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USAGE OF ALGAE SPECIES *CHAETOMORPHA GRACILIS* AND *CH. AEREA* FOR DEPURATION PROCESS OF THE RESIDUAL WATERS

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Abstract: Rapid increase of the population on the globe scale imposes maximum exploration of the natural resources and first of all of the aquatic resources. As a result are obtained an enormous quantity of residual waters which pollute the waters from rivers, lakes, freatic and underground waters. Elaboration of the depuration methods for residual waters the quantity of which grows continuously, is one of the most up to dated issue of the world. The physical-chemical depuration methods of the residual waters are very expensive and lack the efficiency we would like to have. The most efficient method proved to be the biological method using some species of algae and superior aquatic plants. In our experiences we have involved filamentous green algae *Chaetomorpha gracilis* and *Ch. aerea* for depuration of the sewerage water from town Cimishlia. The concentration of the mineral nitrogen compounds in the residual water is around 92,5 mg/l, and of the phosphates 10,1 mg/l. There were used the following concentration of the sewerage water: 10%, 25% and 50%. The most intense development of algae *Chaetomorpha aerea* was observed in the variant with 10% of residual water, in which the total concentration of the nitrogen was 10,24 mg/l, and of the phosphates 1,05 mg/l. For this variant the depuration water level was about 56,9%. For the case with *Chaetomorpha gracilis,* the depuration level for the same concentration of the residual water constituted 55,9 %. Increase of the concentration of the polluted water inhibits development of the algae reducing to the minimum their capacity to assimilate the nitrogen and the phosphor. In the solutions with 50 % of residual waters, the algae didn't die, but at the same time they didn't develop. From this results that both algae may be used in the phytoamelioration of the residual waters being diluted at 10% with purified water.

Key words: nitrogen, phosphor, residual water, depuration, inoculate, green filamentous algae.

Introduction

During the recent years, pollution of the atmosphere has become one of the most important issue for the society. Residual waters from towns and industrial, agricultural factories flow into natural basins of water, being a danger for all living aquatic organisms and for the health of the human being [1, 2, 3].

Is being intensified eutrophication of the natural basins of water and appeared the necessity for elaboration of new methods of depuration of the polluted waters. There were performed studies in this direction using algae and superior aquatic plants during the autodepuration process of the polluted waters[4, 5, 6].

The results have proved the efficiency of some green filamentous algae and aquatic plants from genders: *Cladophora*, *Chara, Rhizoclonium, Lemna* during the depuration process of the residual waters [8, 9]. Some authors have used for this scope species of algae from genders *Oscillatoria, Scenedesmus, Navicula, Nitzschia, Chlorella, Chlamydomonas* etc [7].

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The scope of our work is to use some species of green filamentous algae *Chaetomorpha aerea* and *Chaetomorpha gracilis* for the depuration process of the sewerage waters from town Cimishlia.

Materials and methods

In order to elaborate new methods for phytoamelioration of the residual waters of sewerage origin from town Cimishlia, there were made experiments on two species of green filamentous algae, *Chaetomorpha gracilis* and *Ch. aerea.*

These algae were collected from the lake of village Danceni and from village Calimaneshti during summer period of 2006 and maintained in laboratory conditions in the water from the respective lakes, at the room temperature and natural illumination. For our studies there were used the following concentrations of sewerage waters: 10%, 25% and 50%. The inoculation was done with 5 g of green biomass for each sample.

The experiments were performed during 29.05.06 - 26.06.06. The experiments were performed in glass containers with a volume of 10l. There were analyzed the following chemical parameters of the water at the beginning and end of the experiment: (PO_4^{3-}, CCO-Mn, NO_2^-, NO_3^-, NH_4^+). The chemical analyses of the water was done within the Algaeology Laboratory of the State University of Moldova and in the analytical laboratory of the Republican Center for Agrochemicals Maintenance, using contemporary methods for estimation of the water qualities.

