ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque

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Effect of Nanoclay on Mechanical Properties of PLA-Clay Nanocomposite

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Keywords: Nanocomposite, Nanoclay, Mechanical property, XRD, TEM.

Abstract. Polymer filled with nanoclay gained a significant interest to the researcher because of the anisotropic behaviour of nanoclay. This paper focused on the fabrication of a nanocomposite with different percentage of nanoclay. The effect of different percentage of nanoclay on the mechanical properties of nanocomposite was investigated. The result revealed that with addition of nanoclay the impact strength and flexural properties significantly increased. From X-ray defraction (XRD) it was found that with addition of nanoclay percentage of crystallinity of the nanocomposite was increased which was also supported by transmission electron micrograph (TEM) where clay particle was found partially intercalated and exfoliated.

Introduction

Polymers like plastic, fibers, and synthetic rubbers have been developed and extensively used in packaging, construction materials, agriculture and medical devices purposes. But these polymers are all are derived from petroleum. In plastic category, PLA is gaining attention because it can be synthesized from renewable resources and it represents an interesting way to replace petroleum-based plastic. It is necessary to improve the properties of the polymeric material for specific application. One way to improve the properties of polymeric materials is to incorporate nanofillers like smectite clays, particularly montmorillonite (MMT). MMT is characterized by negatively charged aluminosilicate layers bounded by electrostatic forces via alkaline cations, such as sodium cations or ammonium cations (in organomodified MMT) located in the interlayer space. This kind of blend is called polymer-layered silicate nanocomposite, and their properties such as thermal, mechanical, flammability, barrier etc can be strongly improved at low filler level (generally under 10wt% in weight) [1,2]. Nanofillers can be classified according to their morphology, such as particles that are (i) layered (e.g: clays), (ii) spherical (e.g: silica) or (iii) acicular (e.g: whiskers, carbon nanotubes). Their specific geometrical dimensions, and thus aspect ratios, partly affect the final materials properties. Layered silicate clays offer high surface area, more than $700m^2/g$, i.e., a huge interface with the polymer (matrix), which governs the material properties. The final behavior can be considerably improved by the strong and extensive polymer–nanofiller interactions, as well as, good particle dispersion.

Different kinds of nanocomposites can be obtained depending on the dispersion of the clay into the polymer matrix. If the polymer chains are located between the silicate layers, the structure is intercalated (Fig. 15.1). If the silicate layers are fully delaminated in the matrix polymer, the structure is exfoliated. To determine the dispersion of MMT in a polymer matrix, x-ray diffraction (XRD) and transmission electron microscopy (TEM) are generally used [3]. It is also possible to investigate the dispersion of clay using nuclear magnetic resonance (NMR). NMR is able to quantify the degree of dispersion of the clay, in contrast to XRD and TEM; which give information about the kind of structure, but remain generally qualitative [4]. Several articles discussed the