Diamine Modified Polymeric Membranes for Hydrogen/Carbon Dioxide Separation

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Abstract: The separation of H_2/CO_2 is technologically crucial to produce clean and renewable H_2-based energy. There are several established methods used to separate H_2 from CO_2, but membrane based separation is becoming more prominent due to high energy efficiency and cost effectiveness. However, separation efficiency of existing polymeric membranes is limited due to unfavourable diffusivity and selectivity between H_2 and CO_2. As such, research objective for this work is to investigate the effectiveness of diamine modification towards two different polymeric membrane materials, PSf and P-84, on their performance in H_2/CO_2 separation. The effects of different operating pressures and modification time on the permeance and selectivity are also studied. Comparison of pure and modified membranes will be further interpreted. The fabrication of membranes is done by using controlled evaporation method. Then, the prepared membranes will undergo diamine modification using BuDA for 10 and 30 minutes reaction times. All samples were analyzed by gas permeation test for separation performance and SEM and FTIR for membranes characterization. From SEM analysis, the images show that both polymers have defect-free surfaces and porous cross-section structures. FTIR spectra validate the cross-linking reaction by observing the existence of adsorption peak at 1529 cm^{-1}. This specific characteristic peak implies the occurrence of C-N stretch within the membranes. The gas permeation test shows the respective modification towards P-84 and PSf for 10 and 30 minutes reaction times causes H_2 permeability to increase drastically. Based on the experimental result, P-84 membrane with 10 minutes BuDA-modification reaction time and 5 bar operating pressure gives the best H_2 permeability performance. By increasing the time to 30 minutes, the H_2/CO_2 selectivity of both polymers were increased to 4.97 and 6.09, respectively compared to its neat membranes.

Keywords: Diamine; Gas Separation; Hydrogen; Membrane