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EFFICIENCY OF DIFFERENT PARTICLE SIZES OF DRIED SALVINIA NATANS IN THE REMOVING OF Cu(II) AND OIL POLLUTIONS FROM WATER

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Aquatic plants can be useful in removing various contaminants from contaminated waters, since they can sorb large amounts of heavy metals and oil spill. To investigate the effects of different particle sizes of biosorbent on the metal biosorption and oil spill capacities, dried biomass of Salvinia natans selected as aquatic plant which found a lot in astrakhan city. From the results we concluded that, the metal biosorption capacity increased with decreasing of particle size, while in the case oil spill, capacities of removing of spill increase with increasing particle sizes.

Key words: biosorption, heavy metal, oil spill, Salvinia natans.

1. Introduction

The use of aquatic plants in water quality assessment has been a common practice for years in-situ bio- monitors (sentinel species). Overviews of this use have been presented earlier [1 – 3]. Aquatic plants have also been used frequently to remove suspended solids, nutrients, heavy metals, toxic organics, and bacteria from acid mine drainage and agricultural, landfill, and urban storm-water runoff [4].

Among these prospected plants in the field of purification of aquatic environment from heavy metal and oil spills is Salvinia natans.

Salvinia natans, a small free-floating aquatic fern with branched creeping stems bearing hairs but no true roots. Leaves basically two types- upper green (photosynthetic) and lower submerged (hairy) bear sori that are surrounded by basifixed membranous indusia (sporocarps). Leaves are present in whorls at each node [5]. It has the potential to be used in constructed wetland systems for wastewater treatment at it a very high growth rate in nutrient-rich and stagnant waters [6 – 9] and as the produced biomass can easily be harvested.

Among all the environmental pollutions, pollution of water resources is a matter of great concern. Poor and developing countries are at high risk due to

lack of waste water treatment technologies. Increasing contamination of aquatic sources with large number of pollutants is not only endangering the aquatic biota but creating a worldwide shortage of recreational waters [10].

Copper at excessive concentration is toxic to living organism of humans and other creatures, especially fish [11].

Oil spill pollution, a severe environmental problem which persists in marine environment or in inland water across the world, has grown to an alarming magnitude with increased levels of oil production and transport. Its causes are either accidental or due to operation wherever oil is produced, transported, stored and used on sea or land. Hence, it is almost impossible for marine life to be free from the danger of an oil spill, though the discharge of oil is controlled by international convention [12].

2. Materials and methods

2.1. Preparation of biomass: The aquatic plants of *Salvinia natans* was used as bio-removing substance for bio-removing of Cu (II) ions and oil spills from contaminated water. Samples of mature water fern (Salvinia natans) were collected from Volga region of Astrakhan city. Salvinia was washed several times with tap water to remove impurities, dried and then were ground in coffee mill. In order to investigate the effect of particle size (θ) on the adsorption process, plant powder was sieved and the following size distribution fractions were obtained: a fraction with particle sizes smaller than 1 mm (θ_1), another one ranging between 1 and 2 mm (θ_2) and a last one ranging between 2 and 3 mm (θ_3).

2.2. Stock solutions. Heavy metal stock solutions (1g/L) were separately prepared by dissolving analytical grade $CuSO_4 \cdot 5H_2O$ in deionized distilled water. A solution of 1 ppm concentration was obtained by diluting the stock solutions.

2.3. General uptake procedure. Experiments were conducted in 250 ml flasks containing 100 ml of heavy metal solutions and 2.5 g of tree different particle sizes of dried biomass. The mixtures were shaken on a shaker (agitation rate, 210 rpm) for 1 h, and then set still. The effect of different particle sizes was discussed. Then the biosorbent was filtered through filter paper and the concentrations of heavy metal ions in the filtrates were analyzed by flame atomic absorption spectrometry- Model МГА-915 [13].

2.4. Water purification from oil pollution.The biosorbent after that can be desorbed from heavy metal with using desorbing agents such as Na_4EDTA or HNO_3, then dried and stored for another biosorption cycles. 2.4 water purification from oil pollution:

To determine the efficiency of different particle sizes of Salvinia natans as a sorbent of oil pollution, 2 ml oil samples putted on 50 ml water (40 ml oil/L), then 0.1 g of different particle sizes of Salvinia natans added, and after one

hour, we visually observed the effectiveness of the sorption process of different particles.

The biosorbent after that can be subjected to squeezing by pressure to liberate the oil collected. Following extraction of the absorbed oil, the biosorbent can be reused for another oil cleanup cycles. Also, the oil extracted from the biosorbent can be used as well [14].

