

Preparation and characterizations of palm oil based rigid nanocomposite polyurethane foam

Abstract

The objective of this research is to study and analyze the basic and mechanical properties of polyurethane (PU) foam. PU foams were initially synthesized with reaction of natural oil polyol and isocyanate with ratio of 1:1.1 by weight. Water was used as the blowing agent and appropriate surfactant and catalyst were added to ensure better performance of final product. Cloisite 30B was added as filler and the percentages were varied from 1 to 5 wt%. The basic properties of polyurethane foams were determined, such as free rise density (FRD), foaming time and rheological index. Clay dispersion in polyurethane nanocomposites was investigated by X-ray diffraction method. Mechanical properties of foams were evaluated using uniaxial compression test where the energy absorption values were determined. Aluminium-polyurethane foam (Al-PU) sandwich composite was prepared and flexural test was carried out to examine the effect of skin attachment to PU foam. The results showed that with increasing nanoclay content resulted an increment in FRD to 74.6 kgm^{-3} , rheological index to 1.07 gcm^{-1} and foaming by almost 133% for the addition of 5wt% nanoclay, respectively. Increasing in percentages of nanoclay filler in PU foam nanocomposite is also found to improve the absorption energy from 89J for pure PU foam to 118J for PU foam with 5wt% nanoclay. It was found that PU foam nanocomposite has better failure deformation as compared to sandwich composite with flexural extension that increase up to 9.4mm. However, flexural stress for sandwich composite are higher up to 3.6MPa. Furthermore, Al sheet acts as ductile skin to PU foam and prevent samples from rupture rapidly or prevent the formation of brittle fracture.

Keywords — Palm oil, polyurethane (PU) foam, aluminium-polyurethane foam (Al-PU), nanocomposite, nanoclay