

STUDIES OF THERMAL DECOMPOSITION AND FLAMMABILITY OF POLY(HYDROXYAMIDE) (PHA) AND ITS DERIVATIVES

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ABSTRACT: The thermal decomposition and flammability of poly(hydroxyamide) (PHA) as well as its phosphate and halogen derivatives have been investigated by multiple analytical techniques. Pyrolysis gases from these polymers are identified by gas chromatography/mass spectrometry (GC/MS). The residual chars are characterized by FTIR and elemental analysis. Simultaneous thermal analysis (STA) is applied to study the thermal decomposition process. The flammability is measured by a milligram-scale pyrolysis-combustion flow microcalorimeter (PCFC).

It has been found that PHA and its halogen derivatives exhibit extremely low flammability. They all show a two-stage thermal decomposition process, in which the first stage corresponds to cyclization into quasi-PBO structure and the second stage is random scission of PBO backbone. However, phosphate PHA derivatives have a relatively high flammability due to the extensive cleavage of phosphate side groups from the polymer main chain at low temperature. Depending on the types of phosphate groups, the polymers decompose in two or more stages. Most of the PHAs produce a large amount of char, around 40~50%.

The decomposition mechanisms of these polymers have also been proposed by analyzing the composition of volatiles and chars at different temperature ranges using pyrolysis GC/MS, FTIR, and elemental analysis. All three methods confirm that in the first stage of decomposition of PHA and its halogen derivatives, water is released during the formation of PBO structure.