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# THE INVESTIGATION AND USAGE OF THE WASTEWATER ALGOCENOSIS FOR THE STUDYING OF THE ORGANOLEPTIC WATER'S PROPERTIES

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**Аңдатпа:** Жұмыс барысында балдырлар оларды судың органолептикалық сипаттамаларын жақсартуда қолдану мақсатында зерттелді. Белгілі бір микроорганизмдердің су ортасын тазарту қабілеті биотехнология, микробиология және экология сияқты көптеген ғылыми зерттеулердің тақырыбы болып табылады. Chlorella vulgaris AK № 001 штаммы сынаудың 16-17 күндерінде қазірдің өзінде ағынды сулар мен қалдықтардың шламдарындағы жағымсыз иісті жояды. Қалдықтардың шөгінділерінің ең төмен концентрациясы бар үлгілерде жағымсыз иіс жоғалады. Сынама үлгісі үшін 10 млн титерлі жасушаларды бастапқы енгізу жеткілікті болды, сонымен қатар зерттелген үлгілердің лайлылығында елеулі жақсару байқалды. Зерттеудің 20-ші күнінде қалдықтардың шөгінділерінің ең төменгі концентрациясы бар сынамалар оптималды болды. Бұл үлгілердің рН-нің сілтілік шамасынан (9,5) бейтарапқа (7) төмендеуі байқалды. Тәжірибені бастағаннан кейінгі 15-ші күнде азық-түліктің жалғыз көзі болып табылатын ластаушы заттар болатын үлгілердегі штамм Chlorella vulgaris AK №001 клеткаларының ең көп саны алынды. Зерттеудің 17-20 күндері жасушалардың өлімі кезеңі басталды. Балдырлар қоршаған ортаға шығарылатын әртүрлі химиялық қосылыстардың, соның ішінде биологиялық белсенді заттардың көзі болып табылады. Басқа организмдердің дамуына реттеуші әсер ете отырып, олар гидробиоценоздардың түзілуіне қатысады, судың органолептикалық сипаттамаларына және табиғи сулардың сапасына әсер етеді.

**Түйін сөздер**: балдырлар, ағынды сулар, органолептикалық сипаттамалар,биологиялық тазарту, алгоценоз, қалдық шламдары, рН.

**Аннотация:** В ходе работы были изучены водоросли с целью использования их в улучшении органолептических показателей воды. Способность некоторых микроорганизмов отчищать водную среду объектом изучения многих наук, таких как биотехнология, микробиология и экология. Было установлено, что штамм Chlorella vulgaris AK №001 устраняет неблагоприятный запах в пробах сточной воды и сточного ила уже на 16-17-ые дни эксперимента. В пробах с наименьшей концентрацией сточного ила неприятный запах исчезает быстрее. Для пробы «Сточный ил + сточная вода + Chlorella vulgaris АК №001 – 6.25мл/43.75мл» было достаточно начальное внесение клеток с титром 10 млн. Также произошло заметное улучшение мутности исследуемых проб. На 20-ый день исследования пробы с наименьшей концентрацией сточного ила имели опалесценцию. Произошло снижение pH данных проб от щелочного значения (9,5) до нейтрального (7). Наибольшее количество клеток штамма Chlorella vulgaris АК №001 в пробах, в которых единственным источником питания являлись присутствующие в них загрязнения, было получено на 15-ый день с момента начала эксперимента. На 17-20 дни исследования наступила фаза гибели клеток.

**Ключевые слова:** водоросли, сточные воды, органолептические показатели, биологическая очистка, альгоценоз, сточный ил, pH

**Annotation.** It has been found that the strain Chlorella vulgaris AK №. 001 eliminates the unpleasantodour in the samples of waste water and sewage sludge even on the 16-17th days of the carried out investigation. In terms of the samples with the lowest concentration of sewage sludge, the unpleasant odor disappears rapidly. For the sample «Sludge + wastewater + Chlorella vulgaris AK №. 001 - 6.25ml / 43.75ml», there has been a sufficient amount of initially applicated cells with a titer of 10 million. There was also a noticeable improvement in the turbidity of the studied samples. On the 20th day of this research, samples with the lowest concentration of sewage sludge had got opalescence. The decrease in pH of these samples has occurred so this amount has dropped from an alkaline value (9.5) to a neutral value (7). The greatest number of cells of the strain Chlorella vulgaris AK №. 001 in samples, in which the only source of nutrition was the contaminants present in them, has been obtained on the 15th day from the moment the experiment began. On the 17-20 days of the study, the phase of cell death has begun.

