

APPLICATION POSSIBILITIES OF LOW-PRESSURE MEMBRANE SEPARATION PROCESSES IN THE DAIRY INDUSTRY

Szabolcs Kertész^{1*}, Aws N. Al-Tayawi¹, Gréta Gergely¹, József Richárd Lennert², József Csanádi³, Gábor Veréb¹, Sándor Beszédes¹, Zsuzsanna László¹, Ábrahám Imre⁴, Garabné Ábrahám Nóra⁴, Süveges-Gruber Andrea⁴, Cecilia Hodúr¹

¹Department of Biosystems Engineering, Faculty of Engineering, University of Szeged, Szeged, HUNGARY

²Department of Power Electronics and E-Drives, Audi Hungaria Faculty of Automotive Engineering, Széchenyi István University, Győr, HUNGARY

³Department of Food Engineering, Faculty of Engineering, University of Szeged, Szeged, HUNGARY

⁴Unichem Chemical, Manufacturing and Trading Ltd., Kistelek, HUNGARY

*corresponding author: kertesz@mk.u-szeged.hu

The treatment of dairy wastewater characterized by high organic loads has become of utmost importance. Through the utilization of membrane processes in conjunction with traditional methods, significant alleviation of environmental burdens can be realized. In our research, we investigate the flow dynamics within different low-pressure membrane separation filter modules on the filtration process parameters. Our primary scope was to mitigate membrane fouling, a major drawback, by enhancing membrane surface shear rates. This was achieved through innovative methods involving mechanical vibration of the module and the incorporation of 3D-printed turbulence promoters within the modules. Integration of these promoters into modules allows for manipulation of flow dynamics, thus enhancing membrane separation efficiency. This results in accelerated operation, characterized by increased flux rates, and reduced membrane fouling, leading to lower resistance values. Dairy by-products, such as buttermilk and whey, abundant in dairy processing, are recognized for their nutritional richness and immune-supporting compounds. Our objective is to explore alternative, non-thermal food processing technologies, such as microfiltration (MF) to diminish initial microbial loads while concentrating milk components, and ultrafiltration (UF) for selective concentration of bioactive compounds. In cooperation with an industrial partner, they also test self-produced special cleaning agents with various compositions for cleaning membranes that are fouled in different ways in order to maintain the filtration of the membranes in as many cycles as possible and in compliance with the strict rules of green chemistry principles. The research is funded by the Hungarian National Research, Development and Innovation Office, NKFI-FK-142414 and 2022-1.2.6-TÉT-IPARI-TR-2022-00011 projects.