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The use of a Wastewater Treatment Plant for 200 People in Uzbekistan

Aliyev M.K.[1], Mahmudova D.E.[2], Kamalova S.N.[3]

[1]Tashkent Institute Of Architecture And Civil Engineering
Associate Professor, Ph.D.
[2]Tashkent Institute Of Architecture And Civil Engineering
Associate Professor, Ph.D.
[3]Assistant Tashkent Institute Of Architecture And Civil Engineering

Annotation:
This article discusses the design and construction of wastewater disposal systems, treatment facilities in rural areas and their solutions. The main goal of the article is to offer a set of convenient, prolusion-free, inexpensive devices that work in accordance with the conditions of Uzbekistan. To achieve this goal, it proposed to apply a number of methods of settle, aeration, and disinfection.Wastewater treatment plants in small settlements, the use of cost-effective, low-cost devices identified as the main challenges in the proposed wastewater treatment technology. The amount of organic matter analyzed in the wastewater of the rural population.
Key words: sewerage, wastewater, ecology, local sewerage, project, typical house, domestic sewerage, drinking water, groundwater, water sources, analysis.

Introduction

The design and construction of sewage disposal systems and treatment plants in rural areas is studied as a systemic problem.Nowadays, the design of sewage systems and treatment plants in rural areas is carried out in the same way as the design of medium and large cities, or is limited to the use of obsolete, environmentally friendly, simple devices.

It is advisable to use wastewater treatment devices that are easy to use in rural areas, simple to implement and treat wastewater at the required rate.The adoption of specific technical solutions depends on local conditions, ie topography, soil composition, location of communications.The use of high-tech devices makes the construction and operation of this system more expensive.In any case, it is necessary to make agreed decisions.These decisions must ensure adequate compliance with environmental requirements, economic performance, construction and use of equipment.

At present, due to the rapid pace of construction of model rural houses, the use of wastewater for treatment and re-irrigation of agricultural crops has become one of the most pressing issues.

One of the most global challenges of our century is to prevent the pollution of water bodies.According to the Ministry of Housing and Communal Services, 98% of wastewater in rural areas of the country is absorbed into groundwater without treatment [1, 4-б.].This leads to contamination of groundwater and surface drinking water resources.

At present, great attention is paid to the prevention of pollution of water bodies.Domestic wastewater is treated at certain facilities and then discharged into water bodies.At the same time, water bodies are polluted to a certain extent.In recent years, our government has adopted a number of resolutions, Cabinet of Ministers Resolution No. 11 of 03.02.2010, Resolution No. 199 of May 1, 2003 and Resolution No. 820 of November 11, 2018, which are mainly aimed at improving the sanitary condition of water bodies.

Rapid development of individual entrepreneurship in rural areas, the rapid construction of rural housing is one of the main factors of pollution of water bodies, groundwater.Along with the discharge of large amounts of wastewater into the water basin, maintaining its cleanliness is one of the important tasks facing our state.Therefore, it is necessary to choose the right methods of wastewater treatment, to ensure the sanitary condition of the water entering the reservoirs and full compliance with the requirements of sanitary norms.

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Wastewater from rural areas is high in organic matter.The organic pollutants in them create favorable conditions for the growth of bacteria.Therefore, one of the most important factors in wastewater treatment is the separation and neutralization of pollutants, especially organic matter, from water.

Sewage is treated by mechanical, physicochemical and biological methods.Sewage is disinfected with chlorine, sodium hypochlorite, ozone and other disinfectants to eliminate disease-causing bacteria.

The peculiarity of wastewater treatment plants in small settlements is that they must be low-cost, economically viable, low-cost devices.Sewage treatment plants should be located in such a way that the treated water flows from one to another in series.

The main purpose of this article is to offer a set of convenient, environmentally friendly, low-cost devices that work in accordance with the conditions of Uzbekistan.We offer the following devices: mechanical, biological, chemical treatment and wastewater treatment, which is carried out inside a device divided into springs.The treated wastewater is discharged to the ground-plant area.First of all, the facilities contain the heaviest and largest contaminants in the wastewater, from which the main insoluble contaminants are extracted.

According to the dry cleaning scheme, agitators are installed in the reagents.The amount of chemical detergents is determined by the amount of bacteria in the water.It is advisable to use sodium hypochlorite as a chemical disinfectant.

Many cities and district centers in Uzbekistan use groundwater as drinking water.60% of the water supply comes from groundwater sources.Due to the large amount of mineral fertilizers applied to agricultural crops in recent years, the mineralization of groundwater has increased sharply.The concentration of nitrate in groundwater averages 90 mg / l, [6,143-б.].

