

BIOSORPTION OF HEAVY METALS IN AQUEOUS ENVIRONMENTS USING BIOSORBENTS**Ermatova A.A, Yusupov B.A, Alibekova M.R.**

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Abstract. *Biosorption methods can be environmentally friendly and sustainable for the detection and separation of heavy metal ions from industrial effluents and waste. Along with several types of biosorbent materials such as algae, bacteria, fungi, and plants, lichens also have good biosorption capabilities for heavy metal ions.*

Keywords: *heavy metal ions, biosorption, lichen, biosorbent.*

With the increase in industrial enterprises on Earth, various environmental problems are also increasing. The most common type of pollution that the world is currently struggling with is water pollution. Water pollution can be caused by various causes, such as agriculture, sewage and wastewater, oil pollution, and radioactive substances. In particular, wastewater discharged by industrial enterprises can contain a wide range of heavy metals. Heavy and toxic metal ions are one of the common causes of water pollution. Heavy and toxic metals accumulate in the environment without being broken down. The accumulation of heavy and toxic metal ions (arsenic, cadmium, chromium, copper, lead, nickel, and zinc) in water bodies poses a serious threat to the growth and development of living nature by damaging living organisms (aquatic plants, aquatic animals, etc.) in water. [1].

In the purification or separation of natural water bodies and industrial wastewaters from heavy metals, in some cases, depending on the state of the ecological environment, algae, lichens and other microorganisms are used as sorbents. These biosorbents are often intended to reduce or maintain the concentration of heavy and toxic metal ions in the natural environment. In this direction, the biomass of biosorbents is important because it does not require much

time and money [2]. Accordingly, this study analyzes the solution to the problem of studying the biosorption properties of lichens for heavy and toxic metal ions.

The outstanding features of biosorption compared to traditional methods of purification of open water bodies and wastewaters are: low cost, high efficiency, minimization of chemical and/or biological sludge, no need for additional nutrients, the possibility of biosorbent regeneration and metal recovery [3]. Biosorption methods are considered a sustainable and effective method for removing heavy metals from aqueous environments.

Biosorption is the rapid and reversible binding of ions in aqueous solutions to functional groups present on the surface of biomass. This process is independent of cellular metabolism. [3] Biosorption can be carried out over a wide range of pH values from 3 to 9 and temperatures from 4 to 90 ° C. Since the optimal biosorbent particle size is 1 to 2 mm, the equilibrium state of adsorption and desorption is reached very quickly. In addition, biological materials are often inexpensive and can be obtained from agricultural or industrial waste [4]. In order to maximize the biosorption of heavy and toxic metal ions to realistic conditions, i.e., when wastewater contains not one but many ions, the sorption of Cr(III), Hg(II), and Mn(II) ions was studied in multi-ion systems. An experimental methodology was developed, on the basis of which multi-ionic mixtures were prepared by mixing the initial solutions, in which the concentration of each heavy metal ion was set to 1 mmol/l.

It is known from the literature that the dependence of the biosorption capacity of the lichen cell membrane on the equilibrium concentrations of heavy metal ions can be described by classical sorption, in which the formation of a monomolecular layer of the adsorbate on the surface of the adsorbent is noted. The presence of foreign ions in the solution leads to a decrease in the sorption capacity relative to the main component [5]. All this is due to the binding of biologically active substances and functional groups in them to metal ions.

Usually the chemical composition of lichens is also somewhat complex, they contain chitin, lichen starch, lichenin, sucrose from disaccharides, various enzymes, such as amylase, many amino acids, and vitamins C, B6, B12, etc. The polymer matrix that remains after the extraction of biologically active substances from the thallus of lichens is ground into a powder. The basis of the lichen thallus is polysaccharides such as lichenin, isolichenin, galactomannan, and chitin (up to 80%). [6]

Another important feature of lichens is that inanimate lichen biomass can bind more heavy metal ions than living lichens, since the living plasma membrane excludes the entry of metals into the cell. The mechanism of cation uptake by lichens is usually considered as an abiotic process controlled by the surface complexation of cations with open functional groups on the lichen surface. With the idea that carboxylic, hydroxycarboxylic acids and chitin can act as metal-binding ligands in lichens, forming complex compounds, it was planned to study the chemical composition of the extracted products in multi-ionic systems using physical research methods.

References.

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