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Effects of Treated Wastewater on an Open Water Body

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Abstract Falling of pollutants into natural open water bodies changes its physical composition (changes in the initial clarity and color of water, increase of floating substances on the surface of water, formation of excessively large sediments at the bottom, unpleasant smell, etc.); deterioration of its chemical properties, including the appearance of harmful substances in the water, a decrease in the amount of dissolved oxygen used to break down harmful organic substances in the water, as a result, the appearance of pathogenic microorganisms in the water due to a decrease in the self-cleaning properties of water. Due to the pollution of natural waters, they become unsuitable for use as a source of water bodies of either the first or the second category.

Keywords Carbon, Chemical properties, Hydrogen, Oxygen, Nitrogen substances, Physical composition

1. Introduction

The consequences of pollution have a lethal effect on the fauna and flora living in and around the water, on humans and on all natural factors in general. Under the influence of pollutants, primary critical disturbances in the performance of living organisms occur at the level of biological efficiency: after the chemical composition of cells is disturbed, respiration, growth and development of the organism are disturbed, mutation and carcinogenesis occur, orientation and movement in the water environment are lost. Often, morphological changes are manifested in the form of various regional pathologies of internal organs: changes in size, development of mutational forms, which are especially noted in chronic pollution.

Pollutants entering the open water basin have a significant impact on the established order in the water basin and disrupt the balance in the state of water ecological systems. Under the influence of natural factors, in the process of transformation of polluting water bodies into other substances, its primary character is completely or partially restored. Also, secondary products can be produced from the decomposition of pollutants, which have a negative impact on water quality. Industrial wastewater contains various soluble, insoluble and colloidal substances. The description and concentration of pollutants can have different effects on the water status of water bodies. After suspended solids fall into an open water body, some of them dissolve, and the insoluble part increases the amount of suspension in the water. Some substances falling into the water body in a dissolved form can form secondary suspended substances as a result of changes in the pH of the water or other chemical reactions, an example of such changes is the oxidation of iron salts, under aerobic conditions they form iron hydroxide, which is insoluble in water.

The discharge of waste water containing suspensions into an open water body is extremely unpleasant, because the suspensions sink to the bottom of the water, pollute the bottom of the water and slow down or completely stop the life activity of microorganisms involved in the process of self-purification of the water in the bottom of the water. Sediment on the water bottom produces harmful substances and even toxic compounds such as hydrogen sulphide, which lead to the pollution of the entire river bed. Also, the presence of suspensions in the water resists the penetration of light to the bottom of the water and stops the process of photosynthesis in aquatic plants.

Any pollutant that enters a water body causes a decrease in the amount of dissolved oxygen in the water. Surfactants, oils, fats, petroleum residues, lubricants form a film on the surface of water, and this film inhibits gas exchange between water and atmospheric air, which reduces the level of oxygen saturation of water.

Organic pollutants mainly include carbon, hydrogen, oxygen and nitrogen substances. Oxidation of these elements causes many unpleasant situations in the occurrence of pollution in the waters of rivers and lakes.

2. Materials and Methods

Dissolved oxygen concentration decreases when organic matter enters the open water basin together with waste water. This is due to the oxidation of organic matter by bacteria and simple aquatic animals. Mixing water and air in the natural

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state generally has the ability to replace the lost oxygen, but this does not happen quickly.

The main inorganic (mineral) substances polluting open water bodies include copper, zinc, cadmium, fluorine, chlorine, mercury, lead, cyanides, and rhodanides, which are considered toxic to aquatic animals and plants.

However, in natural conditions, many elements: carbon, oxygen, hydrogen, nitrogen in the form of nitrous, phosphorus in the form of phosphate act as "food" necessary for the growth of algae. Lakes that store a large amount of elements necessary for such plants are called eutrophic.

Eutrophication refers to the deterioration of water quality as a result of the large amount of water entering the open water basin, primarily in the form of nitrogen and phosphorus, containing a large amount of "biogenic elements". Eutrophication is a normal, normal natural process associated with the continuous leaching of biogenic elements from the catchment area into the water body. However, in recent times, this process has developed several times in connection with the discharge of a large amount of waste water into the open water basin from densely populated areas, industrially developed regions or areas with a strong agricultural network.

An increase in the temperature of the water body has a destructive effect on the life of aquatic organisms. Most aquatic organisms adapt easily to a water environment with high temperatures. Under natural conditions, the water temperature rises and falls gradually, and the aquatic flora and fauna slowly adapt to it, but when high-temperature or low-temperature waste water is suddenly dumped into an open water body, a temperature shock occurs, which has a devastating effect on aquatic organisms. . One such effect is changes in metabolism, according to Van Goff's law, the rate of chemical reactions doubles for every 100C rise in temperature. Since the body temperature of cold-blooded organisms is controlled by the temperature of the water environment, an increase in water temperature causes the metabolism of aquatic organisms to accelerate. This, in turn, accelerates their metabolism. At the same time, as a result of increasing water temperature, the amount of oxygen in water decreases, but the oxygen demand of aquatic organisms increases, which can cause physiological stress and even death. An increase in water temperature by several degrees due to the hot summer months, especially in the southern temperature range, causes 100% of aquatic organisms to die. An increase in the temperature in an open water body changes the structure of the plants living in it, the cold-water algae are slowly replaced by heat-sensitive species, and then completely replace them.