Results and discussions

In order to determine the oscillations of the chemical composition of the water, the inoculates of the respective algae being exposed, we have determined the quantities of the ions from the nitrogen group as well as the phosphates and oxidization of the polluted water used for experiments. As a result we've concluded that in the polluted water the quantity of the respective ingredients is over about 2-10 times the admissible limits.

The total concentration of the mineral nitrogen compounds from the residual waters diluted at 50% is about 50,32 mg/l, and of the phosphates - 5,2 mg/l. Also, is quite high the content of the chemical oxygen consumption (CCO-Mn), determined through permanganatometry, the quantity of which being higher 7,4 times in respect to the admissible limit which is 222 mgO/l, pHl of the water - 8,3, being determined by the high concentration of the bicarbonates (719 mg/l) and of the ammonium ions (16,3 mg/l), the quantity of which is 8,2 times higher than the admitted limit for the waters with destination for fish growing.

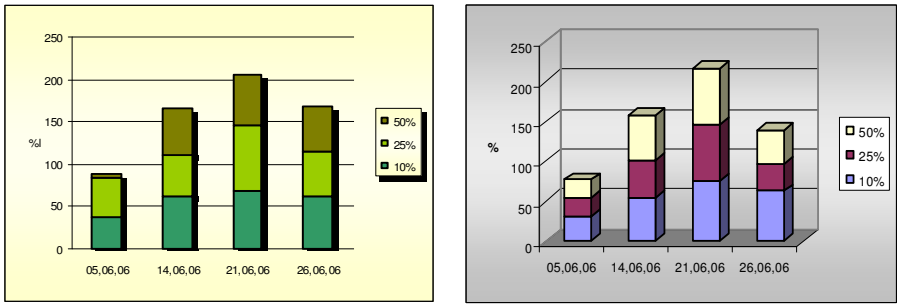
At the beginning of the studies there was determined the maximal and optimal concentration of the polluted water in which the algae develops. There was established that most intensely the algae develop in the concentration of 10% and the tolerance limit of the algae towards the complex of the proposed chemical compounds is 25-50%.

The comparative analyses of the obtained results clearly demonstrate that the most intense development of the algae *Chaetomorpha aerea* and *Chaetomorpha gracilis* is in the variant with 10% of residual waters, where the level of nitrogen, phosphor assimilation constituted 56,9 % and respectively 55,9% (fig.1A, B). according to fig. 1, the assimilation process of the biogenic substances from water is more accelerated during the second and third week of the experiment, when the quantity of the pollutant decrease with about 47-

77%, after which, during the last week the accelerated increase of the algae mass leads to alteration and damages the quality of the water.

That is why after two weeks from inoculation, the algae biomass shall be extracted from the water at least around 50 %.

The depuration process of the water off **phosphor ions**, shown in fig. 2 demonstrates slow decrease of the respective element during the first week. In the variant with 10 % with *Chaetomorpha aerea* the decrease is between 7,7 % and 42,8% oscillating from 1,05 up to 0,60 mg/l, and in the variant with 25% of residual water - between 2,62-2,0mg/l and in the variant with 50 % between 5,2-4,8mg/l. According to fig. 2 the maximal depuration values were observed in variant with 10% surplus of sewerage water, and the minimal in the variant with 50%.



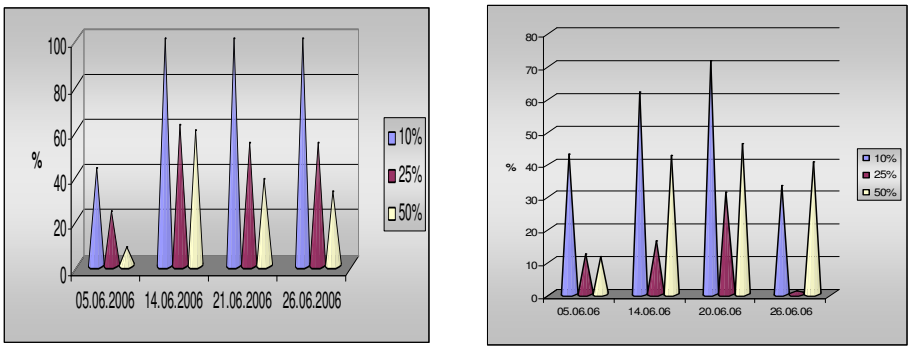
A B

Fig. 1. Depuration dynamics of the polluted water under the influence of the inoculate
A - *Chaetomorpha aerea* and **B -** *Ch. gracilis*

