Adsorption and desorption experiments using carbon dioxide as the adsorbent for membranes containing 30:70 pbat/pbs

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1.ABSTRACT

This study focuses on the experimental investigation of the carbon dioxide (CO_2) adsorption-desorption behavior and mechanical properties of a blend consisting of Polybutylene Adipate Terephthalate (PBAT) and Polybutylene Succinate (PBS). The experiment explores various temperature, pressure, and time conditions to understand the intricate relationship between the CO_2 adsorption process and the mechanical properties of the PBAT-PBS blend. PBAT and PBS are biodegradable plastics. PBAT is polymerized from monomers such as adipic acid, 1,4-butanediol and terephthalic acid. The molecular structure of PBAT gives it soft and malleable properties, making it suitable for applications requiring greater flexibility. Due to its rela-tively low melting point and high melt flowability, it is easy to process and is suitable for methods such as blow molding and injection molding. PBS is composed of monomers such as adipic acid, 1,4-butanediol, and succinic acid. It is relatively hard and possesses a certain level of strength, making it suitable for applications requiring higher mechanical performance. It also has a higher melting point and heat resistance, performing well in applications with elevated temperatures. The biodegradability properties of the two plastics complement each other and can improve the overall biodegradation properties when blended. The experiment concludes that with a composition of 30% PBAT and 70% PBS, higher pressure results in increased adsorption-desorption quantities, and lower temperatures lead to higher adsorption-desorption quantities.

2.Introduction

In recent years, the development of advanced membrane technologies has gained significant traction due to their vital role in addressing environmental challenges and enhancing industrial processes. Among these advancements, the utilization of carbon dioxide (CO_2) as an adsorbent for membranes containing a blend of 30% poly(butylene adipate-co-terephthalate) (PBAT) and 70% polybutylene succinate (PBS) presents a promising avenue for innovation. This paper delves into the exploration of adsorption and desorption phenomena within such membranes, shedding light on their potential applications and contributions to sustainable separation processes.

The blend of PBAT and PBS in a 30:70 ratio represents an intriguing material composition for membrane fabrication. PBAT, a biodegradable polyester, and PBS, a bio-based and biodegradable aliphatic polyester, offer a synergistic combination of mechanical strength, biocompatibility, and environmental sustainability. By leveraging these properties, membranes incorporating this blend exhibit favorable characteristics for various separation applications, including gas separation, wastewater treatment, and environmental remediation.

3.PBAT/PBS

PBAT is a copolyester synthesized from butylene adipate and terephthalate monomers. It possesses excellent mechanical properties and can degrade un-der appropriate conditions into non-toxic by-products, making it an environmentally friendly al-ternative to conventional plastics. Additionally, PBAT is biocompatible, meaning it can be used in contact with food and medical products without ad-verse effects.

When blended together in a 30:70 ratio, PBAT and PBS create a material matrix that combines the desirable properties of both polymers. This blend exhibits enhanced flexibility, mechanical strength, and biodegradability compared to either polymer alone. Moreover, the blend's composition can be tailored to meet specific application requirements, making it a versatile material for various industries, including packaging, agriculture, and biomedical applications.

