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United Kingdom
Street: 2 High Street City: Ashby Phone number 079 6425 7122
Zip code DN16 8UZ Country United Kingdom
USA
Soldiers Field Boston, MA 02163 +1.800.427.5577

International Agency for Development of Culture, Education and Science United Kingdom
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THE RELEVANCE OF THE DEVELOPMENT OF TECHNOLOGY FOR LOCAL WASTEWATER TREATMENT IN THE REPUBLIC OF UZBEKISTAN

Mashrapov Bahodir Olimjonovich
Doctoral student of the Namangan Institute of Engineering and Construction
E-mail: b.mashrapov1991@gmail.com.

Abstract: In general, 17% of the population in the republic uses centralized sewerage. It was determined that the provision of sewerage systems in the whole country in cities is 66.4%, in urban-type settlements 4.9% and in rural areas 0.5%. The low provision of the rural population with sewerage systems contributes to environmental pollution and poses a threat to public health. In this regard, the author has developed an individual local installation with a capacity of 1 m3 for the treatment of domestic wastewater in rural areas of Uzbekistan. The conducted studies have shown that the proposed prototype of an individual installation is effective for the treatment of domestic wastewater. After treatment at the plant, the pollutants contained in wastewater do not exceed the standard values.

Keywords: Ecology, waste water, technology, installation, treatment, biological, adsorption, local.

Introduction. Ecology is becoming a strategic industry that affects all areas of political and economic benefits for the state. The abundant natural resources of Uzbekistan, the quality, health and life expectancy of the population, the future of the country depends on the ecological condition.

Nowadays, it can be achieved for improving ecological situation by the following:

Termination of water and air pollution with substances that is harmful or unfavorable for human life, through the development and implementation of modern technologies;

Increasing responsibility at industrial enterprises for emissions into the atmosphere, area of water, soil of pollutants and harmful substances by widely using a special tax;

Introduction of treatment plants;

Installation at the enterprises of new modern environmentally efficient equipment for the integrated use of raw materials [1].

In recent years, it has been carried out by the state large-scale work on the construction of modern residential buildings and cottages for the rural population. Household effluents, which are the result of human activities, remain a rather serious environmental and economic problem up to the present time. To date, clear, regulated SanPiN standards have been established that determine the compliance of wastewater treatment that goes through a full cycle of disinfection. In order for domestic wastewater not to pose a danger to the environment, they must undergo multi-stage treatment, which is provided by modern cleaning construction. The problem of

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wastewater treatment in small settlements and separately located buildings and structures is relevant at the present time [2].

The provision of the rural population with sewerage systems is only 5.1%, i.e. 94.9% of rural residents use yard cesspools to discharge domestic wastewater. Pollution of the environment with domestic wastewater containing organic, mineral substances, heavy metals and pathogenic intestinal microflora significantly increases the risk of developing cancer and infectious diseases in the rural population. The design and construction of centralized sewerage systems with wastewater treatment and disposal systems for households of the rural population and small industrial businesses is not possible from an economic, technical and environmental point of view [3].

The relevance of the scientific problem is confirmed by the need for an objective assessment of water quality and the ecological state of water supply sources in the regions of the republic over a long period. Of particular importance is the development and creation of a local individual installation of low power for one or two households for the treatment of domestic wastewater for rural areas, ensuring environmental safety and environmental protection.

The purpose of this study is to create a new local installation for the treatment of domestic wastewater for the rural population.

The objectives are to develop an individual local installation of low power for the treatment of domestic wastewater.

The subject of the study is the determination of the state of water supply sources in accordance with the current standard: O'zDSt 951:2011, laboratory and instrumental studies of the composition of household wastewater, selected according to the stages of their treatment at a new local installation in laboratory conditions, determination of hygienic and technical efficiency work of a prototype of a new local installation developed by us [4].

Hygienic, sanitary-bacteriological, chemical, statistical and analytical research methods are used in the work.

