

SUSTAINABLE MEMBRANE FABRICATION USING NON-TOXIC SOLVENTS. CASE STUDY ON THE USE OF γ -VALEROLACTONE (GVL)

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Abstract

The growing attention toward climate change, industrial safety, and environmental pollution has revealed the urgent need for more sustainable and safer practices in membrane fabrication. Conventional membrane preparations are still largely dependent on hazardous organic solvents such as N,N-dimethylformamide (DMF), N,N-dimethylacetamide (DMAc), and N-methyl-2-pyrrolidone (NMP), widely adopted for their polymer dissolution efficiency but classified as substances of very high concern due to their reprotoxic and environmentally harmful profiles. Recent research has focused on the replacement of traditional solvents with green alternatives in accordance with the 12 Principles of Green Chemistry, particularly the number 5 principle, which encourages the use of safer solvents and auxiliaries [1,2]. Among various promising candidates, γ -valerolactone (GVL), a bio-based and biodegradable solvent derived from lignocellulosic biomass, will be evaluated and compared, as an alternative to conventional toxic solvents in the preparation of poly(vinylidene fluoride) (PVDF) membranes through phase inversion techniques such as Non-Solvent Induced Phase Separation (NIPS) and Vapor Induced Phase Separation (VIPS) [3]. The study evaluated the effects of different coagulation baths (ethanol and isopropanol) on membrane morphology, pore size distribution, and overall performance in Membrane Distillation (MD) applications. The results demonstrated that GVL enables the production of membranes with controlled porosity (84-86%) and thickness (90-120 μm), comparable to those obtained with conventional solvents. Additionally, the membranes exhibited a sponge-like morphology, with well-defined pores suitable for MD processes. This study, conducted within the framework of the MEASURED project [4], confirmed that GVL represents a valid greener solvent for sustainable membrane preparation.

Keywords: Membrane fabrication; green solvents; sustainable polymeric membrane; phase inversion techniques

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