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Fully green membranes prepared combining the bio-polymer PHBHV with the green solvent CyreneTM

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To fully respond to the requirements related to the reduction of waste generation and in accordance with the basic principles of the Green Chemistry, this work aimed to develop innovative fully sustainable membranes exploiting raw bio-based materials (polymer, solvent and additive) for targeted applications [1]. For the first time, the bio-polymer poly(hydroxybutyrate-co-hydroxyvalerate) (PHBHV) was combined with the green solvent dihydrolevoglucosenone (Cyrene™) for the preparation of membranes exhibiting different structures [2]. Bio-based additives, such as epoxidized broccoli oil (EBO), were also employed to tune membrane properties and morphology. The membranes were prepared by phase-inversion techniques evaluating the effect of different variables such as: polymer concentration, evaporation time and additives concentration. Asymmetric membranes with suitable mechanical properties were successfully obtained by introducing a pre-evaporation (EIPS) step before the coagulation bath. Besides the improvement of the mechanical properties, this EIPS step also strongly influenced the membrane morphology, including its cross-sectional microstructure and overall porosity. It was, thus, possible to produce more diversified membrane architectures, from dense to porous ones. The different morphologies obtained resulted in membranes permeable to water (up to 350 L/(m^2 h bar), with a pore size in the UF/MF range, and in asymmetric membranes displaying a dense top layer. These latter ones, thanks to the solvent resistance properties of PHBHV, were applied in pervaporation for the separation of a MeOH/MTBE organic mixture at its azeotropic point. The membranes resulted selective for MeOH as a consequence of their hydrophilic nature and of the small dimension of the alcohol molecule, reaching a selectivity of about 30. Porous and dense membranes showed also interesting stability performance when tested under specific degradation environments for long periods of time, suggesting possible applications for the filtration of aqueous solutions.

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References

[1] F. Galiano, K. Brice˜no, T. Marino, A. Molino, K.V. Christensen, A. Figoli, Advances in biopolymer-based membrane preparation and applications, J. Membr. Sci. 564 (2018) 562–586
[2] P. Tomietto, F. Russo, F. Galiano, P. Loulergue, S. Salerno, L. Paugam, J.-L. Audic, L. De Bartolo, A. Figoli, Sustainable fabrication and pervaporation application of bio-based membranes: Combining a polyhydroxyalkanoate (PHA) as biopolymer and CyreneTM as green solvent, J. Memb. Sci 643 (2022) 120061