If the high-temperature water is also contaminated with organic substances and minerals, eutrophication, i.e. increase in the productivity of the water body, is observed. Nitrogen and phosphorus are food for microorganisms in the water, causing them to multiply rapidly, and they multiply and block each other's light path, resulting in their death in large numbers, and a sharp decrease in the amount of oxygen in the water.

Pollution of an open water body with high-temperature waste water causes great damage to the natural ecosystem and has a negative impact on human health and living environment. Damage caused by high-temperature waste water can be divided into three: economic (decrease in productivity of the water basin, increase in costs aimed at reducing pollution of the water basin); social (aesthetic damage caused by landscape degradation); ecological (damage caused by irreversible damage to unique ecological systems) types. Another group of substances that pollute the waters of open water bodies is surfactants, because they are one of the most widely used substances in the public economy and household conditions year after year. These substances belong to the group of "environmentally solid" substances, decompose very slowly in the aquatic environment and cause great damage to the water of the reservoir. A very small amount (0.3 mg/l) of UFM in the waste water entering the water basin causes significant foaming in the raw water source and this foam reduces the oxygen saturation of the water, which in turn has a negative effect on the self-purification process of the water. In the places where the river waters flow smoothly, the presence of UFMs in the amount of 1 mg/l in the river water reduces its aeration by 60%.

3. Result and Discussion

As a result of disposal of waste water from residents and industrial enterprises of Bukhara into an open water basin after treatment at the sewage station, the effect on the water quality of the Dengizkol water basin and on the macro- and micro-organisms in it is currently at the standard level, as shown in the laboratory results.

The chemical and organoleptic parameters of the waste water discharged into the sea water source meet the requirements of SanQ and N. However, the rate of expansion of the city of Bukhara, rapid development of industry and general infrastructure is expected in the next decade, it is proposed to increase the capacity of the treatment plant, increase the number and efficiency of treatment facilities, and build additional treatment facilities.

Conditions for disposal of treated waste water into the water body.

The amount of waste water discharged into open water bodies is determined using the permissible discharge limit (PDL). ХКТЧ is understood as the mass of substances in the maximum quantity allowed to be discharged at this point of the water body in order to ensure the quality standard of water at this control point. All waste water is divided into two groups, which are discharged into the open water basin and discharged into the sewage system. The table below shows the quality composition of wastewater discharged into the sewage system. (Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 820 of 2019) the increase of sewage water quality indicators above this standard has a negative effect on the efficiency of the sewage system facilities. As a result, the disposal of poorly treated waste

water into an open water body leads to the destruction of the existence and development of macro- and micro-organisms in it, and the process of self-purification of water decreases sharply.

The general conditions for discharge of water sources of any category into an open water body are determined by the description of water use and its importance in the national economy. Discharge of wastewater, even if treated, into an open water body degrades water quality and limits water availability.

When determining the conditions for dumping waste water into water bodies, the following are the following: the level of mixing and dilution from the place of waste water disposal to the control point located 1 km above the place of water use of water bodies; the condition of the waters of water bodies from the waste water disposal site is taken into account.

Taking into account the above-mentioned conditions of disposal of waste water, the research includes the following: familiarization with the amount, composition and properties of waste water planned to be disposed of, and the method of disposal; consumption, composition, characteristics, flow rate, mixing conditions of open water basin water, purposes of water use after disposal of waste water; the level of mixing and dilution of water in places of water use; to study separately the quality requirements of wastewater entering the open water basin; includes checking the suitability of the conditions of disposal of waste water during daily sanitary control.

The dilution rate indicates the number of times the wastewater is diluted with water from the reservoir at a distance of 1 km from the place of discharge of wastewater to the established control point. The hygienic value of this indicator is that if we know the degree of dilution of waste water with an open water source, we can estimate the level of water pollution of the water body, and if we know the degree of dilution, the conditions for dumping waste water into the open water body will be determined according to its organoleptic indicators.

1) The dilution rate was calculated by the following formula:

$$N = Q \times a+g / g = 60 \times 0.8+0.6 / 0.6 = 81$$

Here is the lowest consumption of water in the river during the busiest time of Q-year;

g- average daily consumption of waste water;

a- mixing coefficient;

It can be seen from the mathematical calculation that the mixing rate of river water and waste water is 81%. In accordance with the requirements of SanQ and M 0315-18, this indicator cannot be lower than 75%.

