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REACTIVE EXTRUSION OF FLAME RETARDANT POLYPROPYLENE

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PP is an important commodity polymer with good performance. However, its poor fire-resistance restricts its applications. Currently, there is an increasing need for halogen-free flame retardant PP worldwide. Melamine salt of pentaerythritol phosphate (MPP) is a representative composite intumescent flame retardant (IFR) and in its molecule, phosphorus acid (acid source), pentaerythritol (char-forming agent) and melamine (blowing agent) link together via covalent bonds. Such chemical structure can endow MPP with good thermalstability and small molecular polarity.

Reactive extrusion and solid acid catalysis technologies were adopted to synthesize MPP, serving as the intumescent flame retardant for PP. This environmentally-friendly method shows the following advantages as: on one hand, reactive extrusion in a twin screw extruder can effectively mix the viscous reactants difficultly stirred in a conventional reactor, and achieve a continuous synthesis process. On the other hand, the solid acid, silicotungstic acid (STA) serving as a catalyst, can maintain a high conversion even with a relatively lower extrusion temperature and shorter residence time, thus effectively suppressing the foaming during reaction. Furthermore, the solid acid containing Si itself is a good synergist with MPP. This synergistic mechanism may be explained in that the silica and heavy metal ion tungsten involved in STA can thermally stabilize the phosphorus compounds via the formation of silica-phosphate or tungsten-phosphate bonds, reducing the P-O-C bridges scission and maintaining the block of crossing linking structure, thus limiting the degraded product of small molecule to vaporize into the gas phase as fuel, therefore greatly improving the flame retardancy. As a result, the extruded composites can be directly incorporated with PP to prepare flame retardant polymer materials without the additional removal of the catalyst. The obtained flame retardant PP possessed satisfactory flame retardancy and good comprehensive material performances, showing a promising commercial prospective in the future.