Research on carbon dioxide adsorption and desorption experiments of 0.5mm membrane containing 50:50 PBAT/PBS

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Abstract

PBAT is an environmentally friendly polymer known for its excellent biodegradability and mechanical properties, amalgamating the desirable traits of PBA and PBT. PBS, on the other hand, is a milky white resin with no discernible odor, easily decomposing into carbon dioxide and water via microbial or enzymatic action, and boasting commendable heat resistance characteristics. This study involved blending PBAT and PBS in a 50:50 ratio and utilizing carbon dioxide as the adsorbent for adsorption experiments. Findings indicated a progressive increase in carbon dioxide adsorption over time until equilibrium was attained. Notably, the adsorption capacity was markedly lower at elevated temperatures but substantially higher under increased pressure conditions.

Introduction

In today's materials science landscape, the quest for environmentally friendly alternatives poses a significant challenge. Polybutylene adipate terephthalate (PBAT) and polybutylene succinate (PBS) emerge as promising materials, offering a blend of biodegradability and mechanical robustness. This study aims to blend PBAT and PBS in equal proportions to produce a film, aiming for superior composite material performance. Additionally, the study employs carbon dioxide as an adsorbent to explore its adsorption properties under varying temperature and pressure conditions. Through systematic experimentation and analysis, we seek to comprehend how carbon dioxide interacts with the PBAT/PBS film, offering insights for future material design and environmental technology advancement. This research is anticipated to foster innovation in eco-friendly materials and contribute to sustainable development.

Materials and Methods

PBAT/PBS 50:50 samples were exposed to carbon dioxide (CO2) in a high-pressure vessel under specific temperature and pressure conditions. The weight loss of the samples over time was measured to determine CO2 adsorption. This was calculated by subtracting the initial weight of the PBAT/PBS 50:50 samples from the total mass of PBAT/PBS 50:50 and CO2 measured.

To minimize gas diffusion losses, weight measurements were taken 30 seconds after removing the samples from the high-pressure vessel. However, to address potential CO2 diffusion losses during sample transfer, linear fitting and extrapolation of desorption curves were conducted to refine the adsorption data.

Result and Discussion

In our study, we conducted adsorption and desorption tests to find the best saturation time and evaluate CO2 solubility in the polymer under different conditions. Gas diffusion loss during adsorption required desorption tests for accuracy. We found a linear relationship between residual adsorption and desorption time, following Fick's law. Extrapolating the desorption curve allowed precise estimation of initial adsorption.

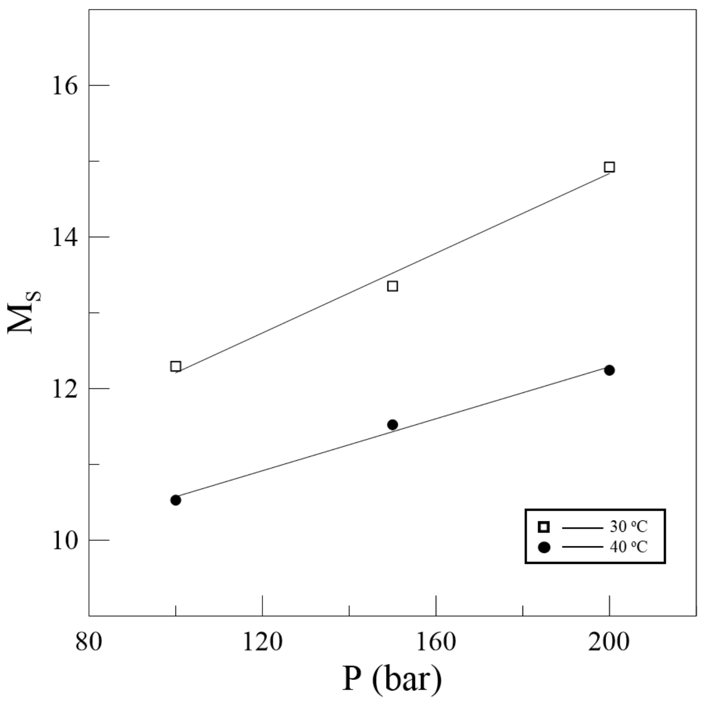

Figure 1. The relationship between adsorption capacity and pressure at different operating temperatures.

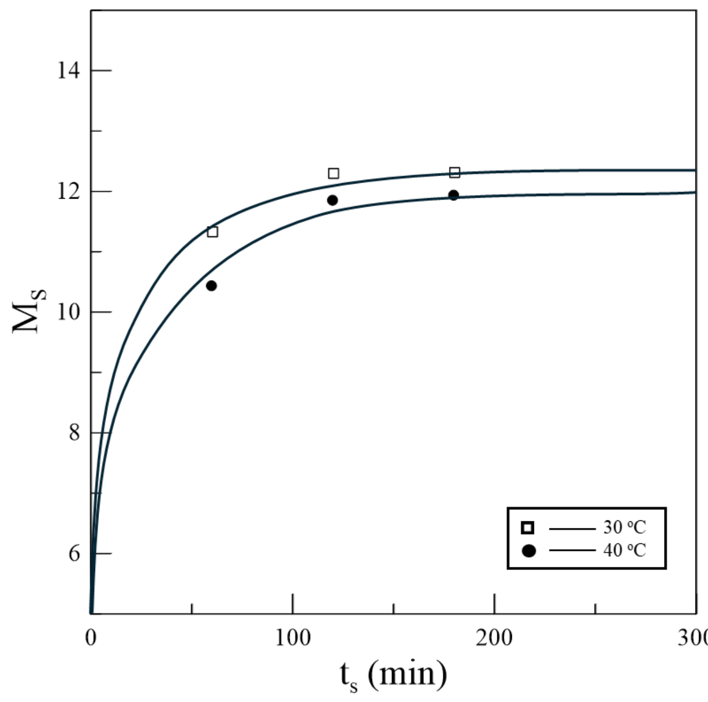

Figure 2. The relationship between adsorption capacity and adsorption duration at different temperatures under 10 MPa pressure.

In Figure 1, we observe a linear increase in CO2 solubility with rising saturation pressure, indicating varying CO2 adsorption under different pressures. Similarly, Figure 2 also illustrates this relationship, suggesting varying CO2 adsorption with changing pressure conditions.

Conclusion

Our study shows that carbon dioxide adsorption on PBAT/PBS(0.5mm membrane) follows a typical pattern, initially increasing with time and then reaching equilibrium. We found that lower temperatures favor higher adsorption capacities, while higher pressures lead to increased capacities. This underscores the importance of temperature and pressure control in optimizing CO2 capture using PBAT/PBS membranes. Future research could focus on enhancing adsorption efficiency under different environmental conditions.

Reference

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