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Flame retardancy of microcellular poly(lactic acid) foams prepared by supercritical CO_2-assisted extrusion

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Abstract

Flame-retardant-treated cellulose (FR-cell) was used as bio-based charring agent in combination with ammonium polyphosphate (APP) based intumescent flame retardant (IFR) system to reduce the flammability of poly(lactic acid) (PLA) foams produced by supercritical carbon dioxide (sc-CO_2) assisted extrusion. FR-cell was obtained by surface treatment of cellulose with diammonium phosphate (DAP) and boric acid (BA). To enhance foamability, the inherently low melt strength and slow crystallization rate of PLA was increased by adding epoxy-based chain extender (CE) and montmorillonite (MMT) nanoclay, respectively. The morphology of the foams was examined using water displacement method, scanning electron microscopy (SEM) and energy dispersive X-ray spectrometry (EDS). Thermal properties were assessed using differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). Flammability was evaluated by limiting oxygen index (LOI) measurements, UL-94 tests and pyrolysis combustion flow calorimetry (PCFC). The continuous extrusion foaming technique allowed the preparation of low density PLA foams with uniform microcellular

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