

EFFECT OF POLYMER MATRIX STRUCTURES ON ITS DEGRADATION AND FLAMMABILITY

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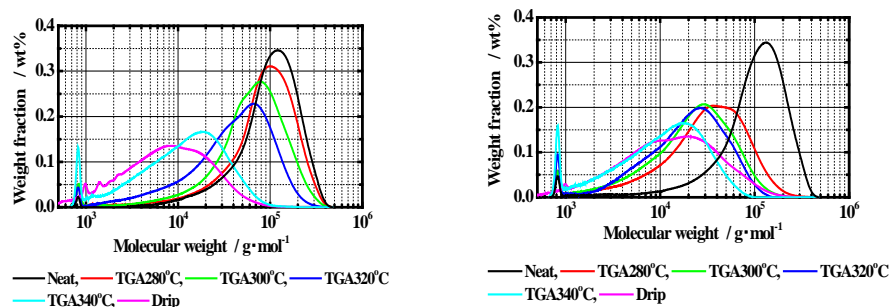
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Polymeric materials are heated during 180 °C to 280 °C where the temperatures are the process in synthesis and processing. However metal oxide catalysts that we used are not reacted at that temperature and it only reacts over 350 °C. Our research clarified that changing matrix structure by adding metal oxide has effected on its flammability.

In this study, a multi calorimeter (MCM-1 manufactured by Toyo Seiki Seisaku-Sho, Ltd.) was used for vertical flame test. For the experiment, strip shaped specimen was suspended in the chamber under controlled atmosphere and heated vertically. And the samples were heated until ignition to study the flammability, whereas in a standard UL-94-V test the samples are heated for 10 sec. After the ignition the methane burner was separated from the sample to a regulated position and the experiment was conducted [1].

From our results, polymer structures were changed until the temperature rises to the combustion temperature by adding metal oxide as a catalyst. In the case of PLA with metal oxide, its flammability was controlled by microscopic and physical factor. It is not only restrained combustibility but also stop ignition and kept dripping down until the specimen completely finished. Figure 1 shows a change in molecular weight due to the thermal history of the sample were PLA neat and adding metal oxide to PLA. The molecular weight was changed before volatilization by adding a catalyst



(a) PLA neat

(b) PLA/SiO₂/MgO 10 wt%

Figure 1 Distributions of molecular weight.

and combustion was also suppressed [2].

In the case of PC, its flammability was controlled by chemical factor such as Fries rearrangement, hydrolysis etc., and macro changes such as the surface structure until the temperature rises to the combustion temperature. The samples that contain PnFBS showed about 20% of residue formation at around 750 °C, which is less than PC-neat. Figure 2 shows that

with increase in addition of PnFBS, the residue decreases. Also as the residue decreases, the total flame combustion time also decreases.

The PC surfaces after vertical flame test were observed by SEM and shown in Figure 3. The small particles and larger particles were observed in the X2000 photos on the surface of PC-neat. It shows that the particles of which the ratio of carbon/hydrogen is richer because the hydrogen in the specimen, were separated from the melted PC at higher temperatures and formed the particles.

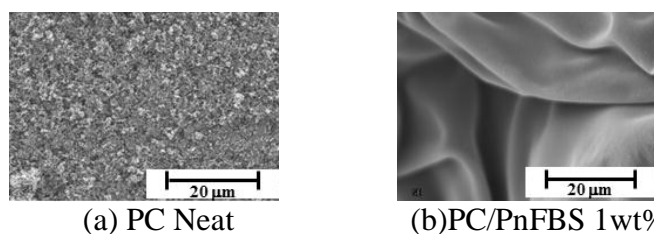


Figure 3 Polymer surface after vertical flame test (X2000).

On the other hand, granular carbide was not found for PC/PnFBS 1 wt% and the smooth surface was observed. However the combustion of PC/PnFBS 1 wt% displayed an excellent retardancy.

Changing matrix structure has effected on its flammability. Specially, the molecular weight of polymer and modification of polymer surface structure were very affected on its flammability.

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2. T. Yamashita, K. Mizuno, et, al., Flame Retardancy of Polylactic Acid Blended with Metal Oxides Catalysts, Kobunshi Ronbunshu, 2008, 65, 4, 288-294.
3. E. Nakashima, T. Ueno, M. Yukumoto and K. Takeda, Control of Polymer Structure during Catalytic Pyrolysis, Kobunshi Ronbunshu, 2011, 68, 7, 464-472.

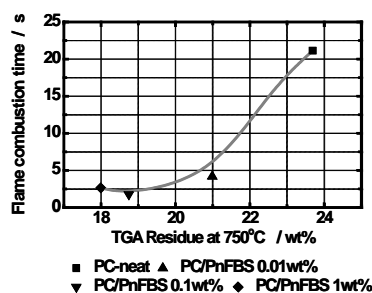


Figure 2 Flame retardancy effect by PnFBS and the relation of residue.