Effect of Molecular weight of CO_2-philic additives on CO_2 Diffusion in Polystyrene Microcellular Foaming

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ABSTRACT

The solubility and diffusivity of gas in polymer matrix play crucial roles in controlling the CO_2 foaming process and foam structure. The low solubility and the high diffusion coefficient (*D*) of CO_2 in polymers lead to the difficulty of controlling the CO_2 foaming. In this work, the effect of molecular weight (M_w) of CO_2-philic additives on the diffusion of supercritical CO_2 into and out of polystyrene (PS) was investigated via experiments and DPD dynamics simulations.

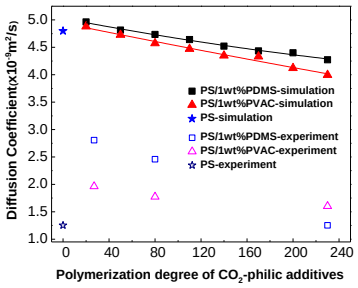

Fig 1. CO_2 diffusion coefficient vs additives with different M_w from DPD and experiment

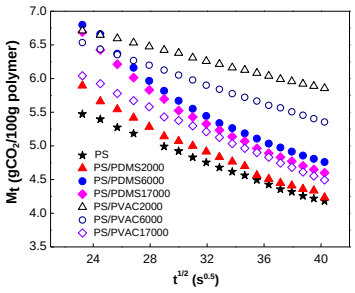

Fig 2. Desorption curves of CO_2 in PS with different additives (the number behind represents the molecular weight)

The CO_2-philic additives with low M_w increased the *D* of CO_2 in PS, while the *D* decreased with the increase of M_w of CO_2-philic additives. The relation between M_w of CO_2-philic additives and the *D* of CO_2 in PS was calculated via DPD simulation, showing a similar variation with diffusion measurements (Fig 1). The desorption test demonstrated the CO_2 desorption rates were smaller in PS with low M_w CO_2-philic additives than that in PS with high M_w additives. Moreover, the CO_2 desorption rates were larger in PS/PDMS than that in PS/ PVAc due to the difference of CO_2 solubility with different additives (Fig 2).

The saturation time of foams was shortened as low M_w CO_2-philic additives increased the *D* of CO_2 in PS. The cell nucleation was favored as low M_w CO_2-philic additives increased the solubility of CO_2 in PS. The slow CO_2 desorption rate in PS with low M_w CO_2-philic additives enabled higher amount of CO_2 retained in the PS. Hence, PS with low M_w CO_2-philic additives foams presented smaller cell size and larger cell density.

REFERENCES

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