Similar is the decrease of the phosphates in the variant with *Ch. gracilis,* where the assimilation of the phosphor in the variant with 10% was the maximal. After seven days of algae cultivation there were stated decrease from 1,05 up to 0,3 mg/l, or with 42,8% of the phosphates. In the variant with 50% there were assimilated only 11,5% from their total initial quantity. The complete assimilation of the phosphor ions was observed in the variant with 10% with *Chaetomorpha aerea.*

For the experiments with the second species - *Chaetomorpha gracilis (fig. 2 B)* there was observed decrease of the phosphates in the variant with 25 % from 2,6 up to 1,8 mg/l with about 31,3 %. During the first week the phosphates quantity decreased from 2,6 up to 2,3 mg/l or about 16,0 % and after 16 days the phosphates concentration comes to its minimal value, around 1,8 mg/l.

As a result of assimilation of nutrition substances, considerable increases the algae biomass which covered the entire water surface. During the last week started decomposition of the biomass, a fact which contributes to secondary pollution of the water, reducing in such a way the depuration process to 1%. Analyses of the witness sample where the decrease of the phosphates come only up to 4% demonstrate the contribution of the algae for the amelioration process of the sewerage waters.

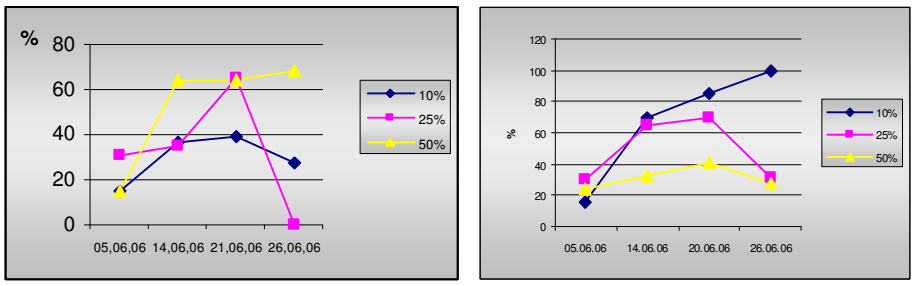


A B

Fig. 2. Dynamics of the phosphor ions from the water subject to experiment with inoculate (5g) **A -** *Chaetomorpha aerea* and **B** - *Ch. gracilis*

It is well known the fact that the most important chemical value that characterizes the sewerage waters is the ammonium ion (NH4+), being very intensely assimilated by algae. In the variant with 50 % sewerage water, *Chaetomorpha aerea* during first seven days has assimilated from 16,3 mg/l up to13,8 mg/l reducing with 15,3 % from its initial concentration. After 16 days of cultivation, the concentration of the ammonium ions has been reduced from 16,3 up to 5,9 mg/l constituting 63,8 %. After 28 days of cultivation, the concentration of the ammonium for this variant has decreased up to 5,2 mg/l (fig.3).

As we can see, during the first week of cultivation of both species of algae there takes place consumption of the ammonium ions. In the variant with 50% and 25% of sewerage water with *Chaetomorpha aerea* (fig.3 A), the most intense assimilation of the ammonium ions has been reduced from 8,0 up to 2,8 mg/l with about 25 % sewerage water and from 16,3 up to 5,9 mg/l in that with 50 % addition of polluted water, constituting 65,0 % and 63,8 %. This demonstrates the role of the algae for the depuration process of the residual waters.



