Perspective direction of small rivers water purification from ions of heavy metals

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Abstract. The article is devoted to the actual problem of purification of small rivers from ecotoxins. In this paper we consider the biological method of cleaning small rivers with biofilters. The degree of bioaccumulation of heavy metals by water plants by Elodea canadensis and Cladophora aegagropila on the example of the river Shugurovka of the Republic of Bashkortostan is estimated.

Streams and small rivers predominate in the hydrographic network of any water basin. The main feature of the small rivers formation is their close relationship with the landscape of the basin. At present their condition as a result of a sharply increased anthropogenic load is estimated as catastrophic. Despite the prevalence of the water bodies pollution with heavy metals problem there are not many research related to the cleaning of small rivers in particular with biotlwological methods of purification from heavy metals [1]. In addition because of the low ability to self purification of small rivers pollutants from them subsequently fall into larger rivers. The studied water body is the Shugurovka river is of interest because melting and storm water from petrochemical and oil refineries located near its bed along the terrain are sources of various ecotoxins including heavy metal ions [2]. As shown by the results of the environmental monitoring carried out by the authors in the water of the river exceedances of MPC for copper strontium iron and other ions of heavy metals. The result of the biotest testify to the high toxicity if water Shugurovka practically along the whole length of the river although the sources of pollution do not exceed the permissible standards [3].

The purpose of this work was to study the biological method of cleaning small rivers from heavy metal ions using the example of the river Shugurovka.

Purification of small rivers and water bodies is proposed to be carried out by applying special designs of biofilters where as bioaccumulators of toxic ecotoxins including heavy metals, water vegetation Elodea canadensis and Cladophora aegagropila.

For this purpose were investigated two types of water plants Elodea canadensis and Cladophora aegagropila. Previously conducted studies indicate their ability to accumulate various organic ecotoxins [2-4].

Elodea is a kind of hydrocharis water plant lives in fresh water reservoirs with a water temperature of 16-24 °C suffers a prolonged temperature drop to 12 °C. Rigidity and hydrogen indicator for Elodea does not matter it grows both in very soft and hard water. Catching sunlight Elodea carries out photosynthesis however can withstand and moderate shading.

Cladophora aegagropila is a colony if green filamentous algae. Their filaments are arranged radially forming a ball. Lives in brackish water bodies with a water temperature 14-18 °C neutral pH 5,5-6,0. By its functionality Cladophora is an excellent mechanical and biological filter for water. In
natural water bodies dwells on the bottom in shaded places.

Studies were conducted with contaminated water taken from the Shugurovka river in a similar pattern.

On the ability of algae to accumulate ions of heavy metals were judged by the reduction in their content in purified water and indirectly by the change in its toxicity.

Analyzes were conducted in an accredited laboratory for certified methods.

The content of strontium manganese iron at concentrations less than 0.05 mg/dm² was determined by atomic absorption spectrometry based on measuring the resonant absorption of light by free atoms of the metal being when light passes through an atomic vapor of the test sample formed in the flame on an atomic absorption spectrometer SHIMADZU [8].

The content of copper manganese ions at concentrations above 0.05 mg/dm² was determined by atomic absorption spectrometry with electrothermal atomization based on measuring the resonance absorption of light by free atoms of the element being determined when light passes through the atomic vapor of the sample being studied which is formed in a graphite atomizer on atomic absorption spectrophotometers Varian Spectr AA - 220 and SHIMADZU according ERD FL 14.1:2:4.140-98, M-03-505-119-08 [6].

Biotesting of the Shugurovka river water samples was carried out at the test object of the paramecium candalatum cultured in a laboratory using standard techniques [9]. The essence of the method lies in the response of the body's test to the action of the toxicant with a change in behavioral responses. The perception if chemicals in paramecium occurs at the receptor level which explains the high sensitivity and speed of response to the effects of ecotoxicant. The criterion of toxicity functioning is the toxicity index the significative difference in the number of paramecium observed in the control and study sample [6].

Results of studying the process of heavy metal ions accumulation in seaweed in the Shugurovka river water are shown in figures 1-4.

The greater accumulating ability from the studied algae is possessed by Cladophora. While the content of copper ions decreased from 0.0014 to 0.0010 mg/l, manganese from 0.061 to 0.010 mg/l, iron from 0.11 to 0.06 mg/l, strontium from 1.00 to 0.61 mg/l, nickel from 0.0059 to 0.0051 mg/l.

In the joint cultivation of Elodea and Cladophora the accumulation of heavy metal ions us higher than when they are separately cultivated. At the same time it was possible to achieve the purification if river water to an environmentally safe level. The concentrations of all the metals studied decreased to below the MPC.

![Figure 1 – Dynamics of accumulation of copper ions in the river water by algae](image-url)
**Figure 2** – Dynamics of accumulation of manganese ions in the river water by algae

**Figure 3** – Dynamics of accumulation of iron ions in the river water by algae

**Figure 4** – Dynamics of accumulation of strontium ions in the river water by algae
Thus the algae of the genera Elodea and Cladophora are capable of bioaccumulating heavy metal ions from natural river water and can be used to clean water objects including small rivers.

The result of the Shugurovka river pollution monitoring indicate that the standard values of the MAC for heavy metals in the period from the beginning of spring high water and to winter. This is connected with the fact that the main amount if pollutants enters the river as a result if surface runoff with melt and rainwater. Correspondingly in this period additional measures are required to purify the river water from heavy metal ions.

Thus the temperature and light regime allows to use algae Elodea canadensis and Cladophora aegagropila as bioaccumulators if pollutants including ions if heavy metals.

Purification of small rivers and water bodies is supposed to be carried out by applying special designs of biofilters where as bioaccumulators if toxic ecotoxicants including heavy metals is used aquatic vegetation Elodea canadensis and Cladophora aegagropila.

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