By studying the data of literature sources on the condition of formation, characteristics, composition and quantity of wastewater, on the development technologies for domestic wastewater treatment in small settlements, for local and physic-chemical treatment, for the method of biological treatment of household wastewater and for post-treatment of wastewater in order to use purified water for household needs allow the following conclusions to be drawn:

The main sources of pollution of water bodies for drinking purposes are industrial enterprises, agricultural production, as well as the discharge of domestic wastewater;

centralized water supply systems in cities and villages of the republic are not reliable due to wear and tear of equipment and water supply networks and cannot provide the population with high-quality drinking water, which poses a threat to health;

Efficiency of domestic wastewater treatment according to the total number of bacteria is: for sand traps 10-12%, for sedimentation tanks 25-75%, for biological filters 80-95%, for aero tanks 90-98%, after chlorination up to 99%;

Provision of the rural population with sewerage systems is currently 5.1%, i's. 94.9% of rural residents use yard cesspools to discharge domestic wastewater;

domestic wastewater contains organic substances, minerals and heavy metals, biological contaminants - pathogenic intestinal microflora and require treatment with new innovative methods;

until now, in the republic, local systems for the treatment of household wastewater are not used, since foreign individual treatment facilities for the conditions of the republic did not give positive results, due to the fact that they are expensive and do not provide wastewater treatment from heavy metals, etc. pollutants.

An urgent problem is the treatment of domestic wastewater for most settlements. By the method of deep biological treatment, it is not always possible to achieve the required degree of purification, which is associated with the operation of biological treatment facilities and the removal of activated sludge from the secondary sedimentation tank due to insufficient time spent in it by water or structural defects in the equipment. To solve these problems, the technology of using reagents - coagulants is recommended. Their use also facilitates the removal of phosphates and improves the efficiency of post-treatment from oil products. The optimal dose of reagents - coagulants with a maximum reduction in the content of suspended solids at the outlet of the secondary clarifier. As coagulants, various metal salts can be used, which allows you to remove phosphorus, nitrogen compounds and suspended solids from the water as much as possible [5].

The construction of centralized sewerage systems in rural areas is economically expensive, so these problems in foreign countries have been solved using other methods over the past 20 years, i.e. local and individual sewage treatment plants.

Methods. In order to use the facilities, an hourly or daily schedule for the discharge of wastewater from the population in rural areas is determined and the composition of wastewater is analyzed.

Local treatment facilities are designed for wastewater treatment and their subsequent discharge after treatment into environmental objects (soil, irrigation canals, surface of water area). This building is:

Individual, that is, working only for the object for which it is designed;

Gravitational, that is, the basic principle of its operation is the gravity movement of the liquid (sometimes pumps are still used);

Biological-mechanical, that is, acting on the basis of a combination of mechanical and biological cleaning methods;

Household, that is, it cleans wastewater generated from washing linen and dishes in a household [6].

At present, the Cabinet of Ministers of the Republic of Uzbekistan has issued a resolution "On measures for the integrated socio-economic development of the Bostonliq district of the Tashkent region." Ensuring the implementation of the tasks set in the Decree No. 1 of May 28 (31/1-2071) and No. 2 of June 14, 2020 (01-31/1-2071), tourism development, preservation of the environmental situation, prevention

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of pollution of ground and surface waters. In order to ensure the implementation of the relevant decisions of the Cabinet of Ministers of the Republic of Uzbekistan in the Bostonliq district, on the basis of research, a 1-individual sewerage system was developed and installed in the homes of the population [7,8].

Before the manufacture of the device, a schedule has been developed for the removal of wastewater from the population of the area, i.e. the schedule has been developed based on the amount of wastewater discharged by consumers per hour in a house where 10 people live. The schedule for wastewater discharge, divided into spring-summer and autumn-winter seasons, is very different. In the spring and summer months of the year, the dynamics of wastewater discharge into the sewer by the population fluctuates sharply. The main reason for this is that in spring and summer the population devotes most of its time to agriculture, gardening and animal husbandry, i’s. Spends most of his time outdoors.

