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Analysis of the Composition of Wastewater in Oil and Gas Production Enterprises

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A B S T R A C T

The formation of waste water reuse technologies based on smart technologies will allow to fully meet the human demand for water in the face of global climate change, and at the same time protect the human being from damage caused by various polluting chemicals and ensure food safety. In particular, to meet the demand for water by using secondary purified water in sectors that produce large-scale food and feed products, such as the cultivation of agricultural crops, livestock, poultry, and fisheries,to proper organization of reuse of wastewater from production enterprises, use of waste water in agriculture as technical water by different methods (chemical, biochemical, physical and biological) treatment of waste water unsuitable for use in production, organization of bioremediation treatment of secondary waste water from agriculture by producing secondary products (receiving microalgae and macrophyte biomass) along with the process of purification from various chemical compounds and substances, products that are extremely important for various sectors of the economy, including, protein, carbohydrates, lipids, protein-vitamin complexes for the food industry, pigments, chlorophylls, carotenoids, biopaints, food additives containing ω-3, ω-6, ω-9, bioplastic, ω-carotene for the pharmaceutical industry, immunostimulant, cardioprotector, antaxant, glycerol, anti-inflammatory and anti-obesity agents, biofertilizers for agriculture, feed and additives, biofuel for the bioenergy industry (biodiesel, methane, hydrogen, liquid hydrocarbons) and cosmetic products. At the primary stage of these processes, one of the important tasks is to determine the degree of contamination of industrial and domestic wastewaters with chemical compounds and substances. Therefore, in this article, the levels of contamination of domestic wastewater from oil and gas production enterprises with harmful chemical elements have been determined. In the course of research, the average level of phosphate pollution in the waste water coming out of the facility at the oil and gas production enterprise was 5.66 mg/l (2.26 times more than the established standard), chlorides 651.74 mg/l (1.86 times the established standard more), sulfates 664.33 mg/l (1.9 times more than the established norm), nitrates 531.62 mg/l (11.8 times more than the established norm), nitrites 16.36 mg/l (5.0 times more than the established norm it is found to be many times more). When the obtained results are compared, the indicators of contamination with chemical compounds in the waste water coming out of the enterprise have a seasonal nature, and the indicators of contamination increase as the winter season passes to the summer season. This situation is explained by relatively more use of tools used in municipal processes during the summer.

Introduction

One of the global environmental problems is the increasing level of large-scale pollution of the environment through wastewater. As a result of uncontrolled discharge of waste water contaminated with various toxic substances into the environment, the pressure of negative consequences is increasing not only on the natural environment, but also directly on human health (Maulin P. Shah, 2021). As the production potential of the enterprises increases, the contamination of wastewater with various toxic elements increases, and the pressure of its impact on the environment increases (Salem and Thiemann, 2022).

One such large production industry is the oil and gas production enterprises, which, in addition to the formation of a large amount of biogenic elements, emit a number of toxic chemicals and exhaust gases.In particular, it is noted in the national report "National report on the state of the environment - Uzbekistan, 2023" that the level of atmospheric air pollution is increasing year by year due to the rapid development of energy and industrial production and utilities (Salem and Thiemann, 2022). The increase in the number of motor vehicles has a big negative impact on this. In addition, the issue of wastewater reuse at the local level has not been effectively resolved yet. Section 5.2 of the National Report (2023) entitled "Water Resources" examines "Water Resources - the main indicators and trends" and "Water consumption (agriculture, industry and communal services)", "Water loss in agriculture, industry and communal services" in our country." and "Water pollution" were evaluated with the lowest rating "Negative", while the indicator "Water loss in agriculture, industry and communal economy" was interpreted with "Extremely negative" rating.Therefore, one of the most important tasks of preventing water shortages and their effective use in our country is to fundamentally update the water use system in industrial enterprises and to implement advanced technologies for the use of wastewater.

Oil and gas production enterprises can be noted as one of the sectors that generate a large amount of wastewater in Uzbekistan, and at the same time emit a large amount of sources of pollution to the wastewater.

Therefore, Shurtan Oil and Gas Production Department enterprise (Guzor city) was selected as the main industrial object of our research. Wastewater from the company of the Shurtan Oil and Gas Production Department is divided into industrial and domestic wastewater. In addition to chemical and physical wastewater treatment, biological treatment is also introduced at the enterprise which are used to be by *eichhornia* and *pistia* higher algae. For this reason, our research was focused on determining the initial composition of the wastewater coming out of the oil and gas production enterprise.

Materials and Methods

The Source of Research

Wastewater where is coming out of the oil and gas production enterprise.

Controlling the composition of treated demostic wastewater

Oil products are monitored once a day. The effluent must not be in water: COD is checked once a week, standard indicator is 15.0 mg/l; floating particles are monitored daily, the standard indicator is 15.0 mg/l; the amount of dry residue is checked daily, the standard amount is 1000 mg/l; pH is monitored daily, the standard indicator is pH-6.5-8.5; BOD - is monitored once a month, standard indicator is 3.0 mg/l; Iron element is checked once a day, standard indicator is 0.05 mg/l; Hydrogen sulfide (H_2S) is monitored once a day, standard indicator is 0.05 mg/l.

Technological processes of domestic wastewater treatment

The wastewater treatment facility is intended for the treatment of wastewater from the gas pretreatment plant, the main facility, the finished product processing plant, and the tank. In the treatment plant, there are two devices for the mechanical treatment of industrial wastewater, and for the treatment of domestic wastewater, there is a biological treatment device. The enterprise's biological wastewater treatment device was put into operation in 1985. The design capacity of the biological wastewater treatment device of the enterprise is 400 m^3 per night.

Devices for biological treatment of domestic wastewater. There are reception chamber is a ditch-shaped pool made of reinforced concrete, with a metal mesh. The metal net serves to catch all kinds of granular particles. CU-200/1,2 (Compact unit) is a compact device made of metal, consisting of 3 units (Aerotank, softener, water storage tank), designed for biological treatment of domestic wastewater.

Contact pool (contact reservoir) that is intended for neutralization (cleaning) of treated wastewater. Leachate ponds are rectangular concrete ponds designed for natural drying of activated sludge. UAP that means upper aquatic plants Algae treatment ponds are concrete ponds designed to treat wastewater using natural algae growth. Biological evaporation ponds are concrete ponds designed for natural evaporation of wastewater.

Technological process of the device for the biological treatment of household wastewater

Domestic waste water from vacant buildings and temporary shelters is treated biologically in the sewage treatment plant. Domestic wastewater enters the receiving chamber of the biological treatment device at the sewage treatment facility, and various granular (calcium) particles are caught through the metal net installed in the chamber.

