SURFACE MODIFICATION OF POLYVINYLIDENE DIFLUORIDE (PVDF) MICROFILTRATION MEMBRANES BY POLYDOPAMINE GRAFTING FOR MORE EFFECTIVE FILTRATION OF OIL EMULSIONS

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Abstract

Membrane separation has several advantages (e.g. excellent cleaning efficiency, chemical-free and easy operation) that allow it to be used effectively in oily wastewater treatment. However, during the operation of the membranes their pores can easily become fouled by the hydrophobic pollutants, which ends up in reduced lifetime. Consequently, it is necessary to increase the antifouling properties of the membranes.

Polydopamine-based membrane modification can be used to form a thin layer on the membrane surface, which due to its excellent adhesion properties can result in a stable, homogeneous, hydrophilic surface, thus reducing the adhesion of the contaminants (e.g. the oil droplets). The advantage of this method (compared to other membrane modification by chemical "grafting") is that the polymerization takes place spontaneously in one step, no need for radical formation (UV light) and for additives (initiator, cross-linking reagent) for the reaction to occure, thus it is a cheaper, faster and more scalable technique [1].

In the present study, the surface of a PVDF microfiltration membrane was grafted with polydopamine for different reaction times (1-8h) in order to improve their filtration parameters (flux, filtration resistance) during the separation of oil-water emulsions (c=400 ppm).

The water contact angle results show that compared to the neat PVDF membrane a slightly more hydrophilic surface (81.1° vs 76.2°) was obtained with 1h of polydopamine modification, while after 8h of reaction time the contact angle was reduced even more to 51.1°. The significantly more hydrophilic membrane surfaces resulted an improvement in filtration of the oil emulsion: the flux was increased by 140% after 8h of modification, compared to the unmodified membrane (36 vs 88 L/m^2h) and a significant increase in the flux recovery ratio (29.2 to 71.7%) was also observed indicating the elevated cleanability of the modified membranes. The modification with polydopamine also improved the purification efficiency of the effluent, reaching 99.9% reduction of the turbidity and more than 96% reduction of the chemical oxygen demand (COD) by using the 1h-grafted membrane, while for the unmodified membrane these values were 98.3% and 94.1%, respectively.

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References

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