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Применение микробиологических
показателей в оценке качества воды

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Application of microbiological indexes is in
the estimation of quality of water

В статье представлен детальный анализ различных микробиологических показателей, которые можно использовать при оценке качества воды. На основании применения основных и интегрированных микробиологических показателей, а также физиологических группы водных микроорганизмов возможно проведение мониторинга санитарно-экологического состояния водных объектов разных категорий и назначений

Ключевые слова: микробиологические показатели, бактериопланктон, гетеротрофы, качество воды, мониторинг

The detailed analysis of different microbiological indexes that can be used for the estimation of quality of water is presented in the article. Application of basic and integrated microbiological indexes, and also different physiological the groups of water microorganisms are allowed by realization of monitoring of the sanitary-ecological state of water objects of different categories and setting

Key words: microbiological indicators, bacterioplankton, heterotrophs, water quality, monitoring

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One of the modern problems of hydrogeology is the assessment of sanitary state of water bodies of any category (drinking water, fishery, recreation, transportation, narrowly industrial purposes). Solving the problem of water safety for human health occurs in two key areas: water quality and quality of the fish, because they are able to cumulate many contaminants. The study of the role of bacteria in biogeochemical transformations of organic matter and chemical elements in an aqueous medium, the objective laws of natural cleaning of reservoirs, water quality formation are very important in view of the large-scale anthropogenic pressure on aquatic ecosystems) [2, 145c.; 4, c.446 – 449; 8, 148c.; 9, c. 91–194; 14, c.19; 16, 111c.].

The global monitoring system, which is based on three groups of indicators: basic; optional and global importance. Living organisms are at the global (the first in this list – coliform bacteria) [18, 91c]. Regardless of the choice of the object of observation, which characterizes the change of water quality, bio-indication allows you to

enter the forecast of possible health effects of fish, and ultimately to humans. To determine the suitability of a reservoir for water used different approaches (basin, the ecosystem and organism) and methods (chemical, bacteriological and biological). Principles of bioindication using microorganisms are mainly based on data on the composition, the amount and functional activity of the microbial population [6, 274c.]. Bacteriological method allows us to study microorganisms only by the qualitative or both qualitatively and quantitatively [1, c.64–69; 9, c.91–94.]. At the same time, the traditional quantitative analysis is usually widely used for the classification of water bodies according to their degree of contamination by microorganisms, including and pathogenic, and quality – at physiological groups of microorganisms (various indicators of pollution). Water for drinking necessarily usage standardized against bacteriological, according to the standards. Certain health requirements are also presented to water fishery ponds.

The analysis of data showed that the evaluation of the health of water use a lot of microbiological parameters, which can be divided into three groups:

1. Main: a) total bacterial count (TBC) – integrating indicator of total microorganisms and bacteria (secondary) water pollution, characterizing the type of reservoir, trophic level, the rate of eutrophication, toxic effects of synthetic surfactants [3, 256 c.; 5, c.211–215; 17, 111c.]; b) morphological composition of bacterial plankton (number of spherical shape, rods, spores and their ratio, size) [3, 256 c.; 10, c.107–129; 12, c.45–53; 13, c.70–82; 15, 189c.]; c) the number of heterotrophic bacteria (saprophytes, beat-extract agar) and oligotrophic bacteria (beat-extract agar: 10) – the indexes of the recycling process of large concentration of nitrogen-containing substances and readily available organic matter in the reservoir [3, 256c.; 11, 300c.]; d) coliforms – binding indicator of fecal contamination for counting coli-titer and coli-index of drinking water reservoirs, fishery and recreational purposes; e) the degree of intensity of the oxygen regime (bacterial respiration) by A. Antipchuk – the index of minimum content of oxygen in the water, causing fish kills [2, 145c.]; f) aggregation of bacterial plankton (%) – the number of microorganisms in associations – an indicator of the intensity of bacterial mineralization of organic matter [3, 256c.].

2. Integrated: a) bacterial decomposition-rate amount of biodegradable organic matter and regenerated nutrients in the pond by M. Ierusalimskiy [7, 241c.]; b) index of water purity by S. Kuznetsov – the disposition to number of saprophytes and amount of bacterial plankton (TBC) [11, 300c.]; c) trophic index by N. Gavryshova – exponent eutrophication and processes of self-purification [5, 211–215c.]; d) the coefficient of mineralization by L. Kondratyeva- an indicator of the activity of individual stages of the nitrogen cycle [10, c.107–129]; e) the disposition to amount of total biochemical oxygen demand and bichrom acid capacity – characteristic of the qualitative composition of organic matter in water bodies (lakes) [12, c.45–53]; f) the ratio of the specific activity of bacteria – an indicator of bacterial transformation of primary products formed by photosynthesis, which determines the natural category of reservoirs under anthropogenic load [3, 145c.]. g) P/ B- coefficient – ratio of the specific activity of bacteria – an indicator of bacterial transformation of primary products formed by photosynthesis, which allows to determine the category of natural water bodies. The index is useful for the classification of water bodies in the conditions of

anthropogenic load, it increases when changing the category of the reservoir – from oligotrophic reservoirs (lakes) to mesotrophic, and eutrophic – reduced even with an increase in bacterial density [3, 256c].

3. Individual physiological groups of microorganisms – indicators of various types of contaminants, because the species composition of the bacterial population is determined by the nature of the contamination introduced and their ability to destruction : a) the test culture (*E. coli*, bacteriophage, viruses) – of microorganisms for the diagnosis of typical pollutants ; b) RNA-phages, viruses, *Staphylococcus aureus*, *Enterococcus faecalis*, *Proteus mirabilis* and *P. vulgaris*, sulfidredutsiruyuschih clostridial spores; c) single specific physiological groups accumulating various contaminants (metals, pesticides, hydrocarbons); d) sulphie-reducing bacteria – an indicator of the danger of hydrogen sulfide; e) algobakterial complexes – indicators of degradation of phenol; f) oxidizing bacteria – an indicator of the intensity of water pollution by oil and others; g) nitrifying bacteria 1 and phase 2 – Indicators of intensity of decomposition of ammonia and nitrite, acidification potential, eutrophication; h) aktinomitsety- indicators odors of water [1, c.64-69; 17, c.21-38; 18, 91c].

Thus different values of aquatic organisms are the signal of impending trouble in the state of the pond before the concentrations of certain chemical compounds have reached or exceeded levels of maximum allowable concentrations, and the total water quality meet the requirements. Thus microbiological indicators assess the sanitary condition of water bodies and its ability to cleanse itself, make it possible to take preventive measures for their protection and to determine the environmental strategy [4, c. 446-449; 6, 247c; 8, 148c.; 14, 19c.; 16, 111c.; 17, c. 21-38].

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