**Key words:** algae, wastewater, organoleptic indicators, biological treatment, algocenosis, sewage sludge, pH.

Microalgae include species of unicellular algal organisms that can live individually or in colonies. Algae are a source of various chemical compounds released into the environment, including biologically active substances. Providing a regulatory effect on the development of other organisms, they participate in the formation of hydrobiocenoses, affecting the water organoleptic characteristics, and the formation of the qualitynatural waters. The quality or the extent of water pollution by the composition of algae is evaluated in two ways:

1) by indicator organisms;

2) by comparing the structure of the community in areas with varying degrees of pollution. In the first case, the process is occurring in an accordance to the presence or absence of indicator species or groups and their approximate number, particularly, using pre-developed systems of indicator organisms, a reservoir or its section is assigned to a certain class of waters. In the second case, the conclusion is made by comparing the composition of algae at different stations or sections of the reservoir, which are prone to pollution to different degrees [1].

Currently, wastewater treatment is based on bacterial activity.

Algae, like bacteria, take part in the treatment of wastewater from a number of organic compounds, utilizing the necessary nutrients: phosphoproteins, phospholipids, phosphoglycosides, nucleic acids. Algae can utilize even synthetic detergents as a source of phosphorus. [2]

The organoleptic properties of water are precisely those signs that perceive the human senses. These properties are evaluated regarding the intensity of perception. The olfactory, gustatory and visual, sensory organs participate in the determination of such properties. The sensations they receive are due to both factors physical characteristics of the water and the presence of any foreign chemicals in it [3].

These include smell, taste, sediment, turbidity, colour and transparency, that is, those properties that can be determined by the human senses.

Turbid, dyed in any colour or having an unpleasant smell and taste, the water is not sanitary-hygienic inadequate even if it is harmless to the human body. This is due to the fact that a person experiences turbid, coloured and unpleasantly smelling water with an unpleasant sentiment, sometimes disgusting. Deterioration of the water properties adversely affects the drinking-water regimen, reflexively affects many physiological functions, in particular, the secretory activity of the stomach [4].

Algae are important biological treatment agents and are already used as a “treatment” for wastewater. Introduction to the reservoir, waste water of green algae - chlorella, in addition to solving the problem - elimination of "flowering" of blue-green algae provides: - improvement of organoleptic indicators;

- a significant improvement in water quality by the concentration of chemical elements, such as heavy metals, petroleum products, phenols, inorganic forms of nitrogen and phosphorus;

- a significant reduction in bacterial contamination of water by pathogenic microflora;

- increase in forage resources of the fauna of water bodies. - reduction of biochemical and chemical oxygen consumption;

- an increase in the amount of dissolved oxygen in water throughout the growing season; - restoration of recreational potential

A study of the taxonomic composition of algae in various water bodies with different types of wastewater suggests that the main place among them is occupied by green, euglena and diatoms, sometimes blue-green (cyanoprokaryotes) [5]. Among green algae, chlorococcal, which is mainly represented by species of the genera Chlorella, most often dominates. In some cases, algoflora can be represented, in fact, by the monoculture of any kind of algae that is highly resistant to many toxic substances and able to adapt to their long-term effects [6].

Currently, scientists are also trying to find out other variables that may affect this process, as well as evaluate the economic efficiency of the system [5]. A very effective, cheap and affordable way to treat contaminated wastewater is to grow algae (green, blue-green). They are able to kill harmful bacteria and viruses, to secrete some anti-carcinogenic substances. Research is conducted in many countries around the world [7].

One of the most important problems of water use is a change in the chemical composition of surface sources of drinking water under the influence of various natural factors. The range of pollutants that fall into these reservoirs is very wide: organic, inorganic, organometallic. Among organic toxicants, in recent years, cyanotoxins formed in water bodies as a result of the rapid utilization of inorganic nitrogen by blue-green algae (ammonium cations, nitrite, nitrate anions) have attracted special attention [8].

An innovative approach to significantly reduce the level of pollution of water bodies by cyanotoxins is the correction of algocenoses of these water bodies by planktonic strains of green microalgae Chlorella vulgaris. They differ from other phytoplankton representatives in their ability to live in a wide temperature range (from 2 to 40° C), resistance to shock reactions (freezing), and the ability to develop under extreme conditions, for example, in wastewater of coke plants with a phosphorus content of 1 g / dm3.