Since the population spends most of their time at home in autumn and winter, the dynamics of wastewater discharge is characterized by smooth values of indicators.

It has been determined that the volume and quantity of wastewater discharged from houses in remote areas is not constant, therefore, when choosing individual treatment facilities for households, it is necessary to develop a device that does not affect the quality of treated wastewater in a significantly changing environment.

By studying the coverage and condition of the population with wastewater treatment plants in the republic, it has currently been determined that out of 119 cities, 79 have been centralized with sewerage systems, out of 1085 urban-type settlements, 53 have sewerage, and out of 11012 rural settlements, 51 have been sewered and this, from the available 12216 settlements [9].

Thus, the provision of sewerage systems in the whole country in cities is 66.4 percent, in urban-type settlements 4.9 percent and in rural areas 0.5 percent. In general, 17% of the population in the republic uses centralized sewerage. The population in the sewerage zones is 8335 thousand people, of which 3990 thousand people or 47.9% are connected to sewerage systems [10].

So far, local domestic wastewater treatment systems of foreign production are not used, and there are no domestic developments.

The local treatment plant (VTP) is designed to treat wastewater and subsequently discharge it after treatment into environmental objects (soil, irrigation canals, and surface water bodies). This building is:

Individual that is, working only for the object for which it is designed;

Gravitational, that is, the basic principle of its operation is the gravity movement of the liquid (sometimes pumps are still used);

Biological-mechanical, that is, acting on the basis of a combination of mechanical and biological cleaning methods;

Household, that is, it cleans wastewater generated from washing linen and dishes in a household.

Such individual treatment systems in a septic tank using biologically active additives are an environmentally friendly and economical way to treat wastewater from cottages and individual buildings.

Thus, the solution of problems associated with the disposal of domestic wastewater from rural areas of Uzbekistan, where the construction of centralized sewerage systems is not economically feasible, requires the development of local treatment facilities of domestic production for one or two households.

A rectangular type of a local plant for the treatment of domestic wastewater has been developed and the efficiency of an individual plant for the treatment of domestic wastewater has been evaluated.

The evaluation of the functioning of a prototype of an individual new installation has included the implementation of studies related to determining the effectiveness of domestic wastewater treatment in terms of microbiological and chemical indicators in the laboratory.

It is known that heavy metals are contained in domestic wastewater in concentrations up to 10-12 MPC. In this regard, we have carried out production tests of a prototype of an individual installation in laboratory conditions that were close to natural conditions.

At the first stage of the research, we have studied the hygienic efficiency of the prototype of an individual installation under conditions of a minimum load of domestic wastewater containing harmful substances up to 5 MPC. At the second stage, we have studied the efficiency of the pilot plant for the treatment of polluted domestic wastewater containing harmful substances at concentrations of 6 to 10 MPC, i.e., under medium load conditions [11].

Results and discussion. In the process of testing a prototype of an individual installation in 1-3 series of studies (minimum load) and 4-6 series (average load), the results of analyzes have been compared in terms of chemical and microbiological indicators at the inlet, at the stages of treatment and at the outlet of the domestic wastewater installation water and calculated the percentage of efficiency. According to microbiological indicators, the percentage of domestic wastewater treatment ranges from 4.8 to 32. In terms of mineralization (dry residue), the efficiency of wastewater treatment reaches 37.5-38.5 in 1-3 series of studies and 97.9-90, 0 percent, respectively, in 4-6 series of studies [12,13].

Purification of domestic wastewater from organic pollution at the pilot plant is sufficiently high. This is evidenced by the decrease in the COD value at the outlet of wastewater compared to the initial level: in series 1-3, the decrease in this indicator is 81.5-82.0 percent, and in series 4-6, 88.3-90.0 percent. Ammonium nitrogen has improved by 80.3-81.1 percent, nitrate nitrogen by 53.2-54.0 percent and nitrite nitrogen by 45.4-76.7 percent in series 1-3. Similar results for organic pollutants have been obtained in 4-6 series of studies [14,15].

