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RuPaFENDER: SAFETY BOOT SHOE SOLE

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ABSTRACT

RuPaFENDER is an innovation on shoe sole part of safety boot with flame retardant property. It had been derived from polyvinyl chloride (PVC)/acrylonitrile butadiene rubbers (NBR) composites with silane coupling agent treated palm kernel shell powder (Si-PKS) filler. Carbon black derived petroleum based as filler in the existing shoe sole rubber composites caused the fluctuation of material cost. Therefore, Si-PKS had been found to be the best option for the substitution of carbon black in making shoe sole. Besides, the usage of Si-PKS also able to solve environmental issues that created by abundant palm kernel shell waste during palm oil production. This product able to offer better tensile strength and swelling resistance, better flame resistance with low cost.

Keywords: acrylonitrile butadiene rubbers, polyvinyl chloride, palm kernel shell, silane coupling agent, flame retardant

1. INTRODUCTION

Recently, rapid growth of rubber industry had been reported by many researchers to find other harmless potential natural –based material in order to replace the well-known filler namely Carbon Black (CB) in rubber composites [1]. It is vital because CB also had its limitations such as cannot be used in production of coloured products with high strength requirement and it contributed to the fluctuation of material cost. As noted, natural filler can cause poor bonding to rubber matrix due to its hydrophilicity properties. Hence, most research had been found that the usage of coupling agent in rubber composites will enhance bonding between natural filler and rubber matrix [2]. In this study, RuPaFENDER brand was introduced with an innovated flame retardant shoe sole part using polyvinyl chloride (PVC)/acrylonitrile butadiene rubbers (NBR) composites with silane coupling agent treated palm kernel shell powder (Si-PKS) filler. Si-PKS was used as an alternative natural-based filler with comparable performance for the substitution of carbon black in making coloured shoe sole. Besides, the Si-PKS filler was introduced as the valuable materials that originated from abundant palm kernel shell waste at palm oil factories. It able to minimize the pollution issues and improve the effectiveness of waste management [3].

2. MATERIAL AND METHOD

There are seven different formulations based on the ratio of PKS to CB (0:15, 10:5, 5:10, 15:0) and various loading of silane coupling agent (1%, 3%, 5%, 7%) treated PKS (Si-PKS) filled PVC/NBR composites had been prepared using two-roll mill at ambient temperature. Then, the flame retardant test were performed according to ISO 6940 test methods.

3. RESULTS AND DISCUSSION

3.1. Effect of different concentration silane coupling agent treated PKS (Si-PKS) on flame retardant properties of PVC/NBR composites

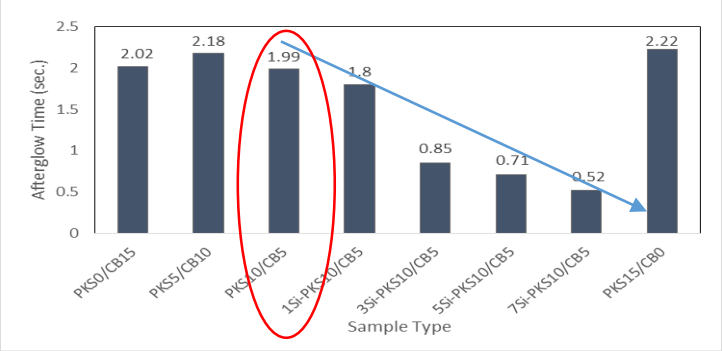

Figure 1 Flame Retardant of PKS/CB and Si-PKS/CB Filled PVC/NBR Composites

Flame retardant of PKS/CB and Si-PKS/CB filled PVC/NBR composites is shown in Figure 1. It can be seen that the afterglow time of all rubber composites is less than 2.5 seconds and replacement of CB with PKS filler does not affect the flame retardant properties of PVC/NBR composites. As noted, halogen group in PVC that responsible in the retardation of the flame by decreasing the concentrations of high energy free radicals [4]. Then, further investigation on the effect of silane coupling agent (Si) based on the optimum loading of 10 phr PKS and 5 phr CB in PVC/PKS loading had been conducted. It found that the increment of Si concentration decrease the afterglow time of PKS/CB filled PVC/NBR composites. It is due to the bonding of fillers in rubber had been improved by the addition of Si, thus, it able to resist further burning effect on rubber composites [5].

4. CONCLUSION

In conclusion, the presence of silane coupling agent treated PKS (Si-PKS) promoted better flame retardant character of PVC/NBR composites with comparable performance in terms of strength and other physical and mechanical properties. Besides, it also able to produce more cost effective PKS filler than CB with various colours selection of rubber products.

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