The waste water passed through the metal mesh in the receiving chamber is sent to the CU-200 water treatment device. KU-200 device consists of three parts: Aerotank - mixer; Sump – septic tank; Sludge storage tank - collection chamber of activated sludge.

The process of the aerotank compartment

Domestic wastewater entering the aerotank of CU-200 is subjected to biological treatment with the help of *Eichhornia*, *Pistia* and activated sludge. *Eichhornia, Pistia* flowers and activated sludges are fed with organic waste in the waste water, andit increasesthe level of purity of the waste water. The degree of purification of wastewater with the help of *Eichorni*a, *Pisti*a and activated sludge is constantly analyzed in the ecology laboratory of our company.

There are four air ducts in the aerotank, through which air is constantly supplied with a pressure of 50-80 kRa. Air promotes the development of *Eichhornia, Pistia* and activated sludges. In order to constantly update the aerotank with active gases, active gases are transferred from the activated sludge collection pool by airlift method (through special pipelines). Due to the mixing of active substances with organic waste in wastewater, the oxidation process takes place and turns into inorganic substances. Wastewater from the aerotank and the active substances in it pass through the barrier through a special channel (pourer) and fall into the clarifier. In order to maintain the normal life activity of activated sludges, biogenic elements such as ammonium nitrate or sodium tripolyphosphate are added to the wastewater before the aerotank. Lack of biogenic elements slows down the process of biochemical oxidation of organic substances. The lack of ammonium nitrate for a long time will cause the active years to harden without slowing down the oxidation process. The lack of sodium tripolyphosphate in wastewater leads to the growth of filamentous bacteria in active waters, which results in slow sedimentation. At the same time, the growth of activated sludges and the oxidation of organic substances slow down.

Under the influence of microorganism mineralizers (activated sludges), the minerality of organic matter increases, or the process of biochemical oxidation occurs, which takes place in the following two stages:- first stage, carbonic compounds are oxidized as a result of oxidation of carbonic acid and water.

Compounds with a chemical reagent are oxidized in two phases, first to nitrite, then to nitrate:- the second stage is the oxidation of nitrogenous organic compounds, and the last stage is nitrification. The presence of nitrates in the wastewater is one of the main parameters that indicate that the wastewater is sufficiently purified.

The oxidizing capacity of the aeration part of the compact device was calculated to be 270 g/m^3 during one night and day with BOD-5 at concentration of activated sludge is 3.5-4.0 g/1. The period of separation of wastewater in the aeration part (aerator) of the compact device is equal to one night, equal to 1.5 hours of the maximum flow consumption passing through the settling and stopping part. Saturated active sludge is periodically (once in 1-4 months) discharged from the aeration part to the mud flat. For this purpose, a special metal pipe is installed under the device, and it is possible to completely empty the device through the slide installed on this pipe.

Process in the compartment of septic tank

Domestic wastewater treated in the aeration tank passes through special holes to the settling pond. Here, the wastewater is settled, and the settled wastewater is sent to the contact pool through special metal channels.

Process in the compartment collection of activated sludge

There are two air supply pipes in the activated sludge collection chamber, which are used to transfer air to the active oil aeration tank by airlift method. Air is constantly supplied to protect the activated sludges from destruction.

The mission of muddy area

In the aerotank, the active sludge saturated with microorganisms contained in household wastewater is poured into the sludge pad through Ø159 mm pipes and dried there. The dried compost is taken out to the garbage collection area. Muddy areas are intended for drying the saturated active sludge produced in the compact unit during biological treatment. The calculated capacity of the mud area is designed to dry 5-6 m^3 of mud per year on 1 m^2 area.

The mission of the contact pool

The domestic wastewater settled in the clarifier is fed to the contact pool. The contact pool is also constantly aerated. Here, domestic wastewater is neutralized by chlorination and pumped to UAP ponds or evaporation ponds.

Preparation of domestic wastewater for the addition of a biological treatment device

Preparation for connection after disassembly and repair of the device. After dismantling and repairing the device, it is connected according to the order of the chief engineer in the following sequence:- as a result of the external inspection, the structure of the building, i.e., entrance-exit ditches, aeration pipes, readiness and grounding of electrical equipment, walls of the building, and shutters are checked.- it is ensured that there are no foreign objects in the household wastewater receiving basin, aeration tank, clarifier, activated sludge collector, and SPS (Sewage pumping station) wastewater receiving basins.- it is ensured that the compressors work at the norm. For this, the compressor is turned on for a short time.- valves in the contact pool network, exit ditches and aeration tanks are closed.- The water supply system in the perforated pipe in the aeration part of the CU-200 is opened. The engineer on duty is notified that the equipment is ready to be put into operation.

Preparing the device for operation

Preparing the device for operation is carried out in the same sequence as when connecting the network. All containers of the network are filled with water for testing and the filled containers are observed overnight. However, if water leaks from somewhere, the water is poured and the leaking place is closed. At the same time, the installation of water spillages is checked and adjusted the level. Airlift operation is checked. Airways are tested for tightness with air. Holes, cracks, and similar air leaks are eliminated. After washing with water, the water is poured and the sewer network is also flushed.

Commissioning of a domestic wastewater biological treatment plant

Commissioning of a domestic wastewater biological treatment plant for the first time. When the domestic wastewater treatment plant is put into operation for the first time, the active element is prepared. These can be done in several ways:- at first, starting from taking clean water into the air tank, after filling the perforated pipes with water up to 50 - 80 cm, the compressor is added to the work to open air to the perforated pipes. - air is alternately sent to the perforated pipes in small amounts.- after the water comes out of the perforated pipe beams, the valves on these beams are closed and the air distribution along the aeration tank is checked. -The aerotank is filled up to the water level.- air consumption per square meter of the aerotank is increased to 9-10 m^3 per hour. - According to BOD, wastewater with a concentration of 100-150 mg/l is pumped through an aero tank.

This concentration is achieved by adding drinking water or low-contamination wastewater to the wastewater.- the process of increasing active years in the air tank, the aeration process is carried out for 2-3 days and nights during the working period without removing water from the air tank.- depending on the production capacity of the active year, the aeration tank is transferred from the work flow to the oil flow.

The aeration period is gradually reduced to the calculated amount. The active year is collected, and in this case adaptation to the composition of wastewater is achieved. At this time, the sewage pipes to CU-200 will be opened. - according to the meeting of the activated sludges in the search engines, an erlift will be put into operation to drive the activated sludges in the aerotank.- after sufficient actives are collected in the air tank, an airlift is added to drive the actives to the actives collection unit. -in order to switch from non-flowing oil to full working oil, the purified water is opened into the water tank and its filling is started. -depending on the filling of the activated sludge collection compartment, air is supplied to the perforated pipes and its operation is regulated.

