

CHAPTER I

INTRODUCTION

In the last decade, recent classes of solid porous materials known as porous clay heterostructures (PCH) have been synthesized (Galarneau *et al.*, 1995). Porous clay heterostructures (PCH) have attracted considerable attention due to their unique properties, such as their high specific surface areas, controllable pore structures, and narrow pore distributions (Won San Choi *et al.*, 2007). These porous materials, which are obtained by combining the pillaring and templating approaches, are formed by the surfactant-directed assembly of mesostructured silica within the two-dimensional galleries of a 2:1 mica-type layer silicate, such as fluorohectorite, vermiculite, and montmorillonite (Polverejan *et al.*, 2000). In the product solids, part of the pore walls is clay layers. The PCH affords uniform pore sizes in the supermicro to small mesopore region (1.2-3.0 nm), with high specific surface areas and high thermal stability (Pires *et al.*, 2004). The advantages of this approach are that the pore volume is controlled by the volume fraction of the template constituents, and pore size is controlled by the size of the surfactant micelles (Zhu *et al.*, 2002).

Several techniques have been developed to modify the chemical properties of mesoporous silicates for a variety of applications such as catalyst, adsorbents and ion exchanger. From this viewpoint, the synthesis of organically modified mesoporous materials has attracted attention. Their structure consist of inorganic frameworks combined with organic groups which can be incorporated either on silicate surface or as part of the silicate walls depend on the methods of producing organic-inorganic hybrid networks, provide high selectivity for organic compounds as a molecular sieve and high adsorptivity for gas molecules as a gas storage device (Nakatsuji *et al.*, 2004).

Both PCH and organically modified PCH are capable of utilizing as inorganic particles in polymer nanocomposites owing to their structures still remain as clay layer. Generally, polymer nanocomposites are generally defined as the combination of a polymer matrix resin and inorganic particles (usually 10 wt% or less), which have at least one dimensional (i.e. length, width, or thickness) in the nanometer size

range, acting as a nano-reinforcement. (Crainic, N and Marques, A.T., 2002). Nanoclay has more advantages than other nano-reinforcement because of their low cost, their ready availability and their non-isometric structure derived from a high aspect ratio, which can maximize the reinforcing effect (Ton-That *et al.*, 2004). Strong interfacial interactions between the dispersed clay layers and the polymer matrix lead to enhance mechanical, thermal and barrier properties of the virgin polymer (Meneghetti, P. and Qutubuddin, S., 2006).

The essential starting clay mineral for the preparation of nanocomposites is derived from the smectite group, such as montmorillonite (MMT). It is a 2:1 phyllosilicate, which has layered and crystalline structure. In this clay mineral the silicate layers are joined through relatively weak dipolar and Van der Waals forces and the cations Na^+ and Ca^{2+} located in the interlayers or gallery (Araujo *et al.*, 2004).

Recently, Nanocomposite technology paves the way for packaging innovation in the flexible film industries, offering enhance properties such as greater barrier protection, increased shelf life, lighter-weight material and magnetic properties for other application. From the previous work, bentonite was synthesized to obtain PCH and organically modified PCH for utilizing as ethylene scavenging system in food packaging. The continued work, surface PCH was modified by ferric chloride hexahydrate to induce the magnetic properties for RFID application. From this point of view, one of the goals of this work is to modify the PCH and organically modified PCH derived from montmorillonite by using Fe ion (Fe^{2+} and Fe^{3+}) to obtain magnetic PCH and study effect of substitution of Mn ion on magnetic properties of iron oxide in PCH. Moreover, magnetic PCH was modified by using volatile corrosion inhibitor (VCI) to improve the anti-corrosion for metal parts packaging. Since, the anti-corrosion packaging is considered as a one-time used packaging, the biodegradable plastics, such as polylactide, is suitable to produce this packaging. Subsequently, the as-synthesized mesoporous materials will be blended with polylactide and investigated the properties which concerned with their function of polylactide-clay nanocomposites.

OBJECTIVES

The objectives of this research are:

1. To enhance the magnetic properties of PCH by using Fe and Mn ions
2. To study effects of incorporation of VCI on magnetic PCH for nanocomposites
3. To study effects of various magnetic PCH-VCI on the properties of nanocomposites for anti-corrosion packaging.

SCOPE OF RESEARCH

The scope of this research work will cover:

1. Synthesis of PCH from Na-Monmorillonite.
2. Modification of PCH by using Fe ion (Fe^{2+} and Fe^{3+}) and variation of Mn ion content.
3. Characterizing pore size, pore structure and specific surface area of mesoporous materials by using XRD, SEM, TEM and nitrogen adsorption.
4. Study the effect of substitution of Mn ion on magnetic properties of iron oxide in PCH
5. Modification of magnetic PCH by using variation of VCI contents.
6. Study the effect of the amount of VCI which suitable for anti-corrosion application in film packaging.
7. Preparing polylactide-clay nanocomposites by melt intercalation method for anti-corrosion for packaging.
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