The role of higher plants in wastewater treatment (on the example of Lemma minor)

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Abstract. The results of the research presented in the article relate to modernization of wastewater treatment and environmental safety technology of remediation nature water after pollution. Have been showed his main criteria and condition of the using of plants in wastewater treatment for protecting ingress of substances into natural reservoirs and causing negative effects such as eutrophication and secondary pollution. The type of plants was selected with taking into account the environmental potential of water treatment on the basis of analysis of the data obtained. Continued for the use technology with plants help to preserve natural reservoirs for drinking for the future.

1 Introduction

Increasing pollution of natural waterbodies by compounds of nutrients that come from insufficiently treated wastewater as a communal, as well as industrial origin, leads to an increase of eutrophication processes in water sources. The results are: the rapid development of aquatic plants and algae, water pollution, reduction of oxygen concentration in water, deterioration of the waterbodies state, strengthening of saprowgenic processes, reduction of the hydrobionts species diversity, etc. Various environmental control measures using express methods \[1-12\], as well as the introduction of clean energy technologies \[13-28\] are holding back the situation. Developed hydraulic structures using new technologies also improve the environmental situation \[29-32\]. But this is currently not enough. Development of new technologies for water treatment is required. One of the possible options for this technology is presented in the paper. This is in line with modern global environmental programs \[33, 34\]. Biological and physico-chemical purification technologies are used for wastewater treatment from nitrogen and phosphorus compounds \[35\]. Recently, biological methods based on processes of denitrification for the removal of nitrate from wastewater and dephosphotation

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for the removal of phosphorus compounds are becoming more widespread [36-39]. Most of the purification technologies are based on biotechnology using active sludge or biofilm. However, not always such methods are effective purification, which are let to achieve the required level of pollution. One of the alternative biotechnologies is the use of phytoreactors with higher aquatic plants to purify the contaminated water. Plants for such phytoreactors should have a uniform growth rate during the year that have been established and protected from the action of the compound with water [36-38].

2 Results of experimental studies and discussion

The requirements to aquatic plants of the genus duckweed are corresponded Lemna minor, which can adapt quickly to artificial conditions of cultivation. An important component in the technology of purifying contaminated water in the phytoreactor is the stage of cultivating the used biomass. Cultivation of plants Lemna minor is one of the key stages, since it simplifies the supply of the required amount of biomass needed for cleaning, and the surplus can be used as feed supplement for fish because biomass is rich in protein. Established the necessary conditions for the cultivation of the higher aquatic plants of Lemna minor in the autumn-winter period; Efficiency of using different types of duckweed for purifying sewage from biogenic compounds of nitrogen and phosphorus is investigated; The use of duckweed with other higher aquatic plants for purification of waste water from nutrient compounds of nitrogen and phosphorus has been investigated.

After analyzing the real wastewater contents and concentrations was prepared a model solution with a concentration of nitrates of 50 mg / dm³ and phosphates of 10 mg / dm³.

Changing the efficiency of cleaning the model solution from NO₃⁻ (fig. 1) and PO₄³⁻ (fig. 2) ions during the experiment are presented on the graphs. m₁= 11g. biomass, m₂=22g. biomass

![Graph 1](image1.png)  ![Graph 2](image2.png)

**Fig. 1.** Changing the efficiency of cleaning the model solution from NO₃⁻ ions during the experiment

**Fig. 2.** Changing the efficiency of cleaning the model solution from PO₄³⁻ ions during the experiment

Lemna minor are able to assimilate and transform various substances, contribute to the deposition of suspended substances, saturate water with oxygen, intensify the processes of purification. Due to rapid growth, duckweed absorbs a large amount of pollutants, thus
clearing water from them. However, there is not enough data of the efficacy Lemna minor to removing a number of compounds of nitrogen and phosphorus from sewage. That is why in the paper directions are defined to researching the process of water treatment from nitrogen and phosphate biogenic components by plants Lemna minor.

Consequently, after analyzing the data obtained, it can be argued that the purification of contaminated water from phosphorus compounds occurs in different ways depending on the weight of the duckweed that was involved. Reducing the phosphate concentration in model solutions is better in experiment, which used a larger weight duckweed Lemna minor.

So, after analyzing the data obtained, it can be argued that the purification of contaminated water from nitrogen compounds occurs in different ways, depending on the weight of the duckweed. The reduction of the concentration of nitrates in the model solutions is better in experiment 2, which used the greater weight of duckweed Lemna minor. This is evidenced by the calculated purification efficiency, where the purification effect in experiment 1 was 83.1% versus 91.76% in experiment 2.

3 Conclusions

It has been established that the efficiency of sewage treatment in the autumn-winter period should adjust the mode of illumination and temperature regime. When installing heaters in a phyto reactor at 23-26 °C and artificial lighting with a working life of 8-9 hours, there is recovery of biomass accumulation.

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