Putting the device into operation after cleaning and repair

Starting from cleaning and repairing the device is carried out in the sequence mentioned above. In this case, activated sludges are used in mud fields.

Resuming work after a short period of suspension

The cover of the inlet pipe to the domestic wastewater receiving trench is opened. After the aeratank is filled with wastewater to the standard working level, the water level in the clarifiers is monitored until it overflows into the collection ditches. Then, the start-up and stoppage of the erlift is carried out according to the manual. The drain valve in the mixing tank is opened to disinfect the treated wastewater. An airlift will be put into operation for dumping active sludge into the aerotank and the active sludge collection pool. The holes in the aeration part and mixing vessel of CU-200 regulate the amount of air in the pipe.

Unloading and stopping the biological treatment of domestic wastewater

Discharge and shutdown of the biological wastewater treatment plant is carried out only on the instructions of the engineer on duty. Stopping is done in the following sequence:- sewage is stopped by closing the inlet pipe to the intake trench; -as soon as the overflow of water into the collection ditches stops, the drain pipes in the CU-200 are opened and emptied. - waste water collected in the clarifier is pumped to the air tank with the help of an airlift.

The remaining wastewater is sucked up with the help of the unit.- the accumulated turbidity is washed with clean water and driven into the aerotank with the help of an airlift. The air supply to the airlift is stopped.- after emptying the air tank, air supply to the perforated pipes is stopped.- the aerotank is washed with clean water.- muddy water falls into the pond.- the wastewater from the contact pond is pumped to the UAP (overwater weed).- notifies the engineer on duty that the device is stopped and released and records this in the time log.

Stop the device for a short time

The pipe for receiving domestic wastewater is closed. The aerotank part of CU-200 and the part given to the mixing vessel will be reduced by 50%. As much as possible is removed from the dryer with the help of an airlift. The air supply pipe to the airlift is closed. The supply of chlorine will be stopped in the contact pool. The outlet pipe of treated wastewater from CU-200 is closed.

Results and Discussion

In the course of the research, it was noted that the chemical composition of the purified domestic wastewater coming out of "Shurtan Oil and Gas Production Department " facility, selected as an object, has a seasonal variable character, Table-1. In order to describe the exact level of the problem, researches were carried out during nine months of monitoring the necessary chemical composition and physico-biochemical indicators of treated domestic and industrial water coming out of the treatment facility during the active work of the enterprise.

When we analyzed the obtained results (Table 1), it was noted that the content of wastewater taken from the wastewater lifting pipe of the enterprise facility is somewhat higher than the indicators specified in the normative documents. In particular, it was found that the odor and color indicators of wastewater are 2.5 times higher than the norm, as well as the odor of the wastewater taken from the facility and entering the aeration tank is 2.3-2.5 times higher than the norm, and it was noted that this situation is not of a seasonal nature. However, the odor level of the wastewater coming out of the aeration tank of the facility and the treatment facility of the enterprise has become somewhat normalized, and in the first decade (ten days) of 2022 it was 1.5-1.0 times higher than the norm, while in the second and third decade (ten days) of observation it was 2.3 and 1.5 it was found to be very high. In these studies, we can consider the indicators of smell in the second and third decades (ten days) of observation as having a seasonal character. Because in these seasons, the average temperature of the day is 22-25 °, and the temperature in the aeration tank is relatively normalized, and the increase in the decomposition of organic substances in the cleaning facilities and the acceleration of the fermentation process may have influenced this situation and caused the odor index to be higher than the standard indicators.

Also, during the researches, it was noted that the change in color index has a relatively stable character in all decades (ten days), but it was found that the color index of the wastewater coming out of the factory is 0.8-1.5 times higher than the norm. Therefore, this indicator cannot be marked as a seasonal indicator. During the researches, it was noted that the change of the pH environment in the wastewater coming out of the enterprise facility stabilized during the entry and exit of each stage and that this indicator corresponds to the normative indicators (Table).

The amount of dissolved oxygen is also important in the treatment of waste water from the enterprise. During the conducted observations, it was observed that the dynamics of change of the amount of dissolved oxygen is not stable, but rather variable. In the first decade (ten days) of the study, it was found that the amount of dissolved oxygen in the waste water taken from the sewage pipe of the facility was 40.23 mgO_2/l, almost 1.5 times higher than the norm, but in the second and third decades (ten days) of observation, it was 2.5-4.0 times higher. During the observations, it was found that the amount of dissolved oxygen has a seasonal nature. In particular, in the first decade (ten days) of observation, the amount of dissolved oxygen in the wastewater treated in the series of constructions was 40.23, 52.41, 68.23, 52.44 mgO_2/l, respectively, while the amount of dissolved oxygen in the wastewater coming out of the aerotank compared to the first decade (ten days), in the second decade(ten days) it was found to be higher in the amount of 2.0-10.77 40.23 mgO_2/l.

This may be due to the increased amount of dissolved oxygen in the process of microbiological processes and photosynthesis of high algae in the air tank due to this lack of cleaning. This can cause the active development of microbiological association in this wastewater, accordingly, the faster decomposition of organic matter and the active development of higher algae. Pathogenic bacteria or microbes that actively develop in an oxygen-free environment can actively develop in agar with a decrease in the amount of dissolved oxygen in the wastewater, causing odors in the wastewater and changes in the color of the water. When the demand for biochemical oxygen in the wastewater leaving the enterprise was studied (CO_2, mgO_2/l (BOD_5), this indicator was also higher than the norm (Table).

In particular, it was found that the results obtained from the first decade (ten days) of observation to the end of the third decade (ten days) were 1.8-2.0 times higher than the normative indicators. As we know from scientific sources, biochemical oxygen demand in water (BOD_5) plays a very important role in ensuring the decomposition of light organic substances (alcohols, phenolic substances, sugar, formaldehydes, etc.). As the decomposition of organic substances in wastewater accelerates, the demand for dissolved oxygen in it increases. This directly affects biochemical processes in water.

Therefore, during the researches, it was noted that the amount of BOD5 in wastewater has a seasonal nature. When analyzing the data reflected in the dynamics of the main indicators of seasonal domestic wastewater (2022) shown in table, in the first decade of the study, the content of wastewater taken from the wastewater lifting pipe of the facility was 2.6 times (6.32 mg/l) compared to the standard indicator. It was noted that there are many phosphates, and the composition of the wastewater taken from the inlet to the aeration tank is slightly suspended, but it is 2.1 times higher (5.33 mg/l) than the standard indicator.

