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Surface modification of commercial cellulose acetate membranes via low pressure plasma for improved reverse osmosis performance: A case study of pomegranate juice concentration

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Reverse osmosis (RO) has been of interest to the fruit juice industry for about 30 years. Despite its many advantages, one of obstacles to the widespread use of RO membranes is their proneness to surface fouling, which may result in declined permeate flux. It has been demonstrated that increasing surface hydrophilicity of the polymeric membranes can reduce affinity of organic foulants and increase transmembrane flux. Low pressure plasma treatment is an emerging technique to rapidly and uniformly modify surface characteristics of membrane without affecting bulk material. In this study, commercial cellulose acetate (CA) membranes have been treated with low pressure nitrogen plasma (LPNP) to improve performance during RO of fruit juices. The effect of plasma power and exposure duration on surface properties has been characterized by surface free energy (SFE) components. The performance of novel LPNP modified RO membranes were compared with that of commercial ones based on flux profile and concentration degree achieved during RO of pomegranate juice. The descriptive components of SFE of the membranes revealed that surface hydrophilicity was significantly improved following LPNP modification. However, no direct correlation was observed between hydrophilicity and plasma power or exposure time. Of all process parameters tested in this study, 90W plasma power with an exposure time of 15min exhibited the most hydrophilic nature, which were determined mainly by the electron donor component of SFE (γ_{SV-}) and SFE of interactions (ΔG_{wi}). The CA RO membranes modified using selected LPNP parameters were performance benchmarked against commercial ones. The benchmark tests showed about 108-117% improvement in permeate flux throughout the operation without compromising selectivity.

Biography

Pelin Onsekizoglu Bagci was graduated from Department of Food Engineering, Hacettepe University (Ankara, Turkey) at 2002. She received her MSc (2005) and PhD (2010) degrees from the same department. She completed a Postdoctoral research focusing synthesis of nanocarrier structures in the lab of Prof. Dr. Sundaram Gunasekaran at University of Wisconsin-Madison. She currently is an Associate Professor in the Department of Food Engineering at Trakya University, Edirne, Turkey. Her primary research goals are directed toward analyzing potentialities of membrane operations for non-thermal processing of fruit juices. Her research activity has mainly concerned with the modelling and analysis of the operating conditions, the comparisons between the proposed integrated membrane operations with the conventional ones in terms of efficiency and quality attributes.

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