

ENHANCING MEMBRANE DISTILLATION WITH SUSTAINABLE PVDF MEMBRANES: THE ROLE OF GREEN SOLVENT AND FUNCTIONAL COATING

**M. C. Carnevale¹, F. Russo¹, A. Gordano¹, A. Corozzi², M. Raimondo², D. Venturi³,
M. Aquino⁴, S. Santoro⁴, E. Curcio⁴, A. Figoli¹, A. Criscuoli¹**

¹ Institute on Membrane Technology (CNR-ITM), Via P. Bucci 17/C 87036 Rende (CS), Italy

² Institute of Science, Technology and Sustainability for Ceramics (ISSMC), Via Granarolo, 64 - 48018 Faenza (RA), Italy

³ GVS SpA, via Roma 50, 40069 Zola Predosa (BO), Italy

⁴ Dept. of Environmental Engineering (DIAM), University of Calabria, Via P. Bucci 45, 87036 Rende (CS), Italy
mc.carnevale@itm.cnr.it

This study evaluates the performance of the membrane distillation (MD) process using supported flat-sheet PVDF membranes fabricated via non-solvent induced phase separation (NIPS) with γ -valerolactone (GVL) as a sustainable solvent. Membrane surfaces were further functionalized with nanostructured, chemically tailored coatings to enhance liquid repellency and separation performance. To improve permeate flux (by reducing thickness) while ensuring mechanical stability, membranes were cast onto GVS non-woven supports (Sanko). Membranes with pore sizes of 0.2–0.5 μm were scaled from lab-scale (6 \times 12 cm) to pilot-scale (21 \times 21 cm). For the 0.5 μm membranes (SUP-PGVL0.5), various casting gap thicknesses (150–300 μm) were tested to determine the optimal one. Casting conditions were optimized both under ambient and controlled (climatic chamber) environments. To confirm reproducibility, five SUP-PGVL0.5 membranes with 300 μm thickness were produced using a single coagulation bath. Experimental tests were conducted in a Direct Contact MD (DCMD) configuration using deionized water as the feed, under defined operating conditions. Variations in casting thickness were found to directly affect membrane structure and permeate flux. The SUP-PGVL0.5_300 membrane exhibited the highest average permeate flux, reaching 13.5 $\text{kg}/\text{m}^2\cdot\text{h}$, with performance remaining stable over time. This membrane was thus identified as a strong candidate for scale-up. Reproducibility tests on the SUP-PGVL0.5_300 membranes, all prepared in the same coagulation bath, demonstrated consistent flux values and temporal performance, confirming the reliability of the fabrication process. This controlled approach was specifically designed to minimize variability and yielded membranes with reproducible properties.

Tests comparing coated and uncoated SUP-PGVL0.5_300 membranes showed a reduction in flux from 13.5 to 7.5 $\text{kg}/\text{m}^2\cdot\text{h}$, respectively. Nevertheless, performance reproducibility and long-term stability were confirmed for the coated membranes. Finally, reproducibility tests on supported membranes with a pore size of 0.2 μm (SUP-PGVL0.2_300) also demonstrated stable flux and consistent performance over time.

Acknowledgements



This work has received funding by the European Commission within MEASURED project under grant agreement N° 101091887. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or HaDEA. Neither the European Union nor HaDEA can be held responsible for them.