The efficiency of removing metals from wastewater in series 1-3 was 56.8-96.6 percent, and in series 4-6 82.7-98.7 percent, respectively. This indicates that the efficiency of an individual local installation does not depend on the amount of metals contained in wastewater. The highest indicators of the degree of wastewater treatment

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in series 1-3 have been established for lead content of 86.6-96.6 percent and cadmium 77.5-97.6 percent, and in series 46 for copper concentrations of 87.8-98.7 percent and cadmium 85.7-98.3 percent, respectively.

To remove organic substances from water, reduce the intensity of tastes and odors, chlorine, potassium permanganate, ozone, or combinations therefore should be used as oxidizing agents. The type of oxidizing agent and its dose should be determined on the basis of technological research data (Table 1).

Table 1

Approximate doses of oxidizing agents for the removal of organic matter from water

Permanganate oxidizable of water, mg O/l	Dose of oxidizing agent, mg/l		
	chlorine	potassium permanganate	ozone
8-10	4-8	2-4	1-3
10-15	8-12	4-6	3-5
15-25	12-14	6-10	5-8

The main places for introducing oxidizing agents and the sequence of introducing reagents should be taken from Table. one.

It is allowed to introduce parts of the dose of oxidizers in front of structures of various types.

If it is impossible to introduce reagents with the required time gaps into pipelines or into the main technological facilities, special contact chambers should be provided.

The use of ozone and potassium permanganate in household and drinking water supply does not exclude the need for chlorination of purified water for its disinfection.

The capacity of the tanks with a stirrer for preparing a solution of potassium permanganate should be determined based on the concentration of the reagent solution of 0.5-2% (by commercial product), while the time for complete dissolution of the reagent should be taken equal to 4-6 hours at a water temperature of 20 °C and 2-3 h at a water temperature of 40 °C.

Table 2

The main points of introduction of oxidizing agents and the sequence of introduction of reagents

Place of entry of oxidizers	The sequence of introducing reagents into water
1. Chlorine before sorption treatment	Chlorination at least 2 minutes before filtration through granular active carbon or the introduction of powdered active carbon
2. Ozone immediately before sorption treatment	Ozonation followed by filtration through granular active carbon or treatment with powdered active carbon

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3. Chlorine before coagulation	Primary chlorination, after 2-3 minutes - coagulation
4. Chlorine and potassium permanganate before coagulation	Primary chlorination, after 10 minutes the introduction of potassium permanganate, after 2-3 minutes - coagulation
5. Ozone before coagulation	Ozonation, subsequent coagulation
6. Chlorine and ozone before coagulation	Primary chlorination with a dose within the chlorine absorption of water, after 0.5-1 h - ozonation and subsequent coagulation
7. Ozone before clarification filters or into purified water	
Note: It should be possible to change the place of input of reagents during the operation of facilities.	

The number of solution or solution - supply tanks for potassium permanganate must be at least two (one reserve). For dosing a solution of potassium permanganate, dispensers designed to work with settled solutions should be taken.

Granular activated carbon should be used as a load for sorption filters located after clarifying filters or other facilities that provide water purification from suspended matter up to 1.5 mg/l . When substantiating, it is allowed to use combined clarification -sorption filters.

The height of the coal load $H_{\text{у.з}}$, m, should be taken at least:

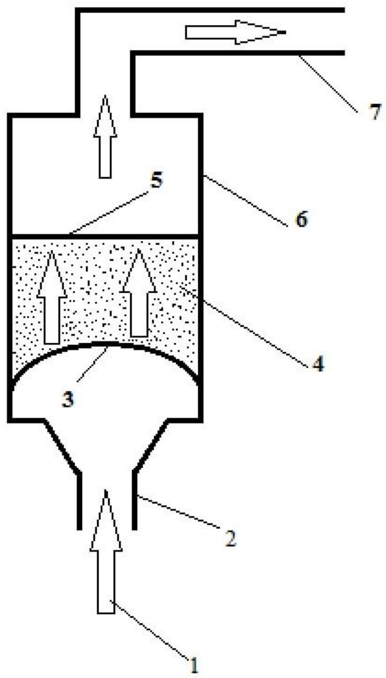
$H_{\text{у.з}} = v_{\text{р.ф}}\ \tau_{\text{у/60}}$

where $v_{\text{р.ф}}$ is the estimated filtration rate, assumed to be 10-15 m/h;

$\tau_{\text{у}}$ is the time for water to pass through a layer of coal, taken 10–15 min, depending on the sorption properties of coal, the concentration and type of water pollution, and other factors, and is specified by technological surveys.