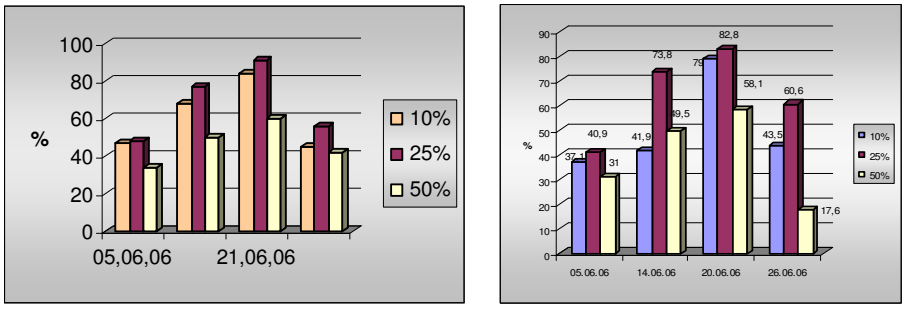
A B

Fig. 3. Decrease in % of the ammonium ions concentration in the polluted water cultivated with **A -** *Chaetomorpha aerea* and **B –** *Ch.gracilis*

An index that characterizes intensity of the pollution process of the sewerage waters is the oxidization process which mainly depends on the activity of the algae. As result of photosynthesis the algae enrich the water with oxygen and reduce the quantity of

the organic substances which alterate in water. The maximal decrease of the oxidization in the variant with 10% of residual water with *Chaetomorpha aerea* were observed during the third week of cultivation and constituted 83,9 % from the initial value, oscillating between 62 and 10mgO/l. During the first week of algae cultivation the oxidization has been reduced from 62 up to 33mgO/l and after 16 days came to a level equal to 20 mgO/l. During the last week of algae cultivation, the oxidization increased up to 34 mgO/l, a fact that speaks about the decomposition of the algae biomass. In the variant with 25 % residual waters, the oxidization has been reduced from 122 up to 54 mgO/l. And in this variant the most intense decrease of oxidization was observed during the third week of algae cultivation, when the content of the chemical oxygen consumption has been reduced up to 11 mgO/l constituting 91,0 % from the initial mass.

In the variant with 50 % residual waters, the oxidization during the first week has been reduced from 222 mgO/l up to 147 mgO/l, and after 16 days constituted 110 mgO/l. Like with other two variants the consumption of chemical oxygen comes to its minimal values during the third week of algae cultivation, its content being not more than 89 mgO/l.



A B

Fig. 4. Dynamics in % of the content for the chemical oxygen consumption in the polluted water of different concentration, cultivated with **A -** *Chaetomorpha aerea* and **B -** *Ch.gracilis*

During the last week the oxidization, increases (fig.4A). The same oscillations are observed in the variant with *Ch. gracilis (*fig.4B*).* In the variant with 10 % of residual waters, the oxidization has been reduced from 62 mgO/l up to13 mgO/l, and in the solutions with 25 % of polluted water - from 122 mgO/l up to 21 mgO/l constituting 82,8 % from the initial quantity. In the variant with 50 % residual waters, the oxidization has been reduced from 222 up to 93 mgO/l. During the last week of experiments was observed a slow increase of chemical oxygen, process based on excessive development and partial extermination of the biomass.

Conclusions

- It was observed and concluded that algae species *Chaetomorpha aerea* and *Ch. gracilis* assimilate the nitrogen and phosphor from the polluted waters and may be used as agent for biological depuration;
- Both species of algae develop most intensely in mediums that contain up to 10 % of sewerage water. Concentration increase of the sewerage water inhibits development of algae;
- Both, *Chaetomorpha aerea* and *Ch. gracilis* during the cultivation process assimilates up to 100% from the concentration of the phosphates and up to 84,8 % of the nitrogen;
- Chemical oxygen consumption under the influence of the algae up to third week decreases with 91,0 %, than it increases. Increase of the concentration of the residual water in the nutrition medium higher than 10 % slows down development of the algae and in some cases, even after these die out.

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