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MEMBRANES FROM MODIFIED CELLULOSE FOR IRON REMOVAL FROM WATER

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Iron contamination of water is one of the pressing environmental and technical issues of modern times. Excess iron in drinking water negatively affects its organoleptic properties, causes sediment formation, changes color, creates favorable conditions for bacterial growth, and leads to pipeline clogging. The sources of such contamination can be both natural – the release of iron from soils and minerals – and anthropogenic, resulting from pipe corrosion and industrial activities. Considering the limits established by the World Health Organization (no more than 0.3 mg/dm^3 of iron in drinking water [1]), there is a growing need to implement efficient and environmentally safe methods for water purification [2-4].

In connection with the growing interest in sustainable development and the reduction of synthetic polymer use, increasing attention is being paid to biomaterials based on natural polymers. Among them, oxidized organosolv cellulose is particularly promising – an environmentally friendly, biodegradable material obtained by treating lignocellulosic raw materials with organic solvents. Importantly, this method of cellulose production is significantly less toxic compared to conventional pulping processes and does not require the use of aggressive chemicals, making it environmentally safe and suitable for large-scale industrial applications. Organosolv cellulose is characterized by high thermal and chemical stability, good mechanical properties, and a considerable ability for modification, which makes it an effective basis for the development of filtration materials capable of removing iron from water without harming the environment [5-6].

In the study, two types of filter materials based on organosolv cellulose obtained from Miscanthus stems were used. The first type was prepared from oxidized–organosolv cellulose fibers pre-modified with an aminating reagent in an amount of 40 % relative to the oven-dry fiber weight. During the formation of the samples, polyvinyl alcohol (PVA) was added to the fibrous pulp in an amount of 20 % relative to the oven-dry fiber weight.

The second type of filter material was also produced from oxidized-organosolv cellulose fibers modified with an aminating mixture, followed by the application of a surface coating through treatment with a 5 % PVA solution.

The obtained samples were tested in a non-flow cell using a model solution containing iron ions. The permeate was analyzed in accordance with DSTU ISO 6332:2003 [7] , which specifies the photometric method for determining the iron content in water using 1,10-phenanthroline.

The results (Fig. 1) showed that the initial concentration of iron ions (Fe^{3+}) in the model solution was 1.90 mg/dm³. After filtration through the first-type membrane, the residual iron concentration was 0.128 mg/dm³, while for the second-type membrane, this value was 0.087 mg/dm³.

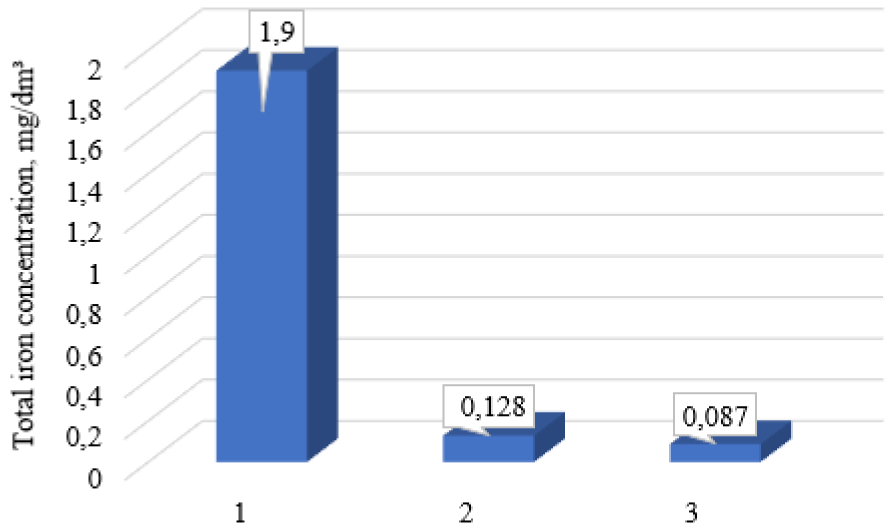

Figure 1 – Total iron concentration in the solutions: 1 – initial model solution; 2 – permeate filtered through the membrane with bulk addition of PVA; 3 – permeate filtered through the membrane with surface application of PVA.

The obtained results indicate effective iron removal from water by both types of filter materials. In both cases, the residual Fe^{3+} concentrations did not exceed the hygienic standard established by DSanPiN 2.2.4-171-10 (up to 0.3 mg/dm³ for drinking water), confirming the suitability of the membranes for application in water purification systems.

Although the second-type membrane showed a slightly lower residual iron concentration, the first variant is more economically feasible due to its simpler fabrication process and lower reagent consumption, making it preferable for further implementation and practical application.

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МАТЕМАТИЧНЕ ПРОГНОЗУВАННЯ МІКРОКЛІМАТУ ДЛЯ КОСМІЧНОГО АПАРАТУ НА ПЕРЕДСТАРТОВИХ ОПЕРАЦІЯХ

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Прогнозування певних умов у головному обтічнику ракети–носія для розміщення космічного апарата є сучасними актуальними вимогами. Ці умови безпечного перебування космічного апарата у повітряному об’ємі головного обтічника мають чіткі межі для створення мікроклімату [1–4]. Космічний апарат має наступні чутливі елементи: сонячні батареї, оптичні інструменти,