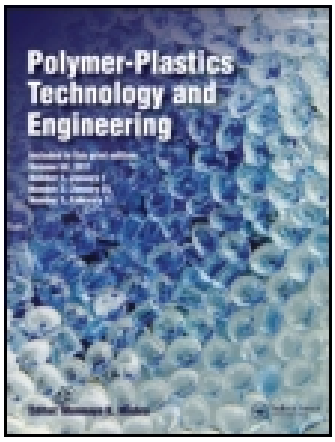

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Influence of Micro- and Nanonatural Fillers on Mechanical and Physical Properties of Foamed SMA Composites

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Influence of Micro- and Nanonatural Fillers on Mechanical and Physical Properties of Foamed SMA Composites

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This study is to investigate the reinforcing effects of fillers on mechanical and physical properties of foamed styrene-maleic anhydride (SMA) composites. According to the results, the best foaming was determined for starch reinforced SMA composite. The best result of expansion ratio was found as 22.75% to SMA/starch composites. Stereo light microscopy results demonstrated that the foamed cell distribution is heterogeneous and composed of two sections. The minimum density was found as 0.64 g/cm^3 for foamed SMA/starch composites. Mechanical properties of all foamed composites were found to be low as compared to neat SMA composite.

Keywords Cellulose nanofibrils; Foamed SMA composites; Nano-/Macrofillers; Specific mechanical properties; Styrene maleic anhydride copolymer

INTRODUCTION

Styrene maleic anhydride (SMA) copolymer is a thermoplastic polymer obtained by the copolymerization of styrene and maleic anhydride monomers. The principal properties of SMA are its transparent appearance, heat stabilizers, coupling agents, compatibilizers, high dimensional stability, and the specific reactivity of the anhydride groups. SMA commonly uses as engineering polymer in the automotive industry for the injection molding, thermoforming of interior parts and improving the reaction and adhesion between polymer and fillers in the composite industry[1–3].

Many types of filler can be used to reinforce polymer composites and composites with fillers typically exhibit superior mechanical properties, but are not as environmentally friendly as composites with natural fillers. Natural fillers can enhance mechanical and thermal properties, and low density, high aspect ratio, and no abrasiveness are attractive features. Moreover, natural fillers contain little extractives, which mean that the emission of volatiles is reduced during processing[4–7].

When a copolymer with group of maleic anhydride as polymer matrix is used with natural particles, reaction between group of maleic anhydride of polymer and hydroxyl groups of natural particles occurs and the reaction generates a byproduct, water and the byproduct vapors during compounding. Therefore, the water appears to be ignored in the overall reaction mechanisms[2]. Natural fillers-filledcomposites can exhibit a good mechanical properties, physical properties and thermal behavior. However these composites have higher densities. Thus, the composites are foamed to decrease their density by using different blowing agents such as chemical and physical agents[8].

Foamed polymers can be produced by using blowing agents such as a gas, a liquid or solid[8,9]. Nearly all these blowing agents have some problems associated with their usage. The use of some agents for foaming is banned in many countries because of their deleterious effect on the ozone layer. On the other hand, common aliphatic hydrocarbons are highly flammable. Chemical blowing agents are expensive, and yield low gas concentration during their decomposition[10]. As a result of persistent public pressure, the government continues to legislate regulations aimed at enhancing environment protection and worker safety.

The development of an environment-friendly, nontoxic, safe and low-cost blowing agent may help the industry in dealing with these regulations and simultaneously save on the cost of chemical blowing agents[11]. Since water (it is obtained with reaction between group of maleic anhydride of polymer and hydroxyl groups of natural particles), which is freely available, non-toxic and environment friendly can be completely transformed into a gaseous state at temperatures above 100°C. It is believed that it can potentially be used as a blowing agent in the production of foams in an extrusion process. Therefore, blowing agent in this study was obtained as byproduct, water with reaction between

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