Construction of water objects for comprehensive filtration gabion treatment

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Abstract. The processes of oil production and its further transportation are accompanied by the discharge of large amounts of waste contaminated water into reservoirs, which pollutes the environment, increases the acidity of water resources, kills the ecosystem of reservoirs, and the process of waterlogging occurs. The purpose of the study is to study methods for purifying water bodies from pollution using gabion filtration purification of water bodies. The authors hypothesize that gabion treatment filtration structures can be used to successfully clean water bodies of contaminants and impurities. The research methods were the study of scientific literature and scientific research in the field of sanitary treatment of the aquatic natural environment, based on the experience learned, the creation of an experimental model of gabion structures. Based on the results of tests of gabion structures in the Khanty-Mansiysk Autonomous Okrug of Yugra, it was experimentally proven that wastewater is effectively purified from impurities of artificial and natural origin through gabion treatment filtration structures. Key words and phrases: gabions, gabion treatment filtration facilities, bioplateau, wastewater, water resources.

1 Introduction

Currently, up to 20 tons of raw materials are produced per inhabitant of the Earth per year, of which less than 10% go to the final product and the remaining 90% are solid, liquid and gaseous wastes.

Russia is the world's leading producer of minerals with a gross value added of more than 3 trillion rubles. Currently, more than 200,000 mineral deposits are being developed, which involves the formation of high-contrast lithic and hydrochemical halos and pollution streams in the mining areas. Pollution of natural water bodies and streams by untreated and insufficiently treated wastewater is a significant factor in the deterioration of the natural environment caused by mining.

According to the Federal Agency for Water Resources of the Russian Federation, up to 52 km^3 of wastewater is discharged into Russian water bodies every year, of which 19 km^3 are discharged without treatment. At the same time, enterprises of the mineral and raw material complex contribute 25% of the total volume of discharged wastewater without treatment.

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Oil extraction processes are accompanied by high water consumption. Much of this water is contaminated by various harmful substances as a result of technological processes. This leads to the ecological imbalance of the environment. Therefore, the problem of sewage pollution is very urgent in the Khanty-Mansiysk Autonomous Okrug - Ugra, which is a region specializing in hydrocarbon extraction. The oil and gas industry is environmentally unfriendly. To improve environmental monitoring, unmanned aerial vehicles [1-5] are used, which find oil leaks in the area under flight. Oil is extracted by a system of reservoir pressure maintenance, thereby pumping huge volumes of water into the reservoir. As a result, water bodies, land and even the atmosphere are polluted. Water consumption is increasing every year, especially for industrial purposes. About 90 percent goes back into the reservoir pressure system. Approximately 10% is discharged into water bodies requiring further sanitation. There are a variety of methods for cleaning impurities: slurry treatment, treatment in hydrocyclones, filtration, coagulation, lightening, iron removal, desalination of water and others. All these methods require special equipment, chemical reagents and constant maintenance costs.

The simplest and cheapest facilities for biochemical treatment of surface wastewater under natural conditions are bioengineering facilities:

- biological ponds;
- bioplateau;
- hydrobotanical sites;
- phytoplastic channels;
- scattering releases;
- treatment plants with a flow along a slope sown with perennial herbs.

2 Bioplateau

Or biological ponds are designed for biological treatment and wastewater treatment in combination with other treatment plants. They are made in the form of a cascade of ponds consisting of 3-5 steps. The wastewater treatment process is implemented in the following way: bacteria use the oxygen released by algae during photosynthesis and oxygen from air to oxidize the pollutants. Algae, in turn, consume carbon monoxide, phosphates and ammonium nitrogen from biochemical decomposition of organic substances. Therefore, for the normal operation of the ponds it is necessary to observe the optimal pH value and the temperature of sewage water, the temperature must be at least 6 oC, so in winter the ponds are not used.

There are natural and artificial aeration ponds. Pond depth with natural surface aeration, As a rule, not more than 1 m. Artificial aeration of ponds with mechanical aerators or air blowing through the water column increases their depth to 3 m. The use of artificial aeration accelerates the water purification processes. The disadvantages of ponds should also be pointed out: low oxidative capacity, seasonality of work, the need for large areas.

Microbes are the backbone of an aerobic wastewater treatment system and require oxygen to operate efficiently.

Biological wastewater treatment is an economical alternative to chemical and mechanical wastewater treatment. It uses bacteria and other organisms to decompose organic waste in wastewater. Micro-organisms feed on organic material to produce the nutrients they need to sustain themselves, either in the presence of oxygen (aerobic) or without it (anaerobic).

Aerobic wastewater treatment is a natural process in which bacteria and other microbes feed on organic matter in an oxygen-rich environment, decomposing it in the process. Used in the process of producing active silt for treatment of municipal or industrial wastewater.

