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MEMBRANE TECHNOLOGY FOR THE EXTRACTION OF LITHIUM WITH THE USE OF CROWN ETHER

Filippova I.S. (ITMO), **Moshkova M.A.** (ITMO), **Poponina N.A.** (ITMO)
Scientific supervisor – doctor of chemical sciences, associate professor Krivoshapkina E.F. (ITMO)

Introduction. Lithium is a key element in the production of electronics and energy storage systems, and demand for it is growing steadily. The cost of lithium has risen by 320% in the last three years and experts predict that this trend will continue. In this context, the issue of lithium extraction is becoming increasingly important. One of the most promising approaches is extraction from associated brines, which contain significant concentrations of lithium, making this method economically viable [1].

Body part of the report summary. The aim of this study is to extract lithium using membrane technology (direct lithium extraction process). This innovative approach will enable oil producers to generate additional revenue by extracting high purity lithium from wastewater generated from oil and gas condensate fields. The proposed multilayer nanofiltration membrane is based on crown ether modified polyamide (PA). In particular, polyamide membranes modified with 4′-aminobenzo-15-crown-5-ether (4AB15C5) show improved performance characteristics. The selective binding capacity of 4AB15C5 enables these membranes to exhibit high efficiency and selectivity in the lithium extraction process. The molecular structure of 4AB15C5 contains two benzene rings linked by a chain of 15 atoms, which enhances its ability to selectively interact with lithium ions. As a result, these membranes promote the preferential permeation of lithium ions while preventing the permeation of other cations, thus increasing the purity of the final product. In this work, a multilayer nanofiltration membrane with an exclusive Li+ transport channel was developed by layer-by-layer surface polymerisation.

In order to study the properties of the membrane modified with 4AB15C5, we applied a series of methods that confirmed the successful synthesis and the presence of a crown ether layer on the membrane surface: Fourier transform infrared spectroscopy allowed us to analyse the composition of the multilayer modified membrane; ion chromatography provided information on the interaction of 4AB15C5 with lithium ions in dilute solution; scanning electron microscopy helped to determine the morphology of the obtained membrane [2].

Conclusions. In summary, the use of polyamide membranes modified with crown ethers appears to be a promising method for lithium extraction from associated brines in oil and gas fields. This approach not only satisfies the growing demand for lithium, but also promotes the development of environmentally sustainable technologies. The introduction of such innovative solutions will reduce the negative environmental impact and increase the scalability of lithium extraction processes.

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References:

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2. Sun Y. et al., “A novel approach for the selective extraction of Li+ from the leaching solution of spent lithium-ion batteries using benzo-15-crown-5 ether as extractant” Separation and Purification Technology, vol. 237, Apr. 2020.