Work performed in the laboratory of biotechnology, Astrakhan State University in the village Nachalo (Volga region, Astrakhan city). Analysis of lead concentrations in residual solution was analyzed in department of environmental control and normalization, engineering and technical center, "Gazprom dobycha Astrakhan"

3. Result and discussion

3.1. Effect of Particle Size. Adsorbent particle size is a significant parameter for adsorption efficiency evaluation [15 – 17]. Various biosorbent particle sizes and their corresponding metal removal capacities in the present study have been represented in Fig.1

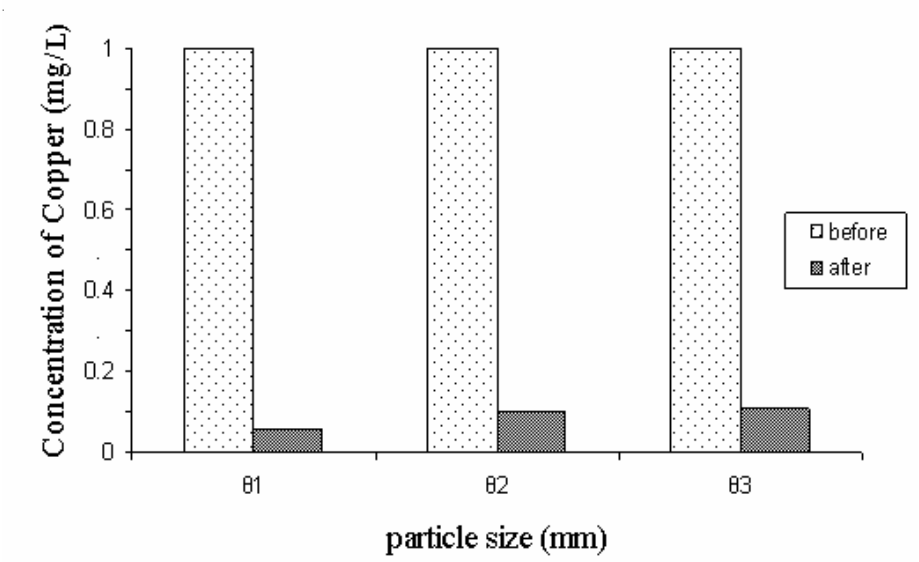

Fig. 1. The effect of different particle sizes on biosorption of Cu (II) by dead biomass Salvinia natans.

From this figure we concluded that, the efficiency of removal of copper (II) from solution increased with the decreasing of sorbent particle size. By assuming spherical shape for particles, it can be shown that the specific surface area is higher for smaller particles. The increase in external surface area due to

small particle size results in increased number of binding sites and contact surfaces, which results in lowering of mass transfer driving force per unit area of adsorbent particles which in turn enhance the uptake/saturation capacity per unit mass of adsorbent particles [18, 19]. Similar results were observed by many authors such as [20 – 24].

Observation of the effectiveness of different particle sizes of Salvinia natans to removing oil spills from water are represented in the following Fig. 2.

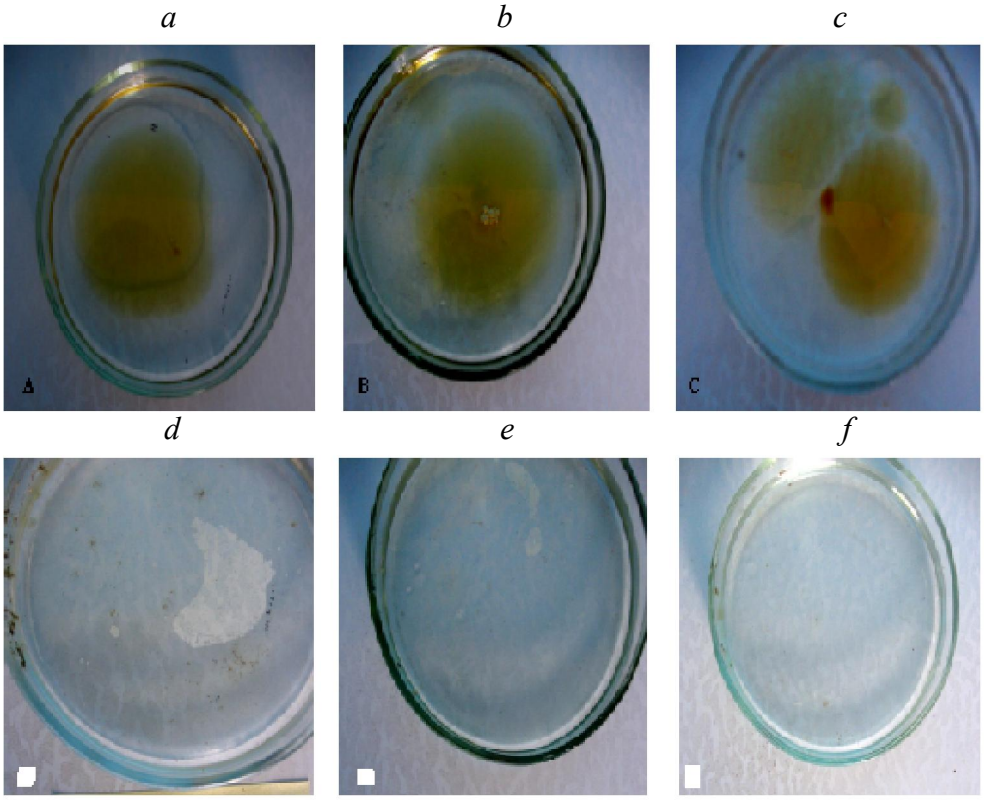

Fig. 2. The efficiency of different particle sizes to remove oil spills: (a, b, c represented Petri dishes with oil spills before experiment, while d, e, f represented the same Petri dishes but after using θ_1, θ_2, θ_3 particle sizes of dried Salvinia natans, correspondingly).

From this figure we concluded that, particle size greater than 1 mm were more effective in the removing of oil spills from water bodies.

In our opinion, it is necessary to continue the studying of other factors which affecting this process such as: different times, different doses of biosorbent and different oil spills to determine optimum condition for removing oil spills by dried Salvinia natans.

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