At this stage of oxidation, the organic components are broken down into carbon dioxide, water, nitrates and sulphates, and the microorganisms multiply, creating a growing colony.

When wastewater contains large amounts of organic matter, more bacteria are needed to break it down. Because aerobic bacteria require oxygen to perform this task, the biochemical oxygen requirement (BOD) will be higher. It is therefore essential that there is sufficient dissolved oxygen in the water to maintain a healthy population of micro-organisms. Aerobic cleavage can be accelerated by adding oxygen to wastewater during treatment using various aeration technologies.

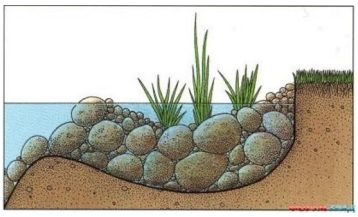

Fig. 1. Gabions.

The authors propose to improve the environmental situation in the region to use one of the methods of sanitary cleaning with gabion filtration facilities (Figure 1).

Gabions have a number of advantages [1,2]. The design of the individual units and the general structure are rigid, not subject to twisting, the body is flexible, it is not subject to bending deformations. In unstable soil, gabion filtration plants retain their original shape.

Gabion filtration plants are made of a mesh filled with high-strength stone with a bundle [6]. All three components create a high-strength and monolithic structure, have high strength and durability. The strength is calculated on forces caused by water and ground masses. It is mandatory for gabion filtration plants to perform strength calculations according to the initial conditions of the structure location. They test the strength of the net for impact, tear and stretch. Particular attention is paid to the calculation of corrosion propagation on the outer surface of the net, as the construction is operated in water.

The task of gabions is to clean water from impurities of different nature. Purification of liquid occurs due to evaporation, chemical reactions. The process of purification will go faster when fluid flow is activated and the liquid is saturated with oxygen. The porous structure of the design also promotes better air circulation.

Gabions have high reliability and low production and installation costs. This is due to their simple design, the production requires affordable and inexpensive materials, the ability to install workers with low qualifications, no maintenance and maintenance costs during operation.

Gabion filtration plants do not lose color, shape and design during operation. Gradually overgrown vegetation becomes very attractive.

3 Materials and methods

On the basis of the conducted theoretical study, a bioplateau was designed using gabion filtration plants. Then a model of the designed structure was created. Studies were conducted on the possibilities of cleaning the artificial water body.

4 Results

When designing the treatment plant complex, it is possible to design a bioplateau using gabion filtration plants. The bioplateau is realized as a cascade of ponds by natural or artificial aeration. Saturation of water with oxygen up to 1 meter is possible naturally, up to 3 meters artificial [3]. Biological wastewater treatment is an alternative to chemical and mechanical wastewater treatment. It uses bacteria and other organisms to decompose organic waste in

wastewater. Microorganisms feed on organic material to produce nutrients for plants that inhabit water bodies.

Aerobic wastewater treatment in the presence of oxygen is a natural process in which bacteria and other microbes feed on organic matter in an oxygen-rich environment, decomposing it in the process. Used in the process of producing active sludge for industrial wastewater treatment. At this stage of oxidation, the organic components are broken down into carbon dioxide, water, nitrates and sulfates, and the microorganisms multiply, creating a growing colony.

When wastewater contains large amounts of organic matter, more bacteria are needed to break it down. Because aerobic bacteria need oxygen to do this, the biochemical demand for oxygen will be higher. It is therefore essential that there is sufficient dissolved oxygen in the water to maintain a healthy population of micro-organisms. Aerobic cleavage can be accelerated by adding oxygen to wastewater during treatment using various aeration technologies.

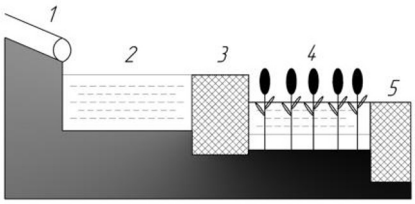

Fig. 2. Bioplateau diagram (designed by the authors)

The authors propose a bioplateau for biochemical treatment of wastewater under natural conditions (Figure 2). Through collector 1, water flows into the sediment 2, flowing through gabion 3 enters the bioplateau 4, contacting sorbent 5 purifying the organic matter. In our opinion, gabion filtration plants from the bioplateau are relevant for HMAO-Ugra, effectively purifying wastewater from impurities of artificial and natural origin. Advantages of gabion constructions: suppleness. durability. durability. permeable. eco-friendly. reliability. low construction cost.

5 Conclusion

Simulation tests were performed. According to the results of the study, gabion filtration plants from the bioplateau effectively clean organic pollutants. About 94% of the organic impurities were removed from the wastewater during the cascade-type experiment of the bioplateau model. The next step will be the development of an experimental bioplateau under natural conditions.

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