Chlorella utilization of inorganic derivatives of nitrogen and phosphorus is so effective that there is no chance for the development of other types of algae (in particular, blue-green algae - cyanobacteria). This, taking into account the toxicity and, correspondingly, unpleasant odours of substances released by blue-green algae, has a positive effect on the quality of water in natural reservoirs used both for the preparation of drinking water and for recreational purposes (bathing, amateur fishing, etc.).

The studies were carried out according to generally accepted methods: the study of organoleptic indicators of water and the cultivation of microalgae cells [9].

A method for determining the state of a water body by directly inspecting it. In organoleptic observations, special attention is paid to turbidity, colour, colour, smell, taste [10].

The technique used was the cultivation of cells of various microorganisms, phototrophic microorganism cells, the cultivation of microalgae cells C. vulgaris was carried out on Tamiyya medium with the addition of 5 g / l glucose, model nutrient media simulating household wastewater and wastewater from the food industry and real wastewater [11].

The biotechnology under development is based on the structural reorganization of phytoplankton by the introduction of the microalga Chlorella vulgaris. Water samples for hydrochemical and hydrobiological analyzes were taken with a bathometer at the points of water intake [12].

Our study of the chemical aspects of wastewater algalosis correction, which was characterized by low water quality and dissatisfaction with organoleptic properties [13]. This paper presents experimental data which obtained by introducing green pure and mixed cultures of

Chlorella vulgaris microalgae into wastewater samples diluted in different concentrations with wastewater to improve the organoleptic properties of water [14].

To determine the organoleptic state of wastewater under laboratory conditions, an experiment was conducted to rehabilitate and eliminate the unpleasant odor and turbidity of wastewater samples with sewage sludge (Fig. 1).

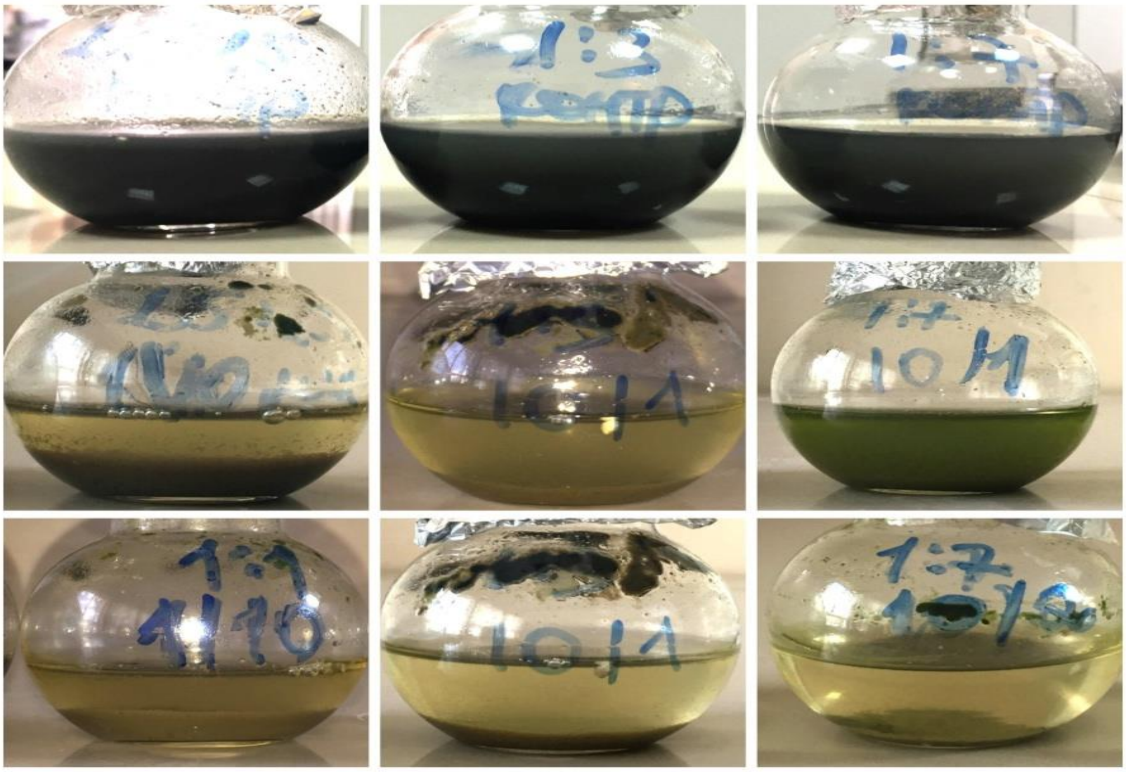

Figure 1. Comparison of the turbidity of the samples after introducing cells of the strain Chlorella vulgaris AK № 001

