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# BIOTECHNOLOGICAL WASTEWATER TREATMENT (БІОТЕХНОЛОГІЧНЕ ОЧИЩЕННЯ СТІЧНИХ ВОД)

*У публікації розглянуто проблематику очищення стічних вод, основні методи очищення стічних вод за допомогою використання технологій сучасної біотехнології. Наведено переваги біологічного очищення порівняно із традиційними хімічними методами.*

***Ключові слова:*** *біотехнологія, очищення, стічні води, бактерії, аеробне та анаеробне очищення, мікроорганізми.*

*The publication discusses the problems of wastewater treatment, the main methods of wastewater treatment using modern biotechnology technologies. The advantages of biological treatment compared to traditional chemical methods are presented.*

***Key words:*** *biotechnology, treatment, wastewater, bacteria, aerobic and anaerobic treatment, microorganisms.*

An undesirable consequence of human economic activity has been the disruption of the natural balance in many water bodies and the deterioration of water quality. Industrial and domestic wastewater discharged into natural bodies is characterized by a high level of pollutants and a significant amount of toxicants. In such circumstances, it becomes impossible to restore water sources on their own. This is where an urgent need arises to develop and apply modern environmentally safe, efficient methods of wastewater treatment, especially those that are returned to water bodies and those that are subject to recycling.

Wastewater is defined as water systems saturated with many substances that have been formed as a result of household and industrial activities, and have therefore undergone significant changes in their primary chemical composition or lost their physical properties and become unsuitable for reverse processes. It should be noted that the constituents of industrial wastewater are very diverse, and their characteristics depend on the type of pollutant production. At the same time, its amount is determined by the productivity of technological processes.

Wastewater treatment is a multi-stage complex process aimed at restoring the quality characteristics of contaminated water to enable its further economic use. Water treatment primarily involves reducing or removing pollutants from water: organic substances, colloidal or suspended solids, as well as the destruction of pathogenic bacteria, etc.

Among all modern methods of industrial and domestic wastewater treatment, biological methods are recognized as the most environmentally friendly. Firstly, biological treatment is based on natural processes, i.e., the ability of heterotrophic microorganisms to use for nutrition, along with organic substances in wastewater (alcohols, proteins, carbohydrates, etc.), some inorganic ones (ammonia, nitrates, phosphates, salts, etc.) plays an important role. In contact with these compounds, microorganisms partially destroy them in the process of obtaining energy, converting them into water, carbon dioxide, anions (sulfate ions) and cations of some metals, and partially consume these substances for their own reproduction, i.e., biomass growth. Secondly, microorganisms are characterized by the property of rapid accumulation and formation of colonies, which makes it easy to separate them from treated water [1].

Living organisms, especially bacteria, play an extremely important role in the treatment of water contaminated with organic matter. However, significant success in water treatment can be achieved by using not only bacteria, but the widest possible range of hydrobionts, starting with bacteria and algae and ending with vertebrates, as is the case in natural hydrocyanoses [2].

The new technology is characterized by multi-stage anaerobic and aerobic wastewater treatment using immobilized microorganisms. The main advantages are: the ability to increase the efficiency of wastewater treatment from high molecular weight organic and inorganic substances, reduce energy consumption for treatment, increase the reliability of treatment facilities in the conditions of daily and seasonal changes in wastewater flow, toxic substances, reduce the volume of sediments produced and the cost of their dewatering and disposal [5].

There are several types of biological wastewater treatment devices: biofilters, biological ponds, and aeration tanks.

The main traditional method of biological wastewater treatment is the treatment with activated sludge in aeration tanks. A typical technological scheme of such treatment is as follows: after thorough mechanical cleaning from various debris, sand, grease, and other dispersed impurities that settle or float in the field of gravity, wastewater enters a narrow (3-11 m), deep (4-6 m), and long (50-250 m) structure, where it is treated with complex hydrobiocenosis - activated sludge - under constant aeration. After a long (6-24 hours or more) treatment, the water enters a secondary settling tank, where it is freed from activated sludge, and then enters the so-called tertiary physical and chemical treatment (sometimes after chlorination) in intermediate reservoirs (ponds) and, finally, the river. A part of the activated sludge that settles in the secondary settling tank is returned to the biological treatment plant - an aeration tank. Excessive sludge creates a difficult environmental and technological problem with this technology: there is a lot of it and it contains dangerous virions, microorganisms, helminth eggs, etc., as well as heavy metal ions, biologically resistant, toxic and even mutagenic compounds[3].

In biofilters, wastewater is passed through a layer of coarse-grained material covered with a thin bacterial film. Thanks to this film, biological oxidation processes are intensified. It is this film that serves as the active principle in biofilters.

In biological ponds, all the organisms inhabiting the reservoir are involved in wastewater treatment.

The biological method gives great results in the treatment of municipal wastewater. It is also used in the treatment of waste from oil refineries, pulp and paper industries, and the production of artificial fiber [4].

The purpose of industrial wastewater treatment is to remove soluble and insoluble components, eliminate pathogens, and detoxify them so that the wastewater components do not harm humans or pollute water bodies. Bacteria of the Pseudomonas genus are practically omnivorous: they can utilize naphthalene, toluene, alkanes and other compounds. Pure cultures of microorganisms capable of decomposing specific phenolic compounds and oil components in contaminated waters have been isolated. Microorganisms of the Pseudomonas genus utilize insecticides, herbicides and other xenobiotics. In the future, genetically engineered strains of microorganisms will be able to solve the problem of treating wastewater and soil contaminated with pesticides and other anthropogenic substances.

Nitrogen-containing compounds (proteins, amino acids, urea) can be removed in the biological process of denitrification - nitrification. The biological removal of nitrogen and phosphorus, which are the causes of overgrowth of lakes and canals, is still under experimentation.

Heavy metals impede biological wastewater treatment processes and have a negative impact on flora and fauna. Natural strains of microorganisms cannot always be used to accumulate these metals due to their significant toxicity. However, there is a protein in higher organisms called metallothionein that actively binds heavy metals. The gene encoding the synthesis of mouse metallothionein has been cloned in bacteria, which opens up the possibility of producing the protein in large quantities using immobilized bacteria and using it for sorption and extraction of heavy metals.

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