4.RESULTS AND DISCUSSION

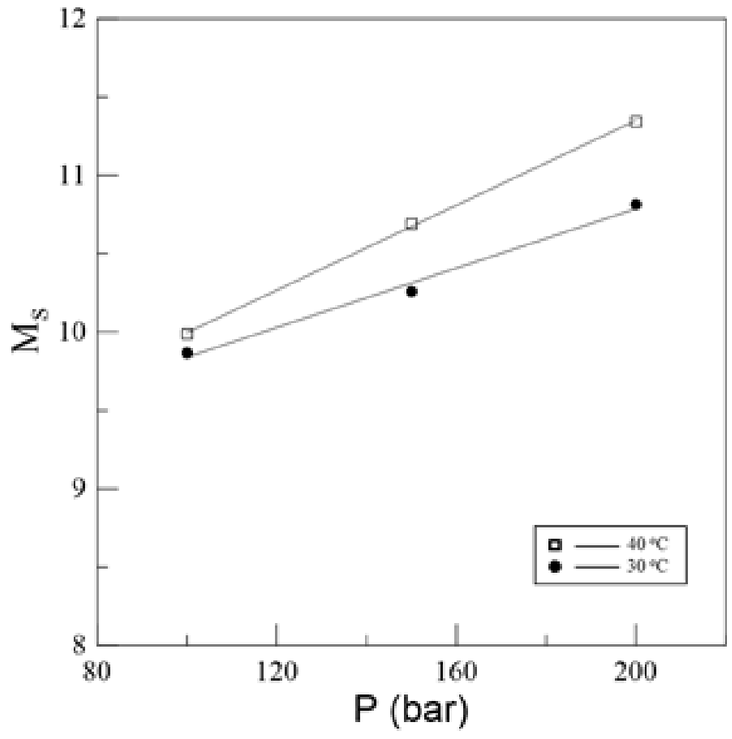

Figure 1. Adsorption quantities in CO_2 different pressures and temperatures

Figure 1 shows that the adsorption quantities of CO_2 increases with increasing pressure, and the adsorp-tion capacity at 40˚C is better than at 30˚C.

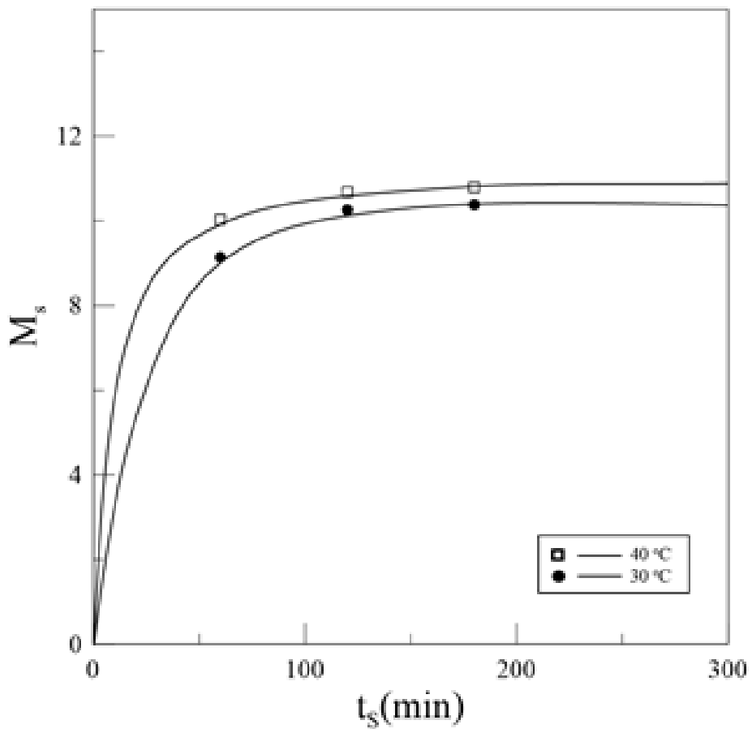

Figure 2. adsorption quantities in CO_2 changes with time

Figure 2 shows that the adsorption quantities of CO_2 increases over time until reaching equilibrium.

5.CONCLUSION

In this paper, for a mixture containing 30% PBAT and 70% PBS, the adsorption of CO_2 increases under high-pressure conditions. This may be because higher pressure enhances the interaction between the gas and the adsorbent material. Additionally, lower temperatures also result in higher adsorption-desorption quantities, possibly due to the increased availability of active sites on the adsorbent material surface, thus enhancing CO_2 adsorption capacity. Therefore, this conclusion supports the idea that, under specific compositions, adjusting pressure and temperature can modulate CO_2 adsorption properties. This has potential significance for addressing climate change and environmental protection.

6.REFERENCES

Dongdong Hu, Kun Xue, Zhen Liu, Zhimei Xu & Ling Zhao, (2022). The essential role of PBS on PBAT foaming under su-percritical CO_2 toward green engineering , Journal of CO_2 Utilization,Volume 60, 101965