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INVESTIGATION OF MEMBRANE DISTILLATION FOR THE RECOVERY OF VALUABLE PRODUCTS

Oleksandra Kataieva[1], Ahmed Tijani Ahmed[1], Ivan Červeňanský[1]

[1]Department of Chemical and Biochemical Engineering, Faculty of Chemical and Food Technology, Slovak University of Technology, Radlinského 9, 821 37 Bratislava, Slovakia

e-mail: ivan.cervenansky@stuba.sk

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Membrane distillation is a thermally driven membrane separation process based on the transport of water vapour through a porous hydrophobic membrane. Due to its ability to treat highly concentrated solutions at relatively low operating temperatures, membrane distillation represents a promising alternative for wastewater treatment, desalination and recovery of valuable compounds from liquid streams. This work is focused on the investigation of the possibilities of using direct contact membrane distillation for concentrating salt solutions and recovering valuable products, focusing on lithium carbonate crystallization. A laboratory-scale experimental apparatus with a hollow-fiber polypropylene membrane module was designed and operated in a counter-current arrangement. The study involved the construction using a 3D printer and subsequent testing of several membrane modules differing in design parameters such as module length, diameter and packing density. The influence of selected operating parameters, including retentate and permeate temperature, flow rate and initial salt concentration, on the transmembrane flux was experimentally investigated. In addition, a mathematical model describing heat and mass transfer in the membrane module was developed and compared with experimental data. The final part of the study examined the possibility of lithium carbonate crystallization directly in the retentate tank during membrane distillation, focusing on the effect of water removal rate on the quality of produced crystals. The work demonstrates the potential of membrane distillation as a hybrid separation and concentration process suitable for the recovery of valuable substances from concentrated aqueous streams.

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