To load sorption filters, granular activated carbons of the AG-Z, AG-M, etc. brands should be used.

The intensity of washing with water of the sorption load of the filter should be taken depending on the required relative expansion of activated carbon according to Table. 3.



Rice. 1. Adsorption plant with activated carbon for additional treatment of domestic wastewater. 1. The flow of water. 2. Inlet pipe. 3. Grid. 4. Activated carbon. 5. Mesh for the filter. 6. Column body. 7. Outlet pipe.

Determination of pressure loss in the sorption layer of activated carbon, calculation and design of the distribution system of devices for supplying wash water, gutters and other elements of sorption filters.

Powdered active carbon should be introduced into the water before the coagulant with a time interval of at

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least 10 minutes. The dose of coal in front of the filters should be taken up to 5 g/l.

Transportation of coal powder from the reagent warehouse to the coal pulp preparation unit is allowed to be carried out by hydro- and pneumatic methods. When using the pneumatic method, the installation for transporting coal powder must be sealed and provided with fire safety equipment, a local anti-explosion valve and grounded.

Table 3

The intensity of washing the sorption filter load depending on the required relative expansion

Active carbon type	The required value of the relative expansion of the load,%	Filter washing intensity, l/(s m^2)	Duration of filter washing, min
AG-Z	25 35 45	12-14 14-16 16-18	8-7 7-6 6-5
AG-M	Thirty 45 60	8-9 9-10 11-12	12-10 10-8 8-7

For dosing of coal pulp, soaking of coal for 1 hour in tanks with hydraulic or mechanical agitation should be provided. Pumps for pumping coal pulp must be resistant to the abrasive effects of coal. The performance of the circulation pumps should provide a 4-5-fold exchange of the soaked reagent during the soaking time.

The concentration of coal pulp should be taken up to 8 %.

Pipelines for supplying coal pulp should be calculated at a pulp velocity of at least 1.5 m/s; pipelines must be provided with revisions for cleaning, smooth turns and slopes.

The design of the dispensers should provide hydraulic mixing of the pulp at a constant level in the dispenser.

A series of experiments on domestic wastewater treatment has been carried out (Table 4), using an additional load of local activated carbon of about 3 kg. The volume of the adsorption unit (Fig. 1) is -15 cm by 25, the filtration rate is -8 l/h.

Table 4

THE results of laboratory studies on the treatment of bit wastewater

Indicators	Norm (MPC)	results	
		state of wastewater at the inlet , mg/l	outlet, mg/l
1. The number of bacteria of the Escherichia coli group (BGKP), in 1 l	1000	1500	350
2. Number of pathogenic enterobacteria, in 1 liter	Ots.	But	but
3. Suspended substances, mg/l	1.5	12.0	1, 1

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4.Hydrogen index (pH)	6-9	10.8 _	7, 1
5. Dry residue, mg/l	1000	2480	1206
6. Ammonium nitrogen (NH_4^+), mg/l	1.5	7.2	0.3
7.Nitrate nitrogen (NO_3), mg/l	45	73	5
8.Nitrite nitrogen (NO_2^-), mg/l	3	5.1	0.06 _
9. Total hardness, mg- eq/l	7-10	9.9	6.8
10. Sulfates (SO_4), mg/l	400	6 3 1	280
11. Chlorides (C l), mg/l	250	321	53.2
12. BOD full. , mg O_2/l	3-7	14.0	3.0 _
13. COD, mg O_2/l	15.0	13 5.0	96
14. Smell _	2	Four	2

The data in Table 4 show that, according to the indicators of chemical analysis, the purified water complies with the MPC standards and the purified water can be used as industrial water and for irrigation when growing crops.

