MONITORING OF WASTEWATER PURIFICATION PROCESS

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Abstract: There were conducted the researches to identify new correlation between traditional controlling process indicators of cleaning stock water from phosphates and concentration of phosphates in purified water that can be used for the development of new techniques.
Analytical laboratory data of the current purification station were carried out with the use of the Pearson correlation coefficient to detect a connection between concentration of phosphates in the purified water and four kinds of hydrobiological data using Microsoft Excel a computer program with functions Corel batch analysis.
The most informative for monitoring of purification from the phosphates is the indicator of the number of types of hydrobionts. Change of concentration of phosphates goes in antiphase to the amount of types of hydrobionts. Therefore, for the convenience of the users there was completed the visualization of the existing trend using the introduced by the authors index-modified number of hydrobionts.
There was presented an algorithm monitoring the process of sewage purification from phosphates, which requires the creation of a database and preliminary plotting of dependence of phosphates Sf concentration on the number of hydrobionts NG. The further displaying of laboratory data indicator NG on the schedule allows to predict the expected concentration of phosphates Sf in purified sewage and in case of poor forecast to carry out operational actions. The survey is based on the basis of a new methodology, which was transferred for the introduction to "Chernihivodokanal" (Chernihiv, Ukraine).
Keywords: sewage, phosphates, informative indicators, the expressive method, wastewater, monitoring of the quality of purification process.

1. Introduction

Increase of water pollution around the world makes undeniable the urgency of preserving this important resource on the planet. This task is appropriate to solve by preventing the pollution of surface water by not enough purified sewage. It is known that in Ukraine, almost 100 % of the existing specialized sewage-purification facilities do not provide the required level of purification on certain components [1]. The complexity of the problem of water conservation is that the existing methods of sewage control on some stages are too long or require complex equipment, do not provide timely information necessary for managing the process.

A significant part of the sewage purification stations of Ukraine works using biological method of wastewater purification. Much attention is given to it in the published sources [2–15]. Authors distinguish the certain types of hydrobionts, which provide purification from certain pollutants [2–6]. New direction in Ukraine is being implemented under the supervision of the properties of magnetically detected biosorbents for sewage purification from heavy metals [7]. Properties of biosorbents are also examined in the works [8–12]. It is clear that a further stage in the work of the introduction of these new methods will be creation of regulations of sewage purification plants required by employees. But even the traditional methods of purifying are not enough stocked with domestic methods of process controlling and harmonized in Ukraine by international standards. That's why in the works [13–17] the need to improve not only the methods of sewage purification from a variety of pollutants but methods of control over the purification process is emphasized. For example, for such dangerous pollutants as phosphates it's actual to create in addition to the existing documents, new methods of operative control over the purification process, so that existing methods only allow to state the results, and monitoring of purification process doesn't actually exist. Control of phosphates is carried out according to the standard ISO 6878:2004, harmonized in Ukraine DSTU 6878:2008 "Water quality. Determination of phosphorus. Spectrometric method using ammonium molybdate"(enter. 01.01.2010). This method allows to define the actual content of the phosphates in the water, but does not provide the control of process and to predict results.

The aim is improvement of the approaches for development of the new method and standard documentation for purification of sewage from phosphates.

Research objectives are setting the new dependence of traditional control indicators of purification of sewage from phosphates on concentration of phosphates in purified sewage that can be used for development of new methods of express control of de-phosphating process.

2. Research methods

To define a new dependence of control indicators were used as research material the laboratory data of SE "Chernihivodokanal" (Chernihiv, Ukraine) within six months [16]. The analytical study conducted by the authors using the Pearson correlation coefficient to detect a relationship between concentration of phosphates in purified sewage at the exit of purification station (on one hand) and hydro biological indices of aeration tanks (on the other hand) using a computer program Microsoft Excel, functions Corel batch analysis.

As the control indicators for purification process from phosphates were used four types of traditional indicators (volume of sludge – 500–880 mg/dm^3, the dose of sludge – 2.5–4.1 g/dm^3, the sediment index – 190–284 cm^3/g, as well as the number of hydrobionts – 10–15).

3. Research resutls

It was found that among the examined in the researched range of indicators there is a weak correlation, to the most informative indicator for purification from phosphates belongs some types of the hydrobionts characteristic for satisfactory operation of sludge: "sediment index- phosphates" provide the correlation coefficient C_{cor}=–0.14638; "the number of hydrobionts, characteristic for satisfactory work of aeration tanks. (HZR)-phosphates have C_{cor}=–0,39381; "the volume of the sludge – phosphates" C_{cor}= =–0,21502; "a dose of sludge-phosphates" C_{cor}=–0,0485. The most informative for monitoring the process of purification from phosphates was an indicator of the number of hydrobionts types, characteristic for satisfactory work of aeration tanks. The use of the rest indicators (that are required at a purifying station that is the costs of reagents, the energy, the work completed by the personnel) turns out in this case not enough effective.

The most informative established indicator was used for working out the algorithm of monitoring the purification process. The analysis showed that the process of changing the concentration of phosphates goes simultaneously in anti-phase to the number of types of hydrobionts, characteristic for satisfactory operation of sludge. Visualization of an existing trend according to the concentration of phosphates for convenience of users was held [16] using the introduced by us the

index-modified number of types of hydrobionts (Nmod) by the formula

$$Nmod=L–N_G,$$

where L – auxiliary indicator of phase change as for the number of the hydrobionts, N_G – the number of hydrobionts.