Also, the amount of phosphates in the waste water taken from the aeration tank has decreased to 1.7 mg/l (4.26 mg/l), and the amount of phosphates in the waste water leaving the plant has decreased to 3.38 mg/l, but compared to the norm, it is 1.35 mg/l. It was noted that it is very high. In the second decade of observation, the average amount of phosphates in the waste water taken from the sewage pipe of the facility was 7.20 mg/l, which is 2.88 times higher than the norm, and compared to the waste water taken from the same pipe in the first decade, it was 0.72 mg/l. more phosphates were found.

It was found that the amount of phosphates in the waste water taken from the entrance to the aeration tank of the second decade was 6.82 mg/l, which is 2.72 times more than the standard, and 1.49 mg/l more than the phosphates in the waste water taken from the same part of the first decade.

It was noted that the amount of phosphates in the waste water taken from the aeration tank in the second decade is 2.56 times more than the standard indicator, and compared to the amount of phosphate in the waste water taken from the same part in the first decade, it was noted that it contains 2.15 mg/l more phosphates.

In the second decade, the amount of phosphates in the purified wastewater leaving the enterprise was 5.38 mg/l, which is 2.15 times more than the standard indicators, and 2.mg/l more phosphates than in the wastewater taken from the same part of the first decade. In the third decade of observation, variable phosphate levels were noted.

In particular, in the third decade, the amount of phosphates in the waste water taken from the waste water lifting pipe of the facility amounted to 6.86 mg/l, which is 2.74 times more than the norm.

It was noted that this indicator contained 0.38 mg/l more phosphates compared to the first deka, and 0.37 mg/l less than the second deka. Also, the amount of phosphates in the waste water taken from the entrance to the aeration tank in the third decade is 6.12 mg/l, which is 2.44 times more than the standard indicator, phosphates are 0.79 mg/l more than the waste water taken from the same place in the first decade. compared to the waste water taken from the same part of the second decade, it was noted that phosphates were less than 0.68 mg/l. In the third decade of control, the amount of phosphates in the waste water leaving the aeration tank was 5.48 mg/l, which is 2.2 times more than the standard indicator, compared to the amount of phosphates in the waste water taken from the same part in the first decade, it was 1.22 mg/l more phosphates., compared to the content of wastewater taken from the same part in the second decade, it was found to be 0.93 mg/l less. The amount of phosphates in domestic waste water coming out of the factory in the third decade is 4.17 mg/l, which is 1.66 times more than the standard, 0.79 mg/l less than phosphates in wastewater from the same part in the first decade, and less than in the second decade. on the other hand, more phosphates were recorded in the amount of 1.21 mg/l.

The amount of phosphates in the waste water coming out of the enterprise was conditionally studied in three dekas, it was observed that the general pollution index has seasonal changes and does not show a specific index. Therefore, a database was formed based on the amount of phosphates in domestic waste water coming out of the enterprise, weekly data on the basis of technological regulations, weekly data in the section of months and monthly data in the section of decades (three months). The obtained results are shown in Figure 1. When the average values of the obtained data in three decades(ten days) are calculated based on logarithmic calculations, the amount of phosphates in the waste water taken from the wastewater lifting pipe of the facility is on average 6.86 mg/l, the waste water taken from the entrance to the aeration tank is on average 6.09 mg/l, the waste water from the outlet of the aero tank is on average 5.38 mg/l, purified wastewater from the facility was found to be contaminated with phosphates in the amount of 4.31 mg/l. Therefore, it was determined that the average phosphate pollution index in the three decades was 5.66 mg/l. Comparing this indicator with the normative indicators, it was found that the wastewater coming out of the enterprise is polluted 2.26 times more than the standard. So, according to the obtained results, it was noted that is appropriate whith additional control of the amount of phosphates.

Also, during the researches, it was aimed to determine the amount of chlorides coming out of the enterprise's facilities in the section of annual decades (Table). According to the obtained results, in the first decade of observation, it was noted that in the samples taken from the sewage pipe of the facility, chlorides were found in the amount of 672.54 mg/l, which is 1.92 times more than the standard indicators. Also, the amount of chlorides in the waste water taken from the inlet to the aeration tank is 618.28 mg/l, which is 1.76 times more than the norm, and the amount of chlorides in the sample taken from the outlet of the aeration tank is 539.24 mg/l, which is 1.76 times more than the norm. 54 times more was noted. In addition, it was found that the amount of chlorides in the waste water coming out of the factory amounted to 472.38 mg/l, which is 1.34 times more than the standard indicator. During the second decade of observations, when analyzing the composition of wastewater coming out of the company's facilities, the amount of chlorides in the samples taken from the wastewater lifting pipe was 832.11 mg/l, which is 2.37 times more than the standard indicator.In the samples taken from the entrance to the aeration tank, the amount of chloride was 753.11 mg/l, and in the waste water leaving the aeration tank, it was 648.28 mg/l, which was 2.15 mg-l and 1.85 mg/l more than the normative indicators. Also, it was found that the amount of chlorides in the waste water coming out of the factory was 557.11 mg/l, which is 1.60 times more than the standard indicator. When we compared the data obtained in the second decade with the data in the first decade, in the first decade, the amount of chlorides was higher than in the samples taken from the sewage pipeline, and in the second decade, the amount of chlorides was 159.57 mg/l in the water samples taken from the same pipeline. Also, it was found that in the water samples taken from the part entering the aerotank, there were more chlorides in the amount of 134.83 mg/l in the second decade compared to the first decade, and in the amount of 109.04 mg/l in the second decade compared to the first decade in the samples from the exit part of the aerotank. In addition, it was noted that in the second decade, the amount of chlorides in the waste water released from the factory was 84.73 mg/l more than the chlorides in the wastewater released from the factory in the first decade. Therefore, the indicators of occurrence of chlorides in the treated wastewater can also have a seasonal character. Therefore, these indicators were monitored in the third decade and compared with the data in the second and first decades (Table).

In the third decade of monitoring, the amount of chlorides in the samples taken from the sewage pipe of the facility was 832.14 mg/l, which is 2.37 times more than the standard indicator, 159.6 mg/l more than the chlorides in the samples taken from the same facility in the first decade, and 159.6 mg/l more than in the second decade. It was noted that it does not differ. The samples at the entrance to the air tank in the third decade contained 754.52 mg/l of chlorides, which is 2.15 times more than the standard value, 136.24 mg/l more than in the same object in the first decade, and only 1.41 mg/l compared to the second decade. An abundance of l was noted. Also, the amount of chlorides in the samples taken from the exit part of the air tank in the third decade was 635.21 mg/l, which is 1.8 times more than the standard indicator, 95.97 mg/l more than in the samples taken from the same facility in the first decade, and 95.97 mg/l more than in the second decade. It was observed that chlorides were low in the amount of 13.07 mg/l.