Regardless of their origin, all water used for irrigation must meet one general requirement - not to degrade soil properties.

Purified water does not silt up irrigation canals or pipelines, does not contribute to contamination of irrigation equipment and is suitable for irrigation of existing equipment.

Water quality affects the possibility and feasibility of successfully growing greenhouse products and plants in hydroponics , using intensive technologies. The chemical composition of irrigation water determines its quality and the possibility of using it in closed ground.

An increase in salt concentration, i.e. increased hardness (dry residue -1206 mg / l, in our case) leads to a decrease in the amount of major macronutrients that can be added to the nutrient solution, while maintaining optimal electrical conductivity of water for irrigation.

When calculating fertilizers and the total electrical conductivity of the working solution, it is necessary to take into account the concentration of individual microelements in the calculations (average mineralization of water -0.5-1.2 g / l or 0.3-0.8 mOhm / cm; strong mineralization of water -1.2- 1.5 g/l or 0.8-1 mΩ/cm; very strong mineralization of water - over 1.5 g/l or 1 me/cm), then, in order not to reduce the amount of fertilizer applied with the working solution, it is necessary to use ballast-free, highly soluble mineral fertilizers and, if possible, salts with lower electrical conductivity: potassium, calcium and magnesium nitrate, mono-potassium phosphate. The use of water with an initially high salinity for irrigation forces the manufacturer to abandon the use of substances with high electrical conductivity: ammonium nitrate, potassium sulfate and some others (according to specialists from UniVOD LLC).

Conclusions.

1. Studied and investigated the current state and functioning of sewerage systems. The provision of sewerage systems in the whole country in cities is 66.4%,

in urban-type settlements 4.9% and in rural areas 0.5%. The efficiency of sewerage systems in the republic and in the context of regions is not satisfactory. Only 40.2% (846.9 million m^3/year) of wastewater from their total amount (2107.3 million m^3/year) entering the sewer network is subjected to the treatment process.

2. Criteria for assessing the composition of domestic wastewater and environmental requirements for their discharge into water areas and soil have been developed, the implementation of which will prevent further pollution of environmental objects.

3. For the first time, a domestic local individual installation for the integrated treatment of domestic wastewater has been created and developed, which, in comparison with existing foreign analogues, is cost-effective and efficient for the conditions of Uzbekistan. The efficiency of the pilot plant in relation to the treatment of household wastewater for various metals is quite high in terms of organic pollution 53.6-91.5%, in terms of BOD 81.7-95.9%. For manganese it is 83.3-85.1%; copper 61.6-91.9%; iron 78.5-99.3%; zinc 80.5-85.4%; aluminum 78.6-86.2%; cadmium 85.0-90.5%; nickel 79.5-86.9%; mercury 87.2-92.5%; lead 92.1-93.0%; chromium 83.9-92.7%. The lowest efficiency of purification of domestic waste water from heavy metals has been established for copper, which is 61.6%, and the maximum for lead is 93.0%.

3. The developed individual local installation of low power is designed for one or two households, the use of which allows you to effectively treat household wastewater generated in the process of life of residents. The volume of capacity of the LOS can be increased based on the requirements of residents (neighbors) of the housing complex according to individuality with design.

4. Reliability of the results of the study due to the use of modern methods and approaches, a sufficient number of analyzed water samples of surface and groundwater, the study of the required number of water quality indicators of water bodies over the past ten years in the context of the regions of the republic.

5. Testing a prototype of a local installation for the treatment of domestic wastewater in laboratory conditions, a large number of wastewater samples taken after their treatment under conditions of minimum and maximum wastewater load, using modern chemical, sanitary-bacteriological, physical, and spectrophotometric, calculated - analytical and statistical research methods. The results of foreign and domestic studies have been compared; the conclusions and the results obtained have been confirmed by the authorized structures of the Republic of Uzbekistan.

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