The constant concentration is 45 mg / l, [7, 2-б.]. This means at least twice of the allowable concentration.This requires the use of nitrate purification methods before using groundwater sources for drinking water consumption.

The presence of nitrogenous minerals (ammonium, nitrates, nitrites) in drinking water leads to an increase in the demand for oxygen in the human body.Nitrogen is released into groundwater in a natural and anthropogenic way.The source of nitrogenous substances can be local or large-area in nature.The main natural sources are: nitrogen in the soil, biological sediments, atmospheric precipitation.The main anthropogenic sources include: nitrogen fertilizers, septic drainage water, livestock farms, industrial and domestic wastewater.This situation leads to a deterioration of groundwater content, mainly due to the fact that the amount of nitrates and nitrites exceeded the permissible norm of 2-3 to 10-16 permissible norms, [6, 156-б.].

The main indicators of contamination of artesian water are: oxidation of ammonium nitrogen, nitrate, permanganate.The increase in nitrogen compounds in natural water resources of the Republic requires the use of modern methods to reduce anthropogenic loads, improve the quality of drinking water.

Drinking water supply and treatment stations to cities and district centers in the country are working with outdated technologies, are obsolete, have equipment that requires repair, and many do not work effectively.In rural areas, centralized water supply is almost non-existent, sewage drainage systems are not built.In recent years, emissions of nitrogen compounds into natural water sources have somewhat declined [6, 180-б.]. Information on the amount of nitrate in the groundwater of the city and region of Tashkent is given in Table 1.As can be seen from Table 1, the content of nitrate exceeded the permissible concentration in 14 out of 4 district water intake wells.

Table 1. Information on the chemical composition of groundwater in Tashkent region.

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Table 1.

	Sampled area	Taste (points)	Colour mg/l	pH	Oxidants mg/dm^3	Ammonia mg/dm^3	Nirtir mg/dm^3	Nitrate mg/dm^3	Alkalinity mg/dm^3	Total hardness mg/dm^3	Xidi 20°	Sulfatemg/dm^3	Chloride mg/dm^3	Dry residue mg/dm^3	Iron mg/dm^3	Fluorine mg/dm^3
1	Angren city	2	2	7-9	0.55	1.3	2.6	50	5.3	9.1	1	75.9	14.6	759	0.04	0.02
2	Bekabod district	3	2	14-18	1	2	3.2	90	7.3	15	2	80.3	18.7	923	0.04	0.03
3	Chirchik district	3	2	8-10	0.73	1.8	2.8	75	7	14	2	78.1	17.2	753	0.03	0.02
4	Boka district	2	2	6-9	0.64	1.5	2.1	73	6.8	12	2	79.6	16.5	793	0.03	0.02

Groundwater has the ability to retain nitrates for a longer period of time than a surface water source.This is due to the fact that the process of biological self-purification does not occur in groundwater sources, and hydrodynamic processes are very slow.

Taking into account the above information, in order to reduce the inflow of untreated wastewater into groundwater, we will consider the use of a wastewater treatment plant for 200 people in Uzbekistan.The specific amount of water is 120 liters per person according to building codes and regulations.

We determine the dimensions of the sewage treatment plant[4, 65-б.].

Determine the size of the septic tank.

Determine the BPK_5 load:

$$M_{BPK} = a_c \times ЭН = 200 \times 60 = 12000\ g/day (1)$$

Taking into account this indicator, the plant-soil area is determined:

The field is defined by the load BPK_5 as follows:

$$F=12000/12=1000\ m^2$$

Based on the hydraulic load, the area is determined as follows:

$$F=24{,}0/0{,}04=600\ m^2$$

A large value surface is acceptable for the area.

The required area can be reduced by 25-30%.

The total area can be reduced by 25 percent due to the decomposition process in the septic tank.But the area should not be less than the area found due to the hydraulic load.In a vertically flowing ground-plant area, a pump selection is required to pump water upwards.In this option, a pump unit can be installed in the second chamber of a two-chamber septic tank, or a separate pump unit can also be installed.We will install a pump that will pump 3.0 cubic meters of wastewater from the reservoir at a depth of 1.5 meters above the ground to an area of 1.0 meters above the ground.The maximum hourly wastewater volume is determined for pump selection. The average hourly wastewater volume is found as follows:

$$Q_h = \frac{Q_w}{24} = 1 m^3/hour (2)$$

The maximum runoff of the effluent is 3.0.

Therefore, the maximum hourly wastewater consumption is determined as follows:

$$Q_{h\ max} = 1 \times 3 = 3\ m^3/h \qquad (3)$$

The septic tank is made of reinforced concrete well with a depth of 2.0 meters and a diameter

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of 1.5 meters, with a volume of 3.5 cubic meters. The septic tank is made up of three chambers.

