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# Studies on mechanical properties of dispersing intercalated silane montmorillonite in low density polyethylene matrix ☆

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ABSTRACT

In order to understand and improve these soft and weak mechanical properties of Low Density Polyethylene (LDPE), we add a silane modifier (Nanocor I.31PS) Montmorillonite (MMT) as reinforcement material, inserted with two kinds of different surfactant (thermoplastic polyolefin elastomers (TPO) or Maleic Anhydride (MA)), the layer distance and hydrophobia are all best; to join the pieces of LDPE together, making it possess polarization. After that, we use a Plastograph-Mixer by the twin-screw mixed method to obtain standard shaped specimens of Polymer-Clay Nanocomposites (PCN) to prepare HDPE/MMT nanocomposite pellets. By adding the different weight percentages (1, 3, and 5 wt.%) of MMT, and 2:1 ratio of MA (or TPO) and MMT, the layer distance of MMT and mechanical property of nanocomposites were investigated.

The chemical structure and polymer morphology of these as-synthesized PCN specimens were characterized by wide-angle powder X-ray diffraction (XRD) and scanning electron microscopy (SEM). In addition, we prepare these experimental specimens in order to probe into its mechanical properties. These tests used are: layer distance of PCN, tensile, impact, shore-hardness, wearing tests, and so on.

In addition, we use XRD to make the characterization analysis, compare it to scatter and layer-distance. It is found that when increasing the TPO into the MMT, layer-distance at 1 wt.% MMT increases from 2.11 nm to 3.14 nm.

It is found that these specimens that graft the TPO have the following results: In the tensile test, the MMT weight percentage of 1 wt.% has the best result, increased by 3.08%. In the impact test, the MMT 3 wt.% strengthens by 11.53%. In the hardness test, the MMT 5 wt.% strengthens the effect by 2.60%. In the wearing tests, the MMT 5 wt.% strengthens the effect by 6.98%.

In addition, the specimens that graft the MA have the following results: In the tensile test, the MMT 1 wt.% strengthens by 5.39%. In the impact test, the MMT 3 wt.% strengthens by 19.71%. In the hardness test, the MMT 5 wt.% strengthens by 10.85%. In the wearing tests, the MMT 5 wt.% strengthens the effect by 44.19%.



## 1. Introduction

Recently, layered materials such as smectite clay (e.g., montmorillonite, MMT) have attracted intense research interests for the preparation of polymer-clay nanocomposite (PCN) materials. PCN materials usually demonstrate unique properties superior to traditional composites and conventional materials. In general, they combine both the characteristics of inorganic nanofillers and organic polymers at the molecular level. Currently, the PCN material is found to be a promising system due to the fact that the clay possesses a high aspect ratio and a platy morphology. It can be employed to boost the physical properties (e.g., thermal stability [1], fire retardant [2], gas barrier [3], and corrosion protection [4]) of bulk polymers), and mechanical properties are a particularly significant issue to study application and development for PCN materials. Kim and White [5] reported a variety of organic modified MMTs to understand the contribution of the organophilicity of organoclay on the formation of the polymer/clay nanocomposite.

Maleic acid (MA) is an organic compound that is a dicarboxylic acid (molecule with two carboxyl groups). Other names are malenic acid, maleinic acid and toxilic acid. In industry, MA is derived from maleic anhydride by hydrolysis. Maleic anhydride is produced from benzene or butane in an oxidation process. Maleic acid is soluble in water, has a melting point of 139–140 °C. Both properties of maleic acid can be explained on account of the intramolecular hydrogen bonding [6] that takes place at the expense of intermolecular interactions.

Thermoplastic polyolefin elastomers (TPO) are unique elastomeric products designed to improve impact performance, melt strength, and overall processability for a variety of markets and applications. TPO combine highly desirable elastomeric properties in a pelletized form

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