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ABSTRACTS
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Maximizing flux in direct contact membrane distillation by using nanofiber membranes

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Membrane distillation (MD) is an emerging separation technology, whose largest potential lies in desalination of highly concentrated solutions, which cannot be treated by reverse osmosis (RO). Despite many attractive features, MD is still waiting for a large-scale industrial application, owing to low fluxes when compared to RO.

MD is a thermal process, driven by a partial vapor pressure difference between a hot feed and a cold distillate. The ideal membrane would have maximum transmembrane flux, distillate purity and thermal efficiency, but these conflicting requirements are limited by pore size, membrane hydrophobicity and thickness. Nanofiber membranes may offer a solution thanks to their fascinating surface to volume ratio, attractive in applications where high porosity is desirable.

Electrospun PVDF nanofiber membranes were tested at various conditions on a direct-contact (DCMD) unit, in order to find optimum properties, mainly membrane thickness and lamination parameters. In addition, the performance was compared to commonly available film PTFE, PE and PES membranes. It was observed that at high recirculation velocity, very thin nanofiber membranes can have nearly 30% higher fluxes that the best reference membranes, but it comes at a cost of higher energy losses via conduction across the membrane. The salt retention of all membranes was above 99%.

Considering that DCMD is the least energy efficient configuration, nanofiber membranes show a promising way to achieve high fluxes with MD. As both mass and heat transfer are connected, it is best to develop new membranes with target application in mind, for the specific membrane module and operational conditions.

Keywords: DCMD, PVDF, Nanofiber, Membrane distillation, Maximum flux

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Effects of heterogeneous photocatalysis on membrane filtration properties using TiO_2 coated membranes

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Membrane filtration is a widely used water treatment technology. Beside its advantages membrane fouling sustains a significant problem. Recently, membrane filtration combined with advanced oxidation processes has become a highly investigated and promising area. In order to improve the

membrane filtration qualities it can be combined with heterogeneous photocatalysis. By coating the membrane with TiO_2 the advantages of membrane filtration -which is the physical separation- and the advantage of photocatalysis –the non-selective organic matter degradation- are combined. Coating membranes may improve filtration qualities e.g. retention and hydrophilicity and may reduce fouling.

In this work polyethersulfone membrane (average pore size 0.2 μm) was coated with TiO_2 by filtering through the membrane the catalyst suspension in a dead end cell. The feasibility of the coated membranes for model dairy wastewater treatment was investigated. The coated membranes were used to filter model dairy wastewater solution in the presence and absence of UV irradiation. Membrane flux and fouling was measured and calculated in every case. The membrane's retention and photocatalytic activity was investigated by turbidity and chemical oxygen demand (COD) measurements.

Keywords: Coated membrane, Photocatalytic membrane, TiO_2, Dairy wastewater, Membrane fouling

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Advanced cleaning strategy for ultrafiltration — analysis of individual steps of a short CIP protocol

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Ultrafiltration is used in multiple types of water sources to remove suspended matter and also dissolved organic compounds depending on their molecular mass and on the molecular mass cut-off of the membrane. An effective chemical cleaning strategy is required to maintain a sustainable operation of Ultrafiltration systems, especially for those applications with a high fouling potential, such as water reuse.

In this study, an advanced cleaning strategy is presented and validated with sustainable long term operation. The main focus of this study, rather than presentation of the strategy, is the evaluation of each single step within the whole sequence and determination of their contribution and effectiveness to the whole efficiency of the cleaning. This detailed evaluation and comparison drives directly to the identification of the best, improved and simplified protocol for the advanced cleaning strategy.

This article compiles the experimental study done with commercial DOW™ ultrafiltration modules in continuous operation using real waste water as feed source, coming from the secondary effluent from a municipal wastewater treatment plant. The statistical analysis and the results obtained will conclude to the most effective recipe applicable using the new cleaning strategy.

Keywords: Ultrafiltration, Cleaning strategy, Fouling