Also, in the third decade, the amount of chlorides in the waste water coming out of the factory was 551.26 mg/l, which is 1.57 times more than the standard indicator. In addition, it was found that the amount of chlorides in the waste water coming out of the factory in the third decade is 78.88 mg/l more than in the first decade, and 5.85 mg/l less than in the second decade.

During the comparative analysis of the obtained results, it was noted that the amount of chlorides in the waste water coming out of the enterprise has a seasonal character and does not have a specific indicator. Therefore, weekly data on the amount of chlorides in the waste water leaving the enterprise, monthly data on the basis of weekly data, monthly data on the basis of decades (three months), and their average indicators were determined (Fig. 2). After a comparative analysis of the obtained results and the average indicators for three decades were calculated based on logarithmic calculations, the amount of chlorides in the waste water taken from the waste water lifting pipe of the facility was 778.93 mg/l on average, the waste water taken from the entrance to the aero tank was 708.64 mg/l on average, the exit from the aero tank was 708.64 mg/l it was found that the waste water in the part is contaminated with chlorides in the amount of 607.58 mg/l on average, and the treated waste water coming out of the facility is 511.82 mg/l. Therefore, it was determined that the average chloride pollution index in the three decades was 651.74 mg/l. Comparing this indicator with the normative indicators, it was found that the wastewater coming out of the enterprise is polluted 1.86 times more than the standard. Therefore, it was concluded that it is necessary to additionally control the amount of chlorides in the waste water coming out of the enterprise and to implement measures to ensure further purification of this pollution.

During the studies, the amount of sulfates, which is one of the main pollutants of domestic wastewater, was also monitored (Table 1). According to the obtained results, it was noted that the amount of sulfates in domestic waste water is higher than the standard indicators. In particular, in the first decade of observation, it was noted that the amount of sulfates in the samples taken from the sewage pipe of the facility amounted to 835.11 mg/ml, which is 2.38 times higher than the standard indicator. In the samples taken from the entrance to the aerotank, the amount of sulfates was 742.08 mg/l, which is 2.12 times higher than the standard indicator. In addition, it was observed that the amount of sulfates in the samples taken from the inlet and outlet parts of the aeration tank in the first decade was 668.24 mg/l and 486.23 mg/l, and it was 1.90 and 1.38 times higher than the standard index, respectively. The amount of sulfates in the second and third decades was comparatively studied in order to determine whether the amount of sulfates has a seasonal character or if it appears in a constant amount. According to the obtained results, it was found that the samples taken from the sewage pipe in the second decade were 792.36 mg/l, which is 2.26 times more than the standard indicator, and it was 42.75 mg/l less than in the first decade.

Table.1 Dynamics of the main indicators of seasonal domestic wastewater of the research object in 2022

No.	Specifiedindicators	Standardquantity, mg/l	January-February-March				April-May-June				July-August-September			
			Waste water taken from the facility's waste water lifting pipe.	Waste water taken from the entrance to the aerotank of the facility	Waste water taken from the aerotank exit of the facility	Waste water coming out of the facility	Waste water taken from the waste water lifting pipe of the facility	Waste water taken from the entrance to the aerotank of the facility	Waste water taken from the aerotank exit of the facility	Waste water coming out of the facility	Waste water taken from the waste water lifting pipe of the facility	Waste water taken from the entrance to the aerotank of the facility	Waste water taken from the aerotank exit of the facility	Waste water coming out of the facility
1	Odor	2,0	5,0	4,4	3,5	3,0	5,0	5,0	4,8	3,5	5,0	5,0	4,8	3,5
2	Color	2,0	3,6	3,2	2,6	2,1	3,6	3,2	3,0	3,0	3,6	3,2	3,0	3,0
3	pH	6,0-8,0	8,9	8,6	8,0	7,5	9,0	8,6	7,8	7,0	9,0	8,6	7,8	7,0
4	Dissolved oxygen, mgO_2/l	15,0	40,23	52,41	68,23	52,44	32,81	45,28	62,44	53,22	42,68	48,23	70,23	63,21
5	BOD5, mgO_2/l (BOD5)	3,0	6,32	6,24	6,00	5,80	7,20	6,80	6,20	5,40	7,20	6,80	6,00	5,20
6	Phosphates, mg/l	2,5	6,48	5,33	4,26	3,38	7,23	6,82	6,41	5,38	6,86	6,12	5,48	4,17
7	Chlorides, mg/l	350,5	672,54	618,28	539,24	472,38	832,11	753,11	648,28	557,11	832,14	754,52	635,21	551,26
8	Sulfates, mg/l.	350,0	835,11	742,08	668,24	486,23	792,36	683,45	571,32	503,28	786,54	703,63	627,34	572,42
9	Nitrates, mg/l.	45,0	648,16	605,38	543,44	468,36	652,36	598,15	507,34	468,26	848,36	763,45	702,11	658,23
10	Nitrites, mg/l.	3,3	23,61	19,44	17,36	12,21	18,24	14,36	12,48	10,21	21,36	18,24	16,33	12,27
11	Iron	0,05	0,68	0,53	0,42	0,38	0,53	0,36	0,24	0,15	0,43	0,38	0,26	0,22

ЭКФ$_{0,5}$-0,05

Figure.1 Average indicators of annual phosphate pollution of domestic wastewater

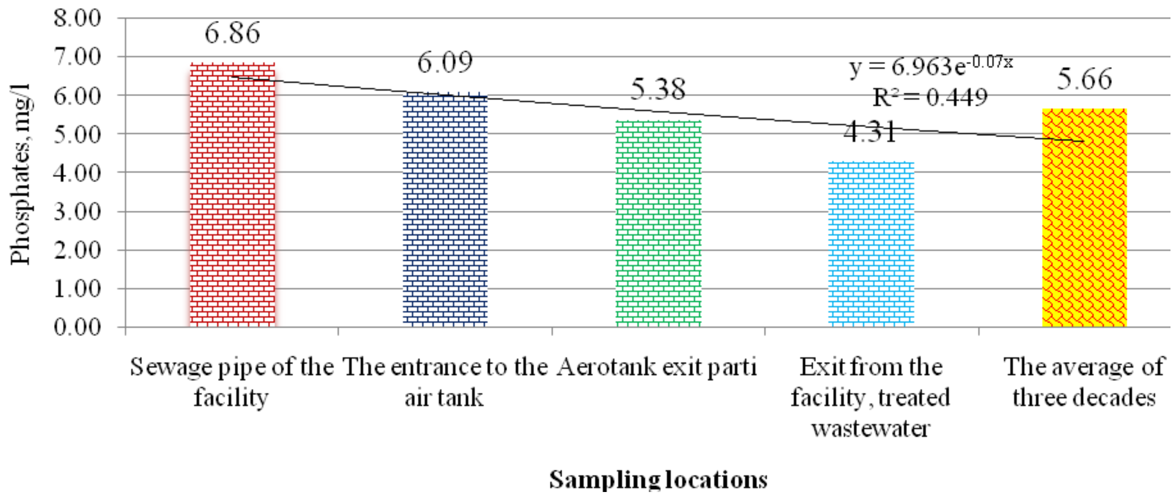


Figure.2 Average indicators of annual chloride contamination of domestic wastewater

