CHAPTER I
INTRODUCTION

In the last decade, a recent class of solid porous materials known as porous clay heterostructure (PCH) have been synthesized (Galarneau *et al.*, 1995). 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 a first step, cationic templates and neutral amine co-templates are intercalated between the sheets of the clay host forming micelle templates. Subsequently, the silica sources are formed in situ by polymerization around the micelle structures and then they are removed either by calcinations or solvent extraction (Benjelloun *et al.*, 2001). In the product solids, part of the pore walls are clay layers. The PCH afford 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 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 have more attracted 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 from the smectite group, such as montmorillonite (MMT). It is a 2:1 phyllosilicate, which has layered and crytalline 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 (Arau´jo *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 and lighter-weight material. From this point of view, one of the goals of this work is to modify the PCH and organically modified PCH derived from bentonite clay for utilizing as ethylene scavenging system in food packaging. Subsequently, these as-synthesized mesoporous materials will be blended with polypropylene and investigated the properties which concerned with their function as ethylene scavenger of polypropylene-clay nanocomposites. Furthermore, the nanocomposite will be also evaluated their roles as ethylene indicating system in smart packaging.

OBJECTIVES

The objectives of this research are:

1. To synthesize the PCH and hybrid organic-inorganic PCH (HPCH) from bentonite clay minerals.
2. To prepare the polypropylene-clay nanocomposites by melt intercalation method.
3. To investigate behavior of the nanocomposite as the ethylene scavenging system.

SCOPE OF RESEARCH WORK

The scope of this research work will cover:

1. Modification of PCH and HPCH from Na-bentonite clay.
2. Study the effect of pH on the formation of mesoposous materials and ethylene adsorption properties.
3. Characterization of pore size, pore structure and specific surface area of mesoporous materials by using XRD, SEM, TEM and nitrogen adsorption.
4. Preparing polypropylene-clay nanocomposites by melt intercalation method and fabricating the nanocomposite films by blow film extrusion machine.
5. Investigating the behavior as ethylene scavenging system of the nanocomposites by using gas chromatography and gas permeability tester.