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MEMBRANES FROM RENEWABLE MODIFIED RAW MATERIALS

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Abstract
The work describes the result of the investigation of the effect of monoethanolamine and epichlorohydrin on the properties of membrane from modified cellulosic fibers. The consumption of modifiers and the duration of cellulose fiber modification have a significant impact on the structure of the obtained membranes and their properties. The applied chemical reagents act as plasticizers. The obtained membranes are characterized by high strength and elasticity. A simultaneous increase in the consumption of monoethanolamine and epichlorohydrin, as well as the temperature of the process, leads to a decrease in the productivity of the membranes.

Keyword*: membrane, cellulose, modification, filtration, productivity.*

In connection with the constant increase in the pollution of natural water, there is a need to ensure access to high-quality drinking water. This can be achieved by thorough wastewater treatment, in particular by filtering through highly selective materials. To date, the creation of new membranes for use in water treatment to remove harmful compounds from water is still an important task for researchers in the field of ecology. Membrane technologies are considered quite effective in removing various pollutants from water, providing effective wastewater treatment. The use of plant-based natural polymers is well known in the wastewater treatment [1, 2]. Cellulose application in the manufacture of membranes is necessary and promising, but their widespread use is limited by mechanical parameters and unsatisfactory selectivity. To solve this problem, it is possible to give the cellulose fiber the necessary characteristics by modifying it.

The paper presented the result of the investigation of the influence of monoethanolamine and epichlorohydrin on the properties of membrane from modified cellulose fibers. As a raw material, sulfated coniferous bleached cellulose was used. Cellulose was cut to the size of 1 x 1 cm and soaked in a desiccator with distilled water for 20 minutes for swelling. Then the mass was grinded to the degree of grinding 92 ± 2 °SR. Modification of the prepared cellulose was carried out at a mass concentration of 4%. The consumption of modifying substances was 5-15% of the mass of cellulose fiber. The ratio of monoethanolamine:epichlorohydrin was 1:1. Duration of modification was 2-6 hours. Temperature was 120-240 min. After the end of the modification process, the suspension was diluted with water to achieve a fiber concentration of 0.4% and membranes were formed. In laboratory conditions membranes were formed using laboratory sheet-casting apparatus and Buchner funnel. Membrane sheets were prepared with a weight of 80 g/m^2. The results of the study indicate that the process of forming cellulose membranes significantly affects their structural properties (Fig

1). The process of membranes formationn on a laboratory sheet-casting apparatus is accompanied by significant fiber losses, as a result of which sheets were obtained with the weight that did not correspond to the calculated mass. Fiber losses are quite strongly dependent on the content of modifying substances in the fiber suspension. When the content of monoethenolamine and epichlorohydrin increased from 5 to 15%, the turbidity of sub-net waters visually decreased. In general, fiber losses were 35-20%. Moreover, the greater the consumption of modifiers, the smaller the fiber loss.

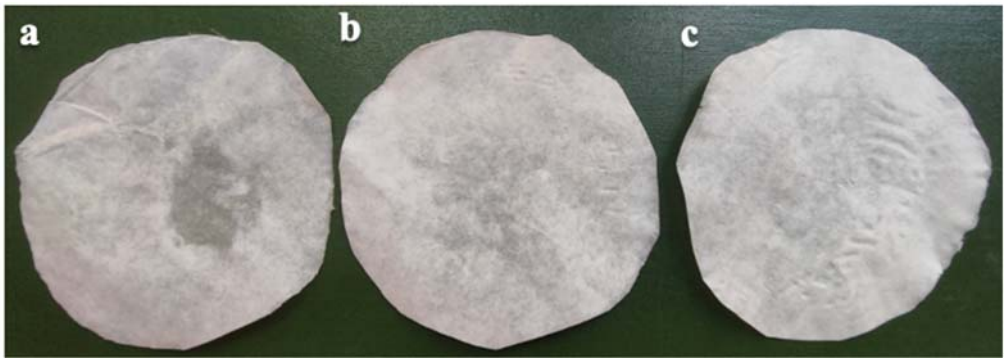

Figure 1. The results of the formation of cellulose membranes: a) with modifiers consumption of 5%; b) with a modifier consumption of 10%; c) with modifiers consumption of 15%

It is obvious that the modifier acts as a binding agent. Research results indicate that with an increase in modifier consumption from 5 to 15%, the thickness of membrane increases from 6.4 to 9.6 microns.

It is also worth noting that the drying temperature significantly affects the structure of the membranes. It is obvious that the increased drying temperature contributes to significant plasticization of the modifier on the surface of the cellulose fiber, as a result of which the finished samples become significantly stiffer. Membrane samples dried at room temperature are characterized by high plasticity and elasticity

Modifier content affects performance, as does cellulose fiber modification temperature. In the case of an increase in the content of the modifier, a decrease in the performance of the membranes is observed.

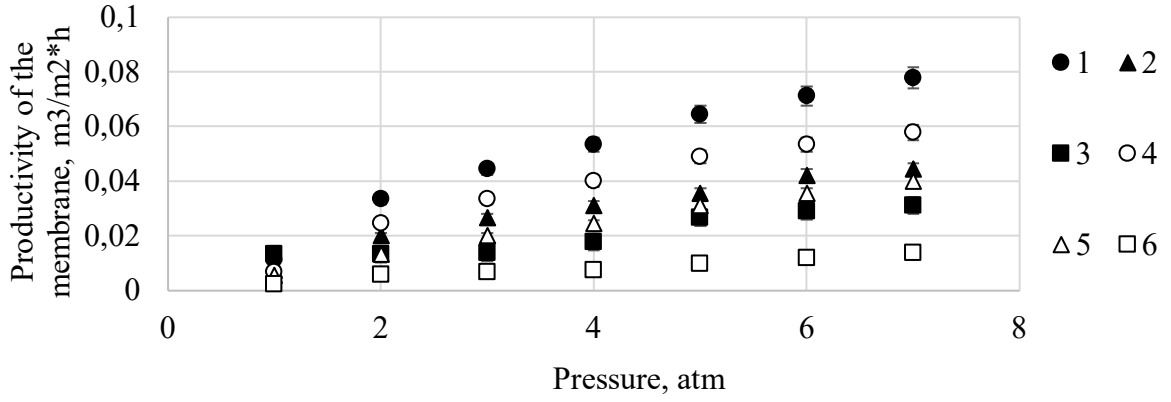

Figure 2. The effect of pressure on the productivity of membranes made from modified cellulose fiber, obtained with different modifiers content and at different temperature: 1 –5%, 20 ºC; 2 – 5%, 40 ºC; 3 –5%, 60 ºC; 4 –15%, 20 ºC; 5 –15%, 40 ºC; 6 –15%, 60 ºC

The obtained results can be used as a basis for further research related to the optimization of the parameters of obtaining and using membranes from modified cellulose fiber.

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МЕМБРАНИ З ВІДНОВЛЮВАЛЬНОЇ МОДИФІКОВАНОЇ СИРОВИНИ

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Ключові слова*: мембрана, целюлоза, модифікація, фільтрація, продуктивність.*

Анотація

У роботі описано результати дослідження впливу моноетаноламіну та епіхлоргідрину на властивості мембрани з модифікованих целюлозних волокон. Витрата модифікаторів і тривалість модифікації целюлозних волокон суттєво впливають на структуру отриманих мембран та їх властивості. Використані хімічні реагенти виконують роль пластифікаторів. Отримані мембрани характеризуються високою міцністю та еластичністю. Одночасне збільшення витрати моноетаноламіну та епіхлоргідрину, а також температури процесу призводить до зниження продуктивності мембран.