

Preparation and Characterisation of Pineapple Peel Waste as Nanoadsorbent Incorporated into Pebax 1657 Nanocomposite Membrane for CO₂/CH₄ Separation

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Abstract:

Membrane processes have received extensive attention for gas separation especially by the chemical and petrochemical industry. Recently, there have been intensive efforts in the development of better and more robust membrane material called nanocomposite membranes which involved the incorporation of nanoadsorbents such as zeolite and silica in the polymer matrix. However, the cost of the aforementioned nanoadsorbents is high which led to the researches on alternative low cost nanoadsorbents prepared from agricultural wastes. In this work, we investigate the use of pineapple peel waste as nanoadsorbent filled in the polyether block amide (Pebax) nanocomposite membrane to improve the membrane's performance in separation of gases. The effectiveness of the membrane was evaluated based on the permeability and CO₂/CH₄ selectivity. Several permeation experiments were carried out by controlling the Pebax concentration (6 wt %), dipping time (5 s), and temperature (25 ± 5 °C) with varying the feed pressure (1–3 bar) and nanoadsorbent concentration (0.5–8 wt % of polymer weight). The pore structure of the newly synthesised nanoadsorbent, structure modification, dispersion of the nanoadsorbents in the polymer matrix, and functional groups exist in the surface of the nanocomposite membranes were analysed using Brunauer–Emmett–Teller (BET), field emission scanning electron microscope (FESEM), energy-dispersive X-ray (EDX), and Fourier transform infrared spectroscopy (FTIR) analyses. The findings from this study suggested that the optimum feed pressure was at 2 bar with 5 wt % nanoadsorbent concentration in the coating solution which showed a significant improvement in CO₂ permeance (225.90 to 1682.76 Barrer) and CO₂/CH₄ selectivity (10.71 to 33.17) in comparison to plain PVDF/Pebax. The incorporation of this low cost nanoadsorbents were reported to alter the polymer membrane structure and chemical properties which led to an improvement of the membrane's separation ability. "Peer-review under responsibility of the scientific committee of the 11th Malaysian Technical Universities Conference on Engineering & Technology"

Keywords: Pineapple Waste; Adsorbent; Pebax; Nanocomposite Membrane; CO₂/CH₄ Separation

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