

## Performance Prediction of ZIF-8/Polymer Blend Mixed Matrix Membrane by Permeation Models for CO<sub>2</sub>/CH<sub>4</sub> Separation

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**Abstract :** Mixed matrix membranes (MMM) with moderate filler loading have been shown to improve the transport properties of polymers and its blends for many gas separations. Currently, the main focus of the research is to invent the new membranes materials and its combinations for gas separation. PES/PSF (80/20%) blend with dispersed inorganic porous zeolitic imidazolate framework (ZIF-8) MMM were fabricated at 10, 20 and 30% ZIF-8 loading by the solvent evaporation method using solvent N-methyl-2 pyrrolidone (NMP). Membranes were characterized in terms of thermal stability by using thermal gravimetric analyzer (TGA) and it was found that, due to addition of ZIF-8 nano particle, the developed membranes exhibit the improved thermal stability and adequate contact between filler particles and the polymer chains with the thickness in the ranges of 90  $\mu\text{m}$  to 100  $\mu\text{m}$ . For the pure gas permeation, the effect of ZIF-8 loading at 3 atmosphere on permeability (Barrer) and selectivity were investigated. By the addition of 10 w/w % ZIF-8 into polymer blend, increased the permeability about two times for gases CO<sub>2</sub> and CH<sub>4</sub>, while the ideal selectivity shows a slight loss (~15 to 16 %) for pure PES/ PSF blend membrane. For the higher ZIF-8 loadings ( $\geq 30$  w/w %) permeability's were increasing but selectivity gets started to reduce rapidly due agglomeration of nanoparticles, but it was found that, still the selectivity improvement with the addition of filler into glassy polymer blend up to 25% and 30% loading.

The theoretical prediction predicts the good agreement of experimental and calculated relative permeability at lower loading of ZIF-8, but at higher loading the absolute average relative error percent (AARE %) was found higher. The models predicted under ideal morphology, result confirmed that, decrease in the AARE % in the order of, Maxwell model > Lewis-Neilson model > Singh model. Hence, Singh model was found to be in a better agreement with the experimental data for the prediction of relative permeability of CO<sub>2</sub> in PES/PSF blend polymer MMM at different volume fraction of ZIF-8. It was observed that, addition of 15 to 25 w/w % ZIF-8 was suitable as an optimum filler loading for membrane formulation.

**Keywords :** Mixed Matrix Membrane, Zeolitic Imidazole Framework (ZIF-8), Gas separation, Permeability, Permeation models, polymer blend.