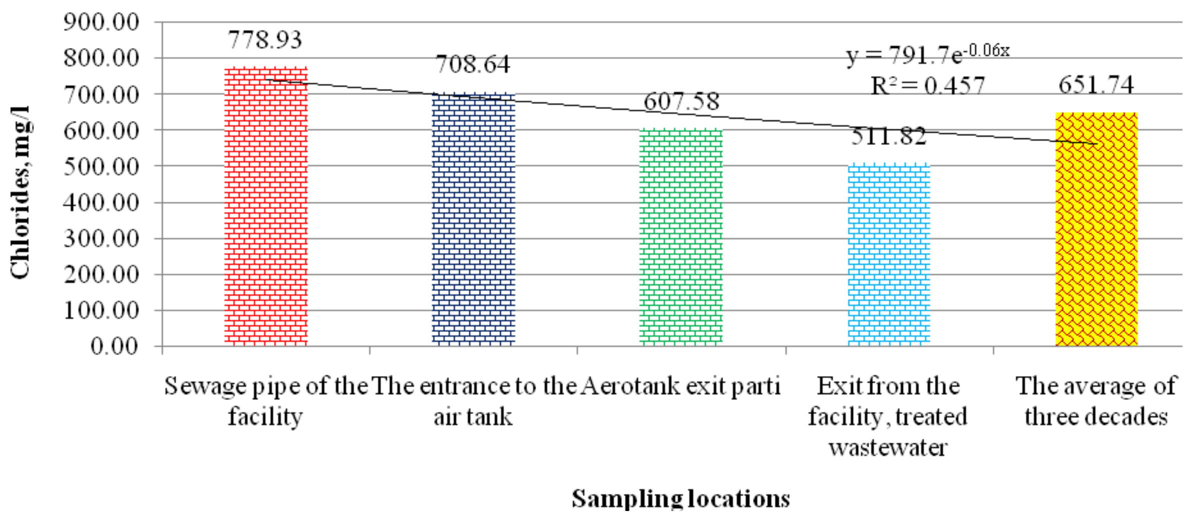


Figure.3 Average indicators of annual sulfate pollution of domestic wastewater

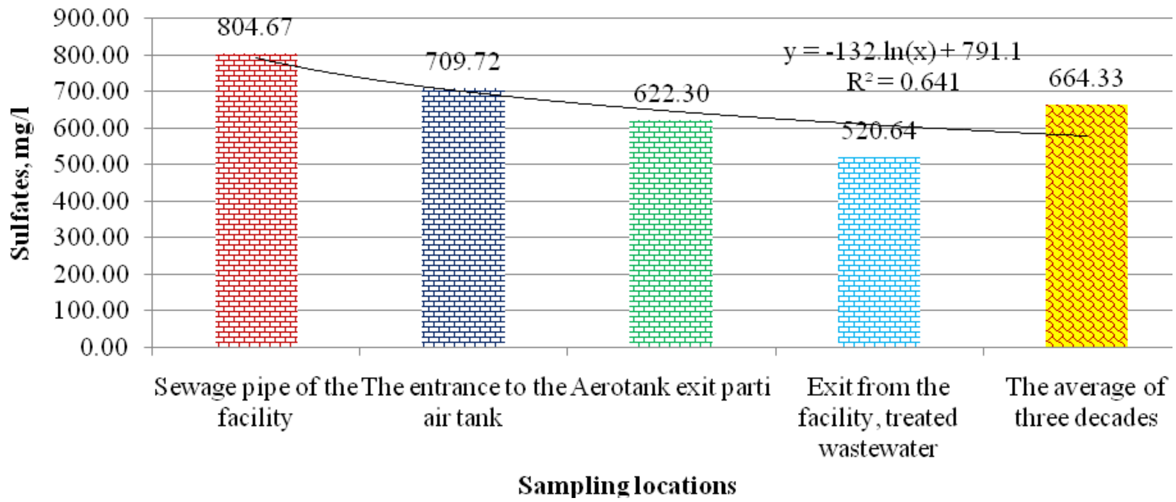


Figure.4 Average annual nitrate pollution levels in domestic wastewater

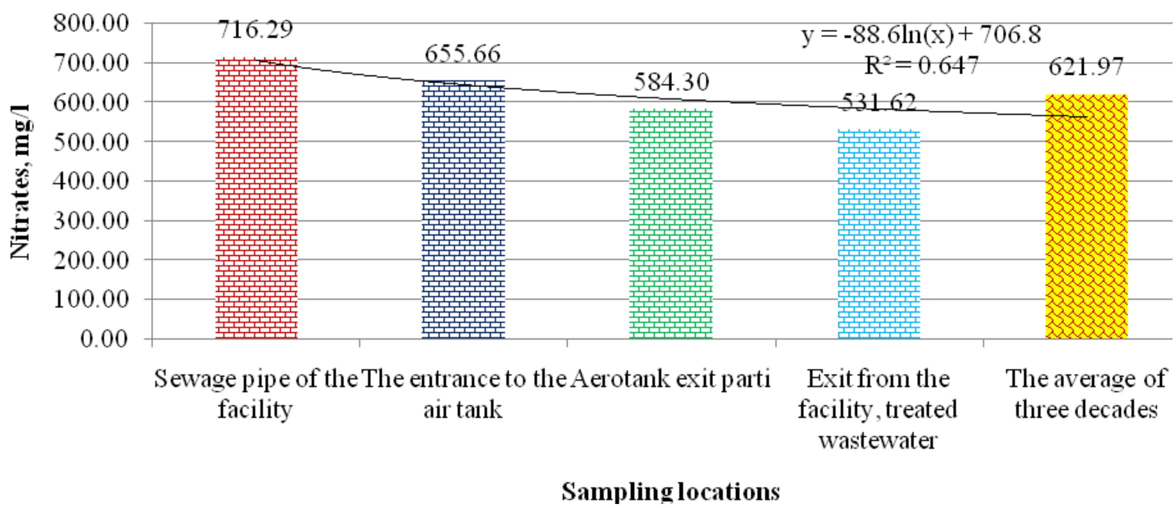
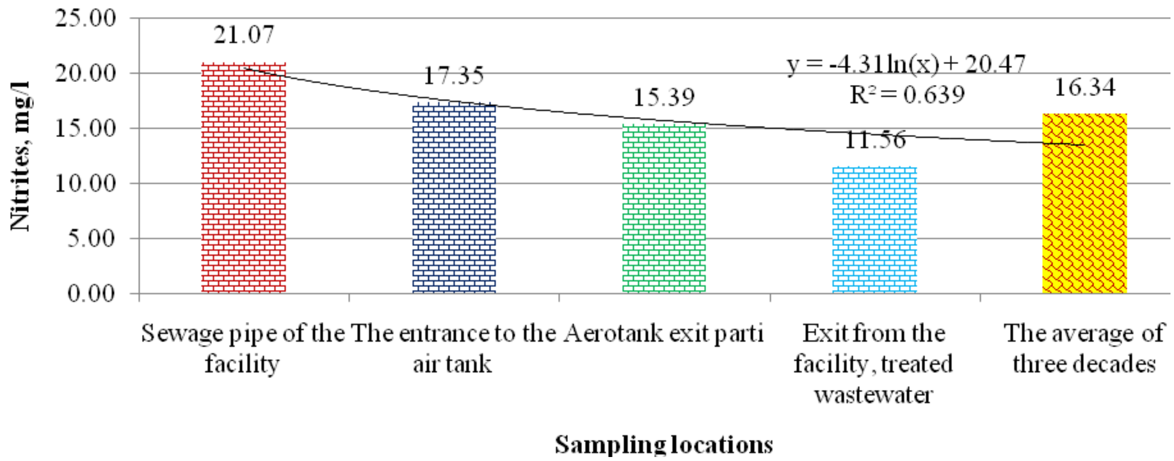