Odour was determined at room temperature. First, the nature of the smell was established (marsh, fecal, putrid, odour of damp, hydrogen sulfide, etc.), then its intensity was determined by the threshold of dilution [15]. Odour was quantified by diluting the wastewater with odourless water to an odour intensity of 1-2 points. To do this, test wastewater in the amount of 5, 10, 25, 50 cm3 was placed in flasks and the volume was brought to 100 cm3 with odourless water. The contents of the flasks were mixed and the dilution at which the odour disappears and the dilution with an odor intensity of 1-2 points were determined.

The results of the experiment were determined in the laboratory of the Hydro Eco Resource LLP. Data on the results of the smell of wastewater and the amount of cell content are shown in table 1.

The number of cells was also counted (figure 1) and the dynamics of pH changes in the studied samples were determined (figure 2).

Thus, the best cell growth of Chlorella vulgaris AK № 001 was in the sample «Sludge + wastewater + Chlorella vulgaris AK № 001 - 6.25 ml / 43.75 ml». The worst cell growth of Chlorella vulgaris AK № 001 was in the sample with the highest concentration of sewage sludge compared to other samples [16]. The largest number of cells in samples in which the contaminants present in them were the only food source was obtained on the 15th day from the moment the experiment began. On the 17-20 days of the study, the phase of cell death began.

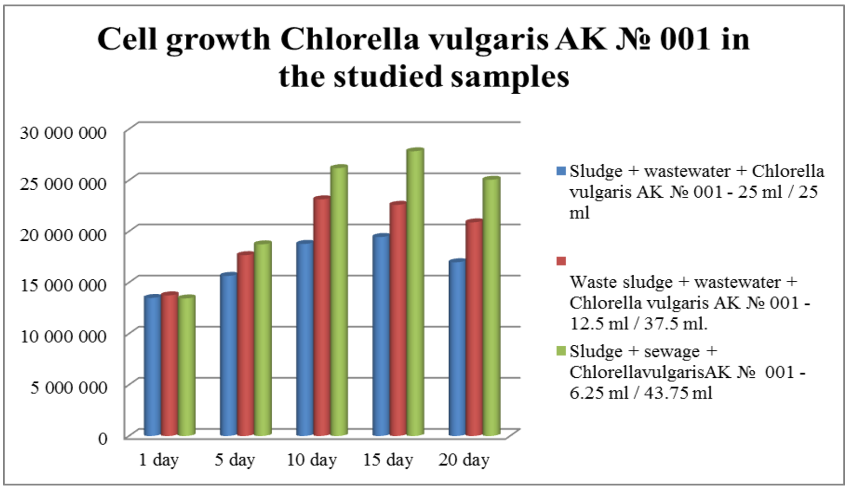


Figure 2. Chlorella vulgaris AK № 001 cell growth in the studied samples.

The data presented in figure 3 indicate that, when growing the culture of the strain Chlorella vulgaris AK № 001, the pH of the studied samples decreased from an alkaline value (9.5) to a neutral value (7), which is a positive result during its biological purification.

