

ABSTRACT

This thesis describes a study of the reactions between epoxidized natural rubber (ENR) and palm oil-based polymers. The study consists of two parts: (i) The reactions between ENR and palm oil-based alkyds and (ii) The reactions between ENR and palm oil-based medium-chain-length polyhydroxyalkanoates (mcl-PHA).

In the first part, the reactions between ENR and a low molecular weight palm oil-based alkyd (A1) have been investigated. From the experimental results (FTIR and toluene swelling tests), it has been concluded that the polyfunctional alkyd having both hydroxyl and carboxylic groups could react with the epoxy groups of ENR at ambient temperature to cause crosslinking. Alkyd A1 was treated with maleic anhydride (MA) at two different temperatures. At 130°C, the anhydride has reacted partially with the hydroxyl groups of A1 to produce alkyd A2 with higher carboxylic content and lower hydroxyl groups. On the other hand, at 185°C the anhydride has reacted completely to produce alkyd A3 with similar carboxylic acid content as A1. Subsequent reactions of A2 and A3 with ENR under similar conditions have demonstrated that the predominant reaction with epoxy groups was due to the carboxylic groups of alkyds from the fact that A2 could form higher amount of crosslinking than A3, which has lower carboxylic content similar to A1. To provide further confirmation, alkyd A4 with much higher carboxylic content was synthesized under the same conditions as A2 and the subsequent reactions with ENR were investigated. It was found that crosslinking reaction could occur in ENR/A4 blend at a more rapid rate when the epoxy content of ENR was in excess or equivalent to the carboxylic content of A4. The ¹H-NMR results provide the ring-opened structures.

In the second part, mcl-PHA was allowed to react with ENR. There was no noticeable reaction at ambient temperature for short reaction time. However at 170°C, the mcl-PHA has undergone thermal degradation to generate twice the amount of carboxylic terminal groups within 30 minutes and could attack the epoxy groups of the ENR. Evidence of the ring-opening reaction was provided by both FTIR and ¹H-NMR.