Figure.5 Average annual nitrite pollution levels in domestic wastewater



In addition, the presence of sulfates in the amount of 683.45 mg/l and 571.32 mg/l was observed in the waste water samples taken from the inlet and outlet parts of the aeration tank, and these indicators were 1.95 and 1.63 times higher than the standard indicator. Also, during the second decade of observations, it was noted that the amount of sulfates in the amount of 503.28 mg/l of domestic waste water coming out of the factory is 1.43 times higher than the standard indicator. Also, this indicator in the second decade was found to be 17.05 mg/l higher than the indicator in the first decade. So, taking into account that the amount of sulfates in the household wastewater coming out of the enterprise may have a seasonal nature, it was compared with the data of the third decade. According to the obtained results, the amount of sulfates in the samples taken from the waste water lifting pipe of the facility was 786.54 mg/l, which is 2.24 times higher than the standard indicator, 48.57 mg/l compared to the sample taken from the same part of the first decade, and 5 mg/l compared to the second decade. It was found to be less than 82 mg/l.

In the third decade of monitoring, it was found that the amount of sulfates in the samples taken from the inlet and outlet of the aerotank was 703.63 mg/l and 627.34 mg/l, respectively, 2.0 and 1.8 times higher than the standard value. It was also observed that the results of the wastewater samples obtained from the inlet and outlet parts of the aerotank in the third decade differ from the results obtained from the same parts in the first decade. In particular, it was observed that the amount of sulfates entering the aeration tank in the third decade was 38.45 mg/l less than the amount of sulfates in the first decade, and it was 40.9 mg/l less during the exit from the aeration tank. Therefore, it was concluded that the amount of sulfates in domestic wastewater may also have seasonal changes. In order to confirm this conclusion, in the third decade, when the amount of sulfates in domestic waste water discharged from the enterprise was determined, this indicator was 572.42 mg/l, which is 1.63 times higher than the standard indicator (Table). Also, it was found that the amount of sulfates in domestic waste water coming out of the factory in the third decade is 86.19 mg/l and 69.14 mg/l, respectively, compared to the amount of sulfates in the wastewater coming out of the company in the first decade and the second decade. The results obtained in this way show that the amount of sulfates contained in the wastewater being purified from the enterprise is much higher than the norm, so it is necessary to prevent their release into the environment and to take measures to process them.

During the comparative analysis of the obtained results, it was noted that the amount of sulfates in the waste water coming out of the enterprise has a seasonal character and does not have a specific indicator. Therefore, weekly data on the amount of sulfates in the wastewater leaving the enterprise, monthly data on the basis of weekly data, monthly data on the basis of decades (three months), and their average indicators were determined (Fig. 3).

After a comparative analysis of the obtained results and the average values for three decades were calculated based on logarithmic calculations, the average amount of sulfates in the wastewater from the sewage lifting pipe of the facility was 804.67 mg/l, the wastewater from the entrance to the aerotank was 709.72 mg/l on average, the exit from the aerotank it was noted that the waste water in the part was polluted with sulfates in the amount of 622.30 mg/l on average, and the purified waste water coming out of the facility was 520.64 mg/l. Therefore, it was determined that the average sulfate pollution index in the three decades was 664.33 mg/l. When comparing this indicator with the normative indicators, it was found that the wastewater coming out of the enterprise is polluted 1.9 times more than the established norm. Therefore, it was concluded that it is necessary to additionally control the amount of sulfates in the waste water coming out of the enterprise and to create opportunities for further purification of this pollution.

In recent studies, the amount of nitrates and nitrites in domestic waste water coming out of the enterprise was studied. According to the obtained results, it was found that the amount of nitrates in the samples taken from the sewage pipe of the facility in the first decade was 648.16 mg/l, and the amount of nitrites was 23.61 mg/l (Table).

Also, it was noted that the amount of nitrates is 14.4 times higher than the standard indicators, and the amount of nitrites is 7.15 times higher. In the samples taken from the inlet and outlet parts of the aerotank, it was found that the amount of nitrates was 605.38 mg/l and 543.44 mg/l, and the amount of nitrites was 19.44 mg/l and 17.36 mg/l, respectively. It was noted that the amount of nitrates and nitrites in domestic waste water coming out of the facility was 468.36 mg/l and 12.21 mg/l, respectively. Nitrates and nitrites were found to be 10.4 and 3.7 times higher than the standard values. In the second decade of observation, it was noted that the amount of nitrates was 652.36 mg/l, and the amount of nitrites was 18.24 mg/l in the samples taken from the waste water lifting pipe of the facility. It was found that the amount of nitrates is 14.5 times higher than the standard value, and the amount of nitrites is 5.5 times higher.