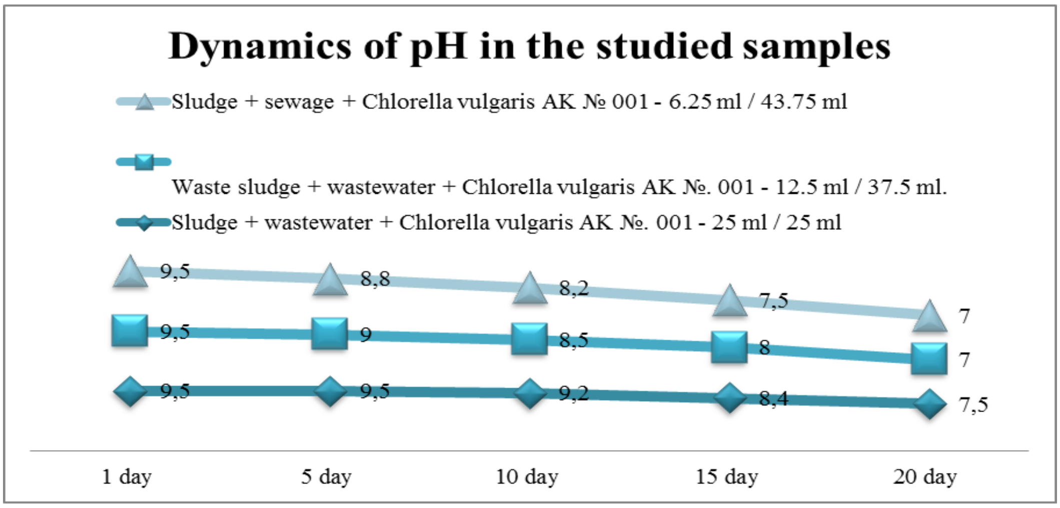


Figure 3. Dynamics of pH changes in the studied samples.

Table 1. Results on the smell and their dynamics of change in samples after introduction of cells of the strain Chlorella vulgaris AK № 001

| Sample Name | Smell Characterization | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st day | | 5th day | | 10th day | | 15th day | | 20th day | |
| | 10 mln c/ml | 15 mln c/ml | 10 mln c/ml | 15 mln c/ml | 10 mln c/ml | 15 mln c/ml | 10 mln c/ml | 15 mln c/ml | 10 mln c/ml | 15 mln c/ml |
| Sludge + wastewater + Chlorellavulgaris AK № 001 - 25ml / 25ml | persistent fecal-putrefactive. Score: V | persistentfecal-putrefactive. Score: V | the smell of stale grass. Score: V | the smell of stale grass. Score: IV | grassysmell. Score: IV | the smell of sewage sludge is hardly perceptible, earthy smell. Score: V | muddysmell. Score: V | muddy smell. Score: IV | muddysmell. Score: IV | muddysmell. Score: III |
| Sludge + wastewater + Chlorellavulgaris AK № 001 - 12.5 ml / 37.5 ml | persistent, pungent odor of hydrogen sulfide. Score: V | persistent, pungent odor of hydrogen sulfide. Score: V | the smell of stale grass. Score: IV | distinctgrassyodor. Score: IV | noticeable woody smell. Score: III | muddysmell. Score: IV | faint muddysmell. Score: III | faintmuddysmell. Score: III | the smell is hard to smell | nosmells |
| Sludge + Wastewater + Chlorellavulgaris AK № 001 - 6.25 ml / 43.75 ml | persistent smell of hydrogen sulfide. Score: V | persistent smell of hydrogen sulfide. Score: V | grassysmell. Score: IV | grassy smell. Score: III | muddysmell. Score: IV | faint muddy smell. Score: III | the smell is hard to smell | the smell is hard to smell | nosmells | nosmells |

In connection with the increased anthropogenic impact on water bodies, the relevance of water treatment using aquatic vegetation increases [17]. The results of experiments to combat the flowering of cyanobacteria and their replacement with green algae are considered, see table 1.

Thus, the elimination of the unpleasant odour of the studied samples depends on the concentration of wastewater and wastewater in the samples, as well as on the initial introduction of cells of the strain Chlorella vulgaris AK № 001. Since according to the results of this study, the strain Chlorella vulgaris AK № 001 eliminated a completely unpleasant odour in samples with a lower concentration of sewage sludge on the 16-17th days, and in the samples «Sludge + waste water + Chlorella vulgaris AK № 001 - 25ml / 25ml» by 20 The second day there is a faint, muddy smell. According to the analysis of the above table 1, it was revealed that in order to effectively and quickly improve the smell of water with the highest concentration of sewage sludge, it is necessary to add 15 million cells /ml.

For the sample «Waste sludge + wastewater + Chlorella vulgaris AK № 001 - 6.25ml / 43.75ml», an initial application of cells with a titer of 10 million was sufficient. Based on the study, it was found that to improve the organoleptic characteristics of water and for the purpose of bioremediation, the use of the Chlorella vulgaris algae culture is sufficient.

The study found that the algae Chlorella vulgaris have a high cumulative activity in relation to phenolic compounds. Thus, algae from the genus Chlorella can be used in the future for the purification of wastewater from phenolic compounds to standard values [18].

As a result of the studies, it has been investigated that chlorella, by adapting, is included in the consistency of the reservoir, and the species composition of planktonic algae shifts toward green algae [19]. It is shown that the main amount of biogens entering the reservoir is used for biological processes that contribute to the self-purification of the reservoir. The predominance of green algae in algocenosis is a factor in restraining the development of blue-green, and therefore, preventing the «bloom» of water and improving its quality [20].

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