2) Determination of the permissible amount of suspended substances in the discharged waste water:

$$Kchs = (Q \times g / g) \times CREAM + Kdaryo = (60 \times 0.8 / 0.6 +1) \times 0.75+35 = 65.75;$$

3) The KBBE amount of waste water was found by the following formula:

$$KBBEchs = a \times g / g (KBBEREM + KBBEriver) +$$
$$KBBEREM = 60 \times 0.8 / 0.6 (6+3) + 6 = 95 \text{ mg/l}$$

4) Determining the temperature of the waste water content was estimated by the following formula:

$$Tchs = (Q \times a / g + 1) \times TREM + Tdaryo = (60 \times 0.8 /0.6 +1) \times 3+20 = 26.30S$$

5) Calculation of the permissible amount of concentration of minerals, sulfates, chlorides in waste water was carried out as follows:

$$Kchs = Q \times a / g (KREM - Kdaryo) + KREM = 0.8 \times 60 /0.6 \times (500 – 78) = 337.6 \text{ mg/l};$$

$$Kchs = Q \times a / g (KREM - Kdaryo) + KREM = 0.8 \times 60 /0.6 \times (350 – 45) = 244.0 \text{ mg/l};$$

$$Kchs = Q \times a / g (KREM - Kdaryo) + KREM = 0.8 \times 60 /0.6 \times (1000 – 360) = 512.00 \text{ mg/l}.$$

As a result of mathematical calculations, it became known that the composition of waste water treated at the sewage treatment plant of Bukhara city and discharged into the Dengizkol water basin complies with the regulations on organoleptic, chemical and bacteriological indicators.

Dengizkol is an open source of non-flowing water with a high mineral content in the Republic of Uzbekistan. It is a state reserve of international importance, protected by the Ramsar Convention on the Use of Wetlands, for the protection of plants and the prohibition of animal hunting.

The hydrogeological regime of Dengizkol open water basin is not constant throughout the year. The water level has been decreasing in recent years, from 2012 to 2016 the water level dropped by an estimated 85 cm, from December 2016 to November 2019 the water level dropped to 43.0 cm. In April 2019, no water came into the lake from the "Khamza-2" pumping station from the canal. And from the Olot collector, waste water at the level of previous years came. Through the Olot collector, water at the level of previous years fell into the lake. In the hot season of the year, the amount of water in the Dengizkol open water basin has decreased significantly due to a sharp decrease in the amount of water coming from Jiidakol lake. During 2016-2020, the total change of water level in the lake was within 170-180 meters above sea level. Starting from 2019, in the north-west and south-east streams, dehydrated lands (islands) have been formed, and instead of water, plants adapted to grow in saline lands have grown on these lands (ecological monitoring of the Lukoil company in 2019). As a result of the hydrobiological investigation of Dengizkol, it was found that very strong changes were observed in the coexistence of phytoplankton and periphyton in the water body. An increase in the mineral level of water from 11 to 18 g/dm3 significantly reduced the growth and development of fauna and flora living in fresh water, the dominant group is Actinocyclus sp., A. ehrenbergii var. tenellus, Mastogloia lanceolata Thw., M. Braunii Grun.,

Species capable of living in brackish waters, such as M. pumila (Grun.) Cl., Rhopalodia gibberula (Ehr.) O.F. Müll, are increasing. At the same time, a decrease in the development of all representative toxins typical for eutrophic waters was noted, which probably testifies to the state of stress on the ecological system of Lake Dengizkol and a general decrease in the activity of biological processes.

When asking local residents, it became clear that the recreational load around the lake increases due to the large number of vacationers coming from Bukhara, Mubarak and Karshi in the spring and summer months of the year, which led to an increase in the amount of solid household waste around the lake. The issues of disposal of these wastes have not been considered. As a result of the active work of the oil and gas sector around the lake, a lot of road networks, pipe system placement works were carried out, and as a result, soil erosion occurred. Uncontrolled activities carried out by various agencies lead to a sharp decrease in the water level in the lake, and an increase in the amount of mineral substances in it.

The mentioned information once again emphasizes the need to protect Dengizkol and the nearby area, to preserve the fauna and flora living there for the future.

Summarizing the above, it can be concluded that Dengizkol is a huge natural resource that has a great impact on the nature of the Bukhara region, the health of the people living here, and the environmental microclimate factors. If we take into account the year-by-year expansion of the city of Bukhara, the number of residents and the rapid construction of multi-storey residential buildings, public buildings, hotels and large enterprises, treatment and prevention facilities, the need to increase the number and efficiency of waste water treatment facilities and expand their territory is self-evident. will be clear.

4. Conclusions

Falling of pollutants into natural open water bodies changes its physical composition (changes in the initial clarity and color of water, increase of floating substances on the surface of water, formation of excessively large sediments at the bottom, unpleasant smell, etc.); deterioration of its chemical properties, including the appearance of harmful substances in the water, a decrease in the amount of dissolved oxygen used to break down harmful organic substances in the water, as a result, the appearance of pathogenic microorganisms in the water due to a decrease in the self-cleaning properties of water.

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