When comparing the same indicators in the second decade with those in the first decade, it was noted that the amount of nitrates was 4.2 mg/l more, and the amount of nitrites was 5.37 mg/l less. It was found that the amount of nitrates was 598.15 mg/l and 507.34 mg/l, and the amount of nitrites was 14.36 mg/l and 12.48 mg/l in the wastewater samples taken from the inlet and outlet of the aeration tank. It was observed that the amount of nitrates is 13.3 and 11.2 times higher than the standard indicator in the corresponding area. When comparing the amount of nitrates in the wastewater samples taken from the inlet and outlet of the aeration tank in the second decade to the amount of nitrates in the first decade, it was found to be 7.23 mg/l less and 36.1 mg/l less. It was observed that the amount of nitrites was 12.48 mg/l and 10.21 mg/l in the samples taken from the inlet and outlet parts of the air tank. It was found that these indicators are 3.8 and 3.0 times higher than the standard indicators, respectively.

During the comparative study of the results obtained in the third decade of the research, when the waste water samples taken from the waste water lifting pipe of the facility were studied, the amount of nitrates was 848.36 mg/l, which is 8.8 times the nominal indicator, and the amount of nitrites was 21.36 mg/l and it was noted that it is 6.47 times higher. When comparing these indicators in the first decade, it was noted that the amount of nitrates in the third decade is 200.2 mg/l. Compared to the second decade, it was found to be 243.0 mg/l more. It was observed that the amount of nitrates was 2.25 mg/l less compared to the first decade and 3.12 mg/l more than the second decade. Also, in the third decade, it was noted that the amount of nitrates in the wastewater samples taken from the entrance to the aerotank of the facility was 763.48 mg/l, and the amount of nitrites was 18.24 mg/l. It was found that the amount of nitrates was 702.11 mg/l, and the amount of nitrites was 16.33 mg/l. When comparing these indicators with the situation in the first decade, it was observed that the amount of nitrates in the third decade was higher by 158.7 mg/l, and the amount of nitrites by 4.12 mg/l. When the same indicators are compared with the situation in the second decade, it was found that nitrates were 194.7 mg/l, and nitrites were higher up to 3.85 mg/l.

In the third decade, it was noted that the amount of nitrates was 658.23 mg/l, and the amount of nitrites was 12.27 mg/l. When comparing the data obtained in the third decade to the data in the first decade, it was observed that the amount of nitrates was 189.87 mg/l, and the amount of nitrites was insignificantly different (0.06 mg/l). When comparing the results of the third decade with the results of the second decade, it was found that the amount of nitrates was 190.0 mg/l, and the amount of nitrites was 2.06 mg/l. When the obtained results were compared, it was noted that the amount of nitrates and nitrites in the waste water coming out of the enterprise has a seasonal character and does not have a specific indicator. Therefore, weekly data on the amount of nitrates and nitrites in the waste water coming out of the enterprise, monthly data on the basis of weekly data, monthly data on the basis of decades (three months), and their average indicators were determined (Fig. 4-5). After a comparative analysis of the obtained results and the average values for three decades were calculated based on logarithmic calculations, the amount of nitrates in the waste water taken from the waste water lifting pipe of the facility was on average 716.29 mg/l, the waste water taken from the entrance to the aero tank was 655.66 mg/l on average, the exit from the aero tank it was noted that wastewater from the construction site was contaminated with nitrates at an average of 584.30 mg/l, and treated wastewater from the facility at 531.62 mg/l. Therefore, it was determined that the average nitrate pollution index in the three decades was 621.97 mg/l (Fig. 4). Comparing this indicator with the normative indicators, it was found that the wastewater coming out of the enterprise (531.62 mg/l) is polluted 11.8 times more than the established norm.

After a comparative analysis of the results obtained for the determination of nitrites, and when the average values for three decades were calculated based on logarithmic calculations, the amount of nitrites in the waste water from the waste water lifting pipe of the facility was 21.07 mg/l on average, and the amount of nitrites from the entrance to the aerotank was 17.35 mg/l on average., it was found that the effluent from the aerotank is contaminated with nitrites at an average of 15.39 mg/l, and the treated effluent from the facility at 11.56 mg/l. Therefore, it was determined that the average nitrite pollution index in the three decades was 16.36 mg/l (Fig. 5). Comparing this indicator with the normative indicators, it was found that the wastewater coming out of the enterprise (16.36 mg/l) is 5.0 times more polluted than the standard. Therefore, it was concluded that it is necessary to additionally control the amount of nitrates and nitrites in the waste water coming out of the factory, and to find ways to further purify this pollution and to introduce it into operation as soon as possible.

It is known that the oil and gas industry is a potentially dangerous industrial facility all over the world. Therefore, one of the most important tasks is to identify objects and sources that threaten the environmental situation at oil and gas production enterprises and eliminate them. The share of waste from oil and gas production enterprises in nature, including volatile organic compounds, is up to 20%. In addition, contaminated wastewater from oil and gas production enterprises is a source of extremely dangerous environmental situations in nature. A number of scientific studies have been conducted to determine the sources of pollution of wastewater from oil and gas producing enterprises, including the composition of wastewater from oil and gas producing enterprises in Qatar. As a result of these studies, it was found that wastewater generated at various stages of processing contains many harmful components. Including polyaromatic hydrocarbons, phenol, heavy metals, ammonia and other hydrocarbons and hydrocarbons (PWW is enriched with zinc and iron, sixteen different hydrocarbon compounds have been identified, including acenaphthene, acenaphthylene, fluorene, anthracene, phenanthrene, benzo(a)anthracene and pyrene) and the amount of salts (salinity 38.2 ppt, from 38.9 ppt to 260 ppt) also exceeded the standard values (Eldos *et al.,* 2022).

In addition, studies have been conducted on soil pollution by wastewater from oil and gas production enterprises and it has been noted that these wastewaters contain hundreds of chemicals, many of which directly affect the environment and human health (John Pichtel, 2006). The present study have shown that chemicals contained in wastewater from oil and gas production facilities exceed established regulatory levels. It has also been noted that the amount of phosphates, sulfates and chlorides in domestic and industrial wastewater leaving the facility exceeds the required level. We believe that it is necessary to improve the technologies implemented in the processing of these wastewaters. It is advisable to implement the widespread use of highly algal and microbiological objects, the most effective in cleaning wastewaters, especially at oil and gas production enterprises.

Author Contributions

Musirmonov Jamoliddin J: Formal Analysis, Investigation, Data Curation, Writing –Original Draft, Writing – Review & Editing. Urinova Adolat A: Writing – Review & Editing. Abdullayev Xurshidbek O: Formal Analysis, Investigation, Resources. Gyanendra Tripathi: Conceptualization, Formal Analysis, Investigation. Alvina Farooqui: Writing – Review, Investigation & Editing. Nortoji A. Khujamshukurov: Conceptualization, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Project Administration, Funding Acquisition, Supervision.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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