THE POSSIBILITIES OF MEMBRANE SEPARATION INTENSIFICATION BY 3D PRINTING

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ABSTRACT

The dairy industry uses a large volume of water to produce different, various products, and generates wastewater, which has to be treated efficiently before releasing it into the water bodies. Membrane technology, such as ultrafiltration or nanofiltration, has been often considered as a promising method for dairy wastewater purification as part of a complex cleaning system due to their high energy efficiency and small footprint. However, the membranes are often susceptible to fouling, and contaminants can accumulate on the membrane surface, resulting in different problems, such as permeate flux decline. One of the effective approaches to mitigate the fouling is to improve the hydrodynamic flow conditions using commercially available spacers in the feed channel or membrane module. Compared to simple plastic spacers, the application of 3D printed spacers can result in significant improvements of the overall filtration efficiency due to their characteristics. Since the significant development of three-dimensional (3D) printing proceeded significantly cheaper and unimaginably fine and detailed 3D printed elements that can be integrated easily into membrane filter modules.

In this study, the possibilities of the intensification of different membrane separation processes using 3D printing promoters have been reviewed based on literature survey. Especially, the advantages of the 3D printed elements integrated into membrane module were summarized. Some laboratory experiments were carried out with different polylactic acid (PLA) 3D printed element configuration in batch, classical cell and in a continuous operation, cross-flow membrane module using polyethersulfone ultrafiltration membranes and model dairy wastewater. The implication of this research is that the 3D printed promoters have shown great promise in terms of flux enhancement and fouling reduction. However, the factors to be considered in promoter fabrication by 3D printing technique are important, and should be researched more details in the near future.

Key words: membrane fouling, 3D printed elements, spacers, ultrafiltration

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