Accurate determination of bubble size and expansion ratio for polymer foaming with non-isothermal PBB model

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Abstract

A non-isothermal pressure-balanced bubble-growth (PBB) model has been proposed based on mass, momentum and energy conservation, which additionally considered the decrease in the internal energy of gas due to the work done by gas expansion in bubble. The model could accurately predict the bubble size and expansion ratio for the melt foaming of four polymers for a wide range of cell densities from 1.5×1013 to 1.9×1015 cells/m3. Furthermore, the simulation results indicate that the bubble shell resisted bubble growth and consumed significant energy, preventing the growth of some small nucleations. During the melt foaming process, the energy cost of the linear polymer had a long-term effect, which reduced the bubble size, while that of the long-chain branched polymer had a short-term effect, thereby increasing the expansion ratio. Finally, we defined the gas efficiency of the foaming agent to evaluate the economic feasibility of the foaming agent in a foaming process.

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