

# Fabrication and Utilization of Bottle Plastic Waste Polyethylene Terephthalate and Modification with Pebax as Membrane for H<sub>2</sub>/CO<sub>2</sub> Gas Separation

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**Abstract-** Polyethylene terephthalate (PET), a commonly used polymer in packaging, contributes to a significant environmental issue due to the disposal of millions of PET bottles daily. Dealing with the challenge of non-biodegradable PET waste is crucial. This waste, originating from PET plastic bottles, holds potential for repurposing as a thin membrane for gas separation. In this research, we fabricated a PET/Pebax membrane through flat-sheet modulation. The membrane will be used to separate H<sub>2</sub> from CO<sub>2</sub>, given hydrogen's global prominence as a clean energy source due to fuel cell progress and environmental concerns like climate change. It's primarily produced through hydrocarbon steam reforming and the water-gas shift reaction. This separation of hydrogen from CO<sub>2</sub> is essential for obtaining pure hydrogen from syngas or water-gas shift reaction outputs. We subsequently subjected it to analysis using FTIR and Scanning Electron Microscopy (SEM) to explore its gas transportation mechanism, permeability performance, and selectiveness. SEM analysis revealed a smoother surface

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and fewer cracks on the PET membrane when compared to higher Pebax concentrations. The membrane operates based on adsorption and diffusion principles. Optimal conditions for CO<sub>2</sub> and H<sub>2</sub> gasses were achieved with a 12%wt Pebax variation. The addition of Pebax led to increased selectivity for H<sub>2</sub>/CO<sub>2</sub>, with values of 0.95±0.01; 2.47±0.12 ; 2.93±0.04 and 5.03±0.09 at neat, 6, 9, and 12%wt Pebax concentrations, respectively. From these results the purity of the separation of H<sub>2</sub> to CO<sub>2</sub> reached 84%.

**Keywords-** Polyethylene terephthalate; Pebax; Gas Separation; Flat-sheet.