It has allowed to develop an algorithm of monitoring the process presented in **Fig. 1.**

The traditional method allows to define the contents of the phosphates in the water, but does not provide the control of wastewater purification process, forecasting results, implementation of operational actions by the personnel of the station, that is, there is no monitoring of the purification process. The use of express-method of control process is offered in addition to the traditional methods of sewage control, which are traditionally according to ISO 6878:2004, harmonized in Ukraine, DSTU 6878:2008 "Water quality. Determination of phosphorus. Spectrum method using ammonium molibdate".

4. Discussion of the results

Monitoring of wastewater purification process needs (as can be seen from **Fig. 1**) accumulation of data (database) and an earlier plotting of correlation of phosphates Sf concentration and the number of hydrobionts of types N_G by actual data of a particular wastewater purification plant. The personnel of wastewater purification plant uses the data in the schedule of laboratory data as for the indicator NG allows to predict the expected concentration of phosphates Sf in sewage, and in case of poor forecast to undertake operational actions.

The proposed algorithm for express-control of phosphates is designed to complement the existing mechanism on DSTU 6878:2008 "Water quality. Determination of phosphorus.

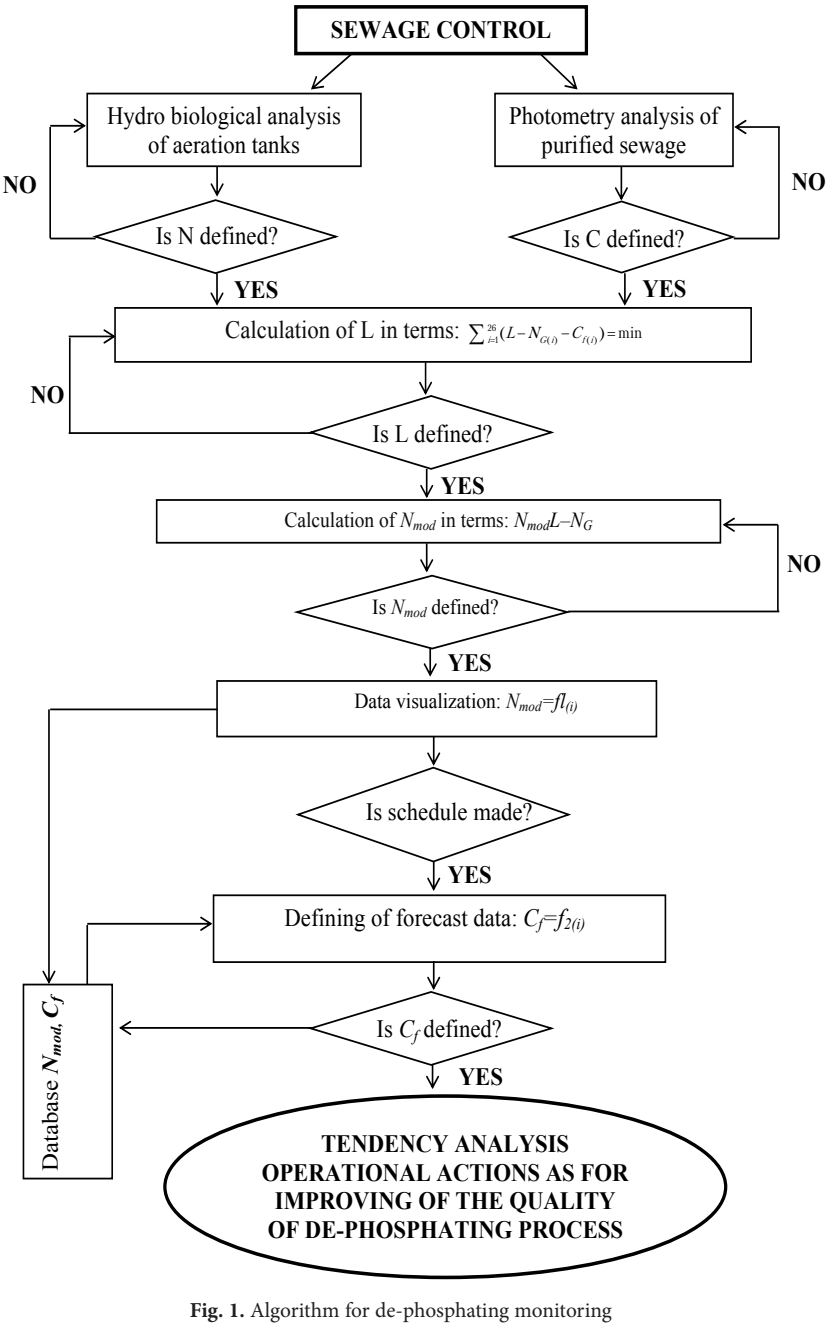

Fig. 1. Algorithm for de-phosphating monitoring

Spectrum method using ammonium molibdate. Further work is planned to develop in the direction of detection of new correlation of key indicators of sewage purification process in order to create new express techniques and introducing them into production. The results of this study has been placed in the framework of the new "Methods of control of de-phosphating process", which was transferred for introduction to State enterprise "Chernihivodokanal" (Chernihiv, Ukraine).

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