UDC 66.081

ZIF-8 MEMBRANE FOR LITHIUM EXTRACTION

Doroshenko I.V. (ITMO), **Dmitrieva M.A.** (ITMO), **Filippova I.S.** (ITMO)
Scientific supervisor – doctor of chemical sciences,
associate professor Krivoshapkina E.F. (ITMO)

Introduction. A constantly-growing need for electric-powered vehicles and sophisticated electronics operating on lithium-ion batteries has made lithium the «Energy Metal in the 21st Century» [1]. Global lithium demand is increasing significantly, and it is expected to become scarce. Continued growth of lithium-ion batteries at an annual compound rate can reach approximately 30 percent [2]. That is why notable attention is being paid towards recapturing waste and converting it into a raw material, increasing the metal's availability, reducing material use, and making lithium production less resource-intensive. Direct lithium extraction technologies have the needed potential to significantly increase the supply of lithium from water projects, including operations with waste waters of oil and gas condensate fields.

Body part of the report summary. The idea of the project is to extract lithium with the membrane technology (direct lithium extraction process), using it as an extractor module. This technology will allow oil producing companies to gain additional profit from the associated waters of oil and gas condensate fields.

The multi-layer composite membrane is based on cellulose triacetate and is modified with a metal-organic framework zeolitic imidazolate framework-8 (ZIF-8). Cellulose triacetate is an affordable carrier material for metal-organic framework structures with a good stability during the metal-extraction process [3]. A choice in favor of ZIF-8 for ion-selective separation was made due to its homogeneous porosity and substantial surface areas, allowing this framework to be highly suitable for lithium recovery applications [4].

To analyze properties of ZIF-8 and membrane various research methods have been applied. These methods include X-Ray Diffraction Analysis in order to control the results of ZIF-8 synthesis, Fourier Transform Infrared Spectroscopy to analyze the modified membrane, Ion Chromatography to study interactions between ZIF-8 and lithium ions in a diluted solution, and other approaches.

Conclusions. There was conducted a comprehensive analysis of lithium extraction methods. It resulted in choosing the ion-selective membrane as the most promising technology for lithium extraction from oilfield waters. Afterwards, practically-applicable modifications of the multi-layer membrane have been researched.

References:

1. L. V. Garcia, Y.-C. Ho, M. M. Myo Thant, D. S. Han, and J. W. Lim, "Lithium in a Sustainable Circular Economy: A Comprehensive Review," Processes, vol. 11, no. 2, p. 418, Jan. 2023, doi: 10.3390/pr11020418.

2. Marcelo Azevedo, Magdalena Baczyńska, Ken Hoffman, and Aleksandra Krauze. "Lithium mining: How new production technologies could fuel the global EV revolution", 2022

3. C. Paredes and E. Rodríguez de San Miguel, "Selective lithium extraction and concentration from diluted alkaline aqueous media by a polymer inclusion membrane and application to seawater," *Desalination*, vol. 487, p. 114500, Aug. 2020, doi: 10.1016/j.desal.2020.114500.

4. H. Yu *et al.*, "Selective lithium extraction from diluted binary solutions using metal-organic frameworks (MOF)-based membrane capacitive deionization (MCDI)," *Desalination*, vol. 556, p. 116569, Jun. 2023, doi: 10.1016/j.desal.2023.116569.