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The Flame retardancy study of the furniture made from corrugated cardboard

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Abstract

Recently corrugated cardboard is utilized for not only packing materials but also furniture and beds at shelters in Japan. The cardboard has widely used due to the characteristics of lightness, high strength, cheapness and recycle ability. Therefore, there is the strong need to add flame retardancy for cardboard beds in medical facilities for prevention of second disaster. The purpose on this study is to add flame retardancy to the cardboards with keeping the recycle ability. In this paper, the cardboard of combusting behavior was measured by using a calorimeter under the UL-94 standard. So far we have used 6 kinds of flame retardant include 3 kinds of commercial flame retardant. As a result ammonium sulfate has given superior flame retardancy to cardboards. However we considered that it has no practical use, because flame retardancy of cardboards must be safety from chemical toxicity. Therefore we selected 2 kinds of flame retardant. As a result a flame retardant which contains phosphorus and nitrogen gave great flame retardancy to cardboards with small quantity.

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Keywords: Combustion; Corrugated cardboard; Flame retardancy; Heat release rate

1. Introduction

Corrugated cardboard was mainly used for packing materials over 100 years. The main function is shipping and impact absorption. However, the cardboard have reviewed as material with the evolution of the design technology

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with IT field in late years, and the useful item except the packing have been increased little by little. For example, cardboards were used instead of cots in the shelters at the time of East-Japan-Earthquake disaster. It is called cardboard bed, which is spreading a lot of shelters.

Flame retardant materials are classified by their retardants. Most of efficiency flame retardant is halogen based flame retardant materials. However, the combustion of halogen flame retardant material is harmful to human life [1-2]. The other flame retardants such as intumescent, phosphorus or nitrogen based flame retardant or inorganic fillers have been widely applied [3-8].

So far as refugees for disaster are forced to lie on the floors directly in Japanese shelters that cause the serious second healthy damage. The cardboard bed is the one of the solution for them. To enhance a safety of cardboard bed, we have to give the flameretardancy for cardboard

2. Background

We have used 6 kinds of flameretardant include 3 kinds of commercial flameretardant. As shown in Fig.1, the Ammonium sulfate showed great effect on flameretardancy. But we considered it is not practical because it needs to apply largely and it has toxicity. Therefore we searched for others flameretardants. We selected 2 kinds of flameretardant contain nitrogen because ammonium sulfate contain nitrogen and show great effect on flameretardancy.

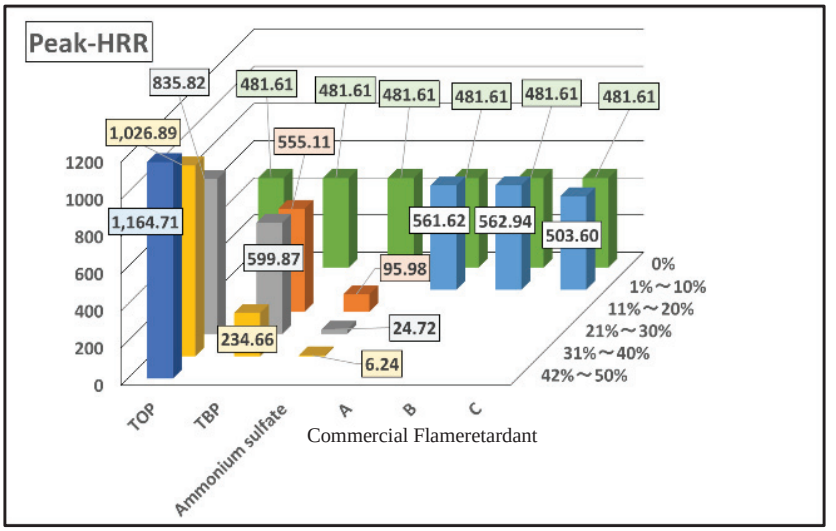

Fig.1 Peak-Heat release rate of each flameretardant

3. Experimental

3.1 Materials

Base material: Corrugated cardboard (JPACKS Co., Ltd.)

Flameretardant: Halogen, Phosphorus and Nitrogen based compound [HPN compound]
Phosphorus and Nitrogen based compound [PN compound]

Both of flameretardants are producted by MARUBISHI OIL CHEMICAL Co., Ltd.

3.2 Flameretardant application

For applying flameretardants to a cardboard, we got flameretardants dissolve in water and made 3 kinds concentration of aqueous solution. Then we soaked cardboards into them and dried. We calculated the Average-Weight-Gain (AWG) from the weight of original cardboard and the weight after application.