relative complexity of the city and the

pISSN:2349-5707 Volume:12,Issue 12,December-2025 eISSN:2349-5715

dense population, the wastewater pumping system is carried out through 21 sewage pumping stations. Most of the pumping stations are remotely controlled automatically, but some are outdated and manually controlled, which leads to low energy efficiency and high operating costs.

In recent years, the city's wastewater consumption has been increasing significantly. In 2018, the average daily wastewater volume was 70 thousand m^3/k-k, while in 2025 this figure reached 130 thousand m^3/k-k. According to expert forecasts, by 2030, the daily wastewater volume is expected to increase to 200 thousand m^3/k-k. This trend is associated with the commissioning of new residential areas and industrial enterprises.

Condition of the sewage system and main problems

The sewage networks in Samarkand are outdated, with 68% of the existing networks fully depreciated in the 2000s. The aging of the system creates a number of problems:

1. The culture of operation and maintenance of sewage networks is low.
2. Lack of timely maintenance of drainage networks.
3. Failure to comply with the rules for using the system by the population.
4. Lack of a program for systematic, scientifically based analysis of sewer networks.

Also, the penetration of tree and shrub roots into the pipes causes mechanical damage to the system. This is especially noticeable in private domestic wastewater systems, where the roots create additional resistance inside the pipes and reduce their reliability.

The following modern technologies are used in the restoration and modernization of wastewater networks: applying a cement-sand coating to the inner surface of pipes, coating with polymer hoses, the "pipe-in-pipe" method, and installing corrosion-resistant spheroidal graphite cast iron pipes. Spheroidal graphite cast iron pipes withstand high pressures and loads, are resistant to electrochemical corrosion, and their guaranteed service life is 80–100 years.

Although the capacity of municipal wastewater treatment plants has been increased to 140–165 thousand m^3 per day by 2025, they face the following problems:

- The wear rate of collectors is 67%;
- Pressure pipes are overloaded;
- The existing parameters of the collectors are not suitable for the flow rate;
- There is no technology to remove biogenic elements (nitrogen and phosphorus) from wastewater;
- The technological equipment of the treatment facilities is outdated and, in some cases, unable to meet environmental requirements;
- There are not enough wastewater treatment plants in the city for private homes and summer cottages.

These problems exacerbate poor-quality wastewater discharges, polluting groundwater and the Zarafshan River.

Atmospheric wastewater is discharged from the city through open channels and ditches. Rainwater flows are discharged into water bodies through separate, open channels and ditches.

This system is considered the most economical, but the direct discharge of atmospheric wastewater into open basins poses a certain sanitary hazard. The increase in the flow of water to the wastewater treatment plant during periods of precipitation indicates the addition of atmospheric wastewater to street networks. This may be due to the lack of covers on the wells and the lack of density in the networks themselves. As of 2020, the total surface area of the discharge area in Samarkand is 10,462 hectares. Of these, the surface area of the area under stormwater management is 1,950.36 hectares, which is 19 percent.

The following strategies have been developed to improve the reliability of the wastewater system:

1. Re-laying and increasing the diameter of existing networks, replacing pipes with new ones made of modern materials.

2. Construction of new sections and pumping stations, passporting of existing networks in electronic databases.

3. Construction of local treatment facilities and modernization of existing facilities.

4. Remote monitoring using ultrasonic analyzers and television cameras to identify accident sites in wells and pipelines.

5. Development of a rating methodology based on a scoring system to assess the technical condition of pipes and collectors.

6. Regularly replace small diameter nets with larger diameter nets to ensure self-cleaning speed.

7. Introduction of biogenic element purification technology for wastewater quality and urban ecology.

Such an integrated approach ensures stable operation of the system, minimizes damage in emergency situations, and maintains the ecological safety of the city.

The current wastewater system of Samarkand is outdated and decentralized, and its efficiency and reliability are not sufficient. The main problems of the system are: outdated pipes, low maintenance, damage by plant roots, outdated wastewater discharge and treatment technologies, and the decentralized rainwater system and lack of drainage system implementation.

To modernize and increase the reliability of the system, it is necessary to use modern materials, re-lay pipes and collectors, build new pumping stations, organize local treatment facilities, and introduce remote monitoring systems. These measures will ensure the long-term stable operation of the urban wastewater system, its ecological safety, environmental impact, and public health.

REFERENCES

1. Project "Reconstruction of sewage treatment and sewage system in the cities of Bukhara and Samarkand" Presentation with preliminary results, Uzbek Agency "Uzkommunkhizmat", 2008.

2. Project application for environmental protection and reconstruction of the sewage treatment and sewage system in the city of Samarkand OVOS, P112719-Project "Reconstruction of the sewage treatment and sewage system in the cities of Bukhara and Samarkand".

3. Yakubov, K. A., Mirzaev, A. B., & Mavlanova, Yu. I. (2018). USLOVIYA OBRAZOVANIya STOChNYX VOD NA PREDPRIyATIYaX TEKSTILNOY PROMYSHLENNOSTI UZBEKISTAN. In Sotsialno-ekonomicheskoe razvitie gorodov i regionov: gradostroitelstvo, razvitie biznesa, jizneobespechenie goroda (pp. 709-713).

4. Zokirov, MR, & Khushvaktov, B. (2024). Removal of sulfides from leather processing wastewater. Interpretation and researches , 2 (3), 25.

5. Yakubov, K. A., & Artikboyev, XB (2023). ANALYSIS OF THE RELIABILITY OF URBAN WASTEWATER NETWORKS. GOLDEN BRAIN,1(1), 171-175.

6. Zokirov, MR (2024, October). DETERMINATION OF MINIMUM CALCULATIVE VELOCITIES IN WASTEWATER DISCHARGING NETWORKS. In INTERNATIONAL CONFERENCE ON ADVANCE SCIENCE AND TECHNOLOGY (Vol. 1, No. 9, pp. 24-28).

7. Mavlanova, Y., Sabirova, D., & Djamankulov, S. (2023). TECHNOLOGY METHODS OF PURIFICATION OF ARTESIAN WATERS ULTRAFILTRATION AND REVERSE OSMOSIS. Innovative Development in Educational Activities, 2(9), 37-39.

8. Mavlanova, Y., Sabirova, D., & Akhmedova, F. (2023). REQUIREMENTS FOR THE DEGREE OF WASTEWATER TREATMENT OF TEXTILE ENTERPRISES OF THE REPUBLIC OF UZBEKISTAN. Innovative Development in Educational Activities, 2(8), 99-101.

9. Oralovich, B., & Zokirov, MR (2023). Treatment of porcelain factory wastewater using coagulants and flocculants. Interpretation and researches , 1 , 17.

10. Norkulov, B., Rakhmanov, J., Tadjiyeva, D., & Zokirov, M. (2025, July). Fundamentals of hydraulic calculation of energy dampers in hydraulic structures. In AIP Conference Proceedings (Vol. 3256, No. 1, p. 020007). AIP Publishing LLC.