We calculate a wastewater treatment plant that has a biological treatment plant through active il.

We adopt wastewater treatment technology through prefabricated devices from building structures.

We determine the size of the device to be cleaned by the active il.

We determine the volume of the aeration zone by BPK_5 12 kg / day.

Depending on the allowable load capacity, the required volume is found as follows:

$$B_R = \frac{\text{BP}K_5}{m^3\ day}, \qquad (4)$$

$$V = \frac{M_{BPK}}{B_R} = \frac{12}{1,0} = 12\ m^3 (5)$$

We check the volume found based on the allowable active country load:

$$B_{TS} = 0.3\ kg\frac{\text{BP}K_5}{kg/day}, a_i = 3,0\ g/dm^3 \qquad (6)$$

The mass of the il in the device is found as follows:

$$\text{M}_i = V \times a_i = 12,0\text{x}3,0 = 36,0\ kg (7)$$

$$\text{B}_{TS} = \frac{M_{BPK}}{\text{M}_i} = \frac{12}{36} = 0,3\ kg\frac{BPK_5}{kg/day} (8)$$

Given that the load does not exceed the allowable active country load, a 1.5 m³ unit is considered sufficient for wastewater treatment.

Determine the age of the active il, taking into account the amount of oxygen required, based on the calculated consumption of the device [5, 136-б.]:

$$V = \frac{t_{TS}P_i}{a_i} (9)$$

P_c- growth of active matter as a result of biological destruction of organic matter - 0.91 kg / kg (determined by BPK_5).

$$\text{M}_{BPK} = 12\ kg/d, \text{P=0,91*12=11,0 kg} (10)$$

The age of the active il is as follows:

$$t_{TS} = V \times \frac{a_i}{P_c} = 12 \times \frac{3.0}{11} = 3.27\ d (11)$$

To increase the age of the active il by 4 days, increase the dose of the active il by 3.5 g/l.

$$t_{TS} = V \times \frac{a_i}{P_c} = 12 \times \frac{3.5}{11} = 3.8\ d (12)$$

The amount of oxygen required for the selection of air handling units is found by adding the amount of oxygen required for the nitrification-denitrification process to the amount of oxygen required for the destruction of organic matter. / 6, 98- б./:

$$OV = OV_c + OV_N - OV_D, (13)$$

OV_c –the amount of oxygen required for the destruction of organic matter, kg / day;

OV_N –oxygen consumption for nitrification process, kg / day;

OV_D –the amount of oxygen depletion due to the denitrification process, kg / day.

Given that nitrification - denitrification processes do not occur, the oxygen consumption due to the destruction of organic matter is found as follows:

$$OV_c = B_d\left(0,56 + \frac{0,15t_{TS} \times 1.0172^{(T-15)}}{1 + 0.17t_{TS} \times 1.0172^{(T-15)}}\right) = 12(0.56 + \frac{\left(0.15 \times 4 \times 1.0172^{(20-15)}\right)}{1 + 0.17 \times 4 \times 1.0172^{(20-15)}} = 12\ \text{kg / day}$$

Given that nitrification - denitrification processes do not occur, the oxygen consumption due to the destruction of organic matter is found as follows:

$$OV_h = \frac{k_c(OV_c - OV_D) + k_N OV_N}{24}, = \frac{1.3 \times 12}{24} = 0.65\ kg/h (14)$$

The technological volume required for the oxygen transferred as a result of continuous aeration of the active il is found as follows:

$$q_0 = \frac{C_T}{C_T - C_i} \times OV_h = \left(\frac{9.02}{9.02-2}\right) \times 0.65 = 0.84\ kg/h (15)$$

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C_T–the solubility of oxygen in water is 9.02 mg/dm³;
$C_\circ$ -the oxygen concentration in the active il mixture is 2.0 mg/dm³.
The specific oxygen content in 1 m³ of air is 4.5-5.5 g 0²/m³
Depth of treatment plant - 1.0 m.
The amount of air required to obtain 1 g of oxygen is -5.0 × 1.0 = 5.0 g/m³
The required amount of air is 840/5 = 168.0 m³/h.
We choose a compressor with a production capacity of not less than 168.0 m³/h

Conclusion

In conclusion, the treatment of wastewater generated in residential areas without centralized sewerage systems through local sewerage facilities is characterized by environmental, economic and simplicity of the construction process.

The proposed local sewage treatment technology is as follows: sewerage; aeration; decontamination.With this technology, the wastewater from the wastewater treatment process reduces the adverse effects of treated wastewater on the environment, nature, surface and groundwater basins.

By involving treated wastewater in the irrigation of industrial crops, it helps to prevent water scarcity in the area, at least in part, and not to waste water.

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