RESEARCH ON THE INFLUENCE OF THE ANTISCALANT ON THE BIOFOULING PROCESS

Hromnadska M., Trus I.
National Technical University of Ukraine
«Igor Sikorsky Kyiv Polytechnic Institute», hro.maryna@gmail.com

Abstract

This work is devoted to the study of water stabilization treatment using the reagent RT-2024-3 in Kyiv tap water. This work also presents the results of an experimental study of the nature of biofouling on the surface of the glass materials using the antiscalant RT-2024-3.

Keywords: *antiscalant, water stabilization treatment, biofouling.*

Introduction. Water is a key resource that is widely used both in industry and in everyday life. However, special attention must be paid to preserving its quality, since in the natural environment water often contains impurities that can harm equipment. These contaminants cause scale formation, corrosion processes and biofouling, which ultimately reduces the efficiency of water circulation systems [1]. One of the most effective ways to combat such problems is the use of reagents for water stabilization treatment.

Stabilization water treatment helps reduce the risk of scale and corrosion, which in turn increases the efficiency of water treatment systems and extends the service life of equipment. In addition, the competent selection and use of stabilization reagents makes the water treatment process more economical and reduces the costs of maintenance and repair of equipment [2]. The use of reagents to prevent biofouling and stabilize water quality is advisable in cases where it is necessary to ensure stable and efficient operation of water systems, reduce operating costs, avoid equipment failures and improve water quality indicators at industrial enterprises and water treatment complexes.

The purpose of our work was to study the effect of the reagent RT-2024-3 on the biofouling process and its stabilization properties in tap water in Kyiv.

Materials and methods. To assess the effectiveness of the antiscalant in preventing scale formation, Kyiv tap water was used as a medium. The calculated amount of antiscalant RT-2024-3 was added to 0.1 dm^3 of tap water samples. The samples were kept for 12 hours at a temperature of 90-100 °C. After that, the residual hardness of the water was measured by the trilonometric method. The antiscalant effect and stabilization effect were assessed by reducing the hardness of the water after heating the solution with the antiscalant in relation to the initial value.

To analyze the nature of biofouling, glass plates were placed in containers with tap water to which 1% of the total volume of antiscalant RT-2024-3 was added. Tap water served as a control. To determine the total number of microorganisms on the surface of the glass plates, washes were made. Washes were inoculated onto MPA nutrient medium with subsequent thermostating for 48 hours at a temperature of 37 °C.

Results and discussion. The study was conducted to determine the stabilization effect and anti-scale effect in the tap water of Kyiv with a hardness of 4,3 mg-eq/dm^3 depending on the dose of antiscalant RT-2024-3. With an increase in the dose of the

studied antiscalant from 2,5 to 50,0 mg/dm^3, its effectiveness increases. At an antiscalant dose of 2,5 mg/dm^3, the stabilization effect was 8.5 %, while at a dose of 50,0 mg/dm^3, the stabilization effect was 85.5%. According to the results of the studies, it was found that at an antiscalant dose of 2,5 mg/dm^3, the antiscalant effect reaches 94%. An antiscalant effect of 95…99 % can be achieved by using antiscalant in doses of 6,25 mg/dm^3 and higher. The anti-scaling effect changes little when using RT-2024-3 in doses of 20,0…50,0 mg/dm^3 and is stably high. In general, the anti-scaling effect was within 94…99 % in the entire range of anti-scalant concentrations used.

As a result of studies of the biodiversity of fouling of glass plates, it was found that the formation of biofouling on glass plates was uneven. Glass plates placed in an aqueous medium using RT-2024-3 contained $8{,}48\times10^4$ CFU/cm^2 at the end of the experiment. Control glass plates were less intensively fouled, the number of microorganisms on which was $2{,}99\times10^4$ CFU/cm^2 at the end of the experiment. The growth of biological contamination on experimental glass plates may be due, in particular, to the presence of biogenic elements in the composition of reagents for water treatment.

The operating conditions of water supply systems generally contribute to the growth of biological pollution, this is due, in particular, to the presence of biogenic elements in the composition of reagents used for water treatment in water supply systems. In turn, the high content of biological pollution in water reduces heat transfer, causes an intensive increase in the corrosion rate, thus reducing the efficiency and productivity of industrial enterprises.

Conclusions. According to the results of the conducted studies, it was determined that at doses of antiscalant RT-2024-3 within 25…50 mg/dm^3, the maximum anti-scaling effect (up to 99 %) and stabilization effect (up to 85 %) is achieved.

It was established that the formation of biofouling on the surface of glass plates occurs within seven days from the beginning of the experiment. Glass plates placed in an aqueous medium with the addition of RT-2024-3 contained $8{,}48\times10^4$ CFU/cm^2 at the end of the experiment.

Considering the formation of biofouling on glass plates, it is recommended to carry out biocidal treatment using the specified antiscalant. To provide more detailed recommendations, it is worth conducting further studies in conditions that are close to those in heat exchange systems.

References:

1. Coetser S. E., Cloete T. E. Biofouling and biocorrosion in industrial water systems. *Critical reviews in microbiology*. 2005. Vol. 31, no. 4. P. 213-232. URL: https://doi.org/10.1080/10408410500304074.

2. Trus I., Gomelya M. Applications of antiscalantsin circulating water supply systems. *Journal of Chemical Technology and Metallurgy*. 2023. Vol. 58, no. 2. P. 360-366. URL: https://doi.org/10.59957/jctm.v58i2.62.