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Flame retardancy of bio-base plastics

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Abstract

This paper describes the evaluation of the flame resistance on bio-based polymer (BBP) and developing inedible woody biomass plastic. Nano aluminum hydroxide nano-$Al(OH)_3$) was used as flame retardant for polyolifin. The effect of nano-$Al(OH)_3$) on flame retardancy of polyolefin was reported. We also developed flame test metho by informing flammability of the combustion process from multi-cone calorimeter. In this research, we studied flame retardancy of poly(lactic acid) and reported flammability of polymer materials by rating of UL-94 using the relationship of heat released rate and time of ignition in multi-cone calorimeter.

Peer-review under responsibility of the organizing committee of the 12th EMSES 2015

-*Keywords:* char; flame retardant; combustion; PLA; cellulose

1. Introduction

Flame retardant property is important especially for polymer products, which various flame retardant materials can be applied for suitable products [1-6]. Petroleum-based plastics are linked to certain environmental problems. One such problem is the depletion of natural resources; another is global warming. Bio-based plastics (BBP) are thus in the spotlight as they are made from renewable resources. However, BBP exhibit very poor properties compared to petroleum-based plastics, thus making it difficult to apply BBP to products. We have studied new BBP using BBP, and applied it to products, but one of BBP causes a food problem, as it is made from corn. It is therefore important to develop new BBP made from inedible resources. We have studied the behavior of neat BBP and flame-resistant BBP under the combustion. We have studied flameretardancy since 2001. It is shown as follows.

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1.1. 1st Nano-Al(OH)3 particle in olefine polymer in 2003

Novel flame retardant mechanism was found from the results. Flame rewardable of EVA composite contained with the novel Nano-particles of the aluminum hydroxide [8]. The result is shown in Fig. 1 and Fig. 2 and summarizes in Table 1.

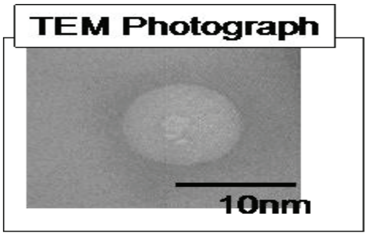

Fig. 1. TEM photograph of nano-$Al(OH)_3$ particle.

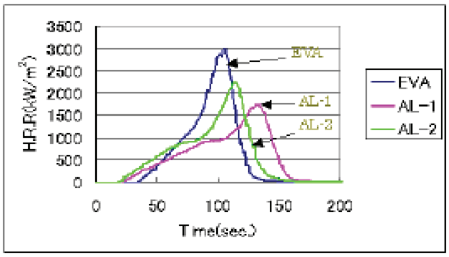

Fig. 2.Heat release rate of EVA, AL-1 (EVA with nano-$Al(OH)_3$) and AL-2 (EVA with micro-$Al(OH)_3$).

Table 1. Composition and mechanical properties of EVA with $Al(OH)_3$ nanocomposites.

Materials	Contents (phr)	$Al(OH)_3$ particle size	Tensile strength (MPa)	Elongation (%)
EVA	EVA(100)	-	4.7	963
AL-1	EVA(100)+Novel $Al(OH)_3$ (10)	10 nm	5.2	1002
AL-2	EVA(100)+Normal $Al(OH)_3$ (10)	1 µm	4.8	974

1.2. 2nd Nano-Sumectilte in olefin polymer in 2005

We found the flame retardacy and mechanical properties of the partial dispersion were better than the complete one’s in sumectite nanocomposite. Fig. 3 and Fig. 4 presents the model of nano-composite flame retardant and the test results, respectively.

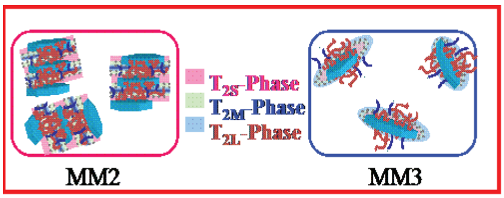

Fig. 3. Modle of sumectite nanocomposites.