# CHAPTER I

# INTRODUCTION

## 1.1 Statement of Problems

Polymers are the materials which were discovered and produced for many purposes. At present, wood, steel and ceramic are replaced by polymers because of theirs usefulness in many ways such as light weight, low cost of fabrication and easy processability. Considering mechanical properties especially in term of stress tolerance, polymers are generally worse than wood, steel and ceramic. However, the mechanical properties of the newly developed polymer systems can be improved by incorporation of traditional fillers such as glass fiber and carbon fiber [1].

Generally, the addition of traditional fillers or microfillers with high content into polymer matrix can be very effective in injection molded products, such as automotive parts and electrical parts, and lead to stiffness of materials. Glass fibers are the most widely used to reinforce plastics but they have some drawbacks such as abrasion to machines, health risk when inhaled [2]. To overcome the disadvantages of polymer composites with traditional fillers, polymer composites filled with nanofillers are developed and become the most versatile industrial advances materials. Using nanofillers instead of traditional fillers possesses several advantages for example, lower contents of fillers, lower density, improved transparency and increased barrier properties [3].

Polymer/clay nanocomposites have attracted great interest due to the potential for exceptional improvement in mechanical [4-6], barrier [7], thermal [8-9] and other physicochemical properties [10-12], at very low clay loading. Therefore, many research studies have focused on developing polymer/clay nanocomposites using various kinds of polymers [13-14].

Generally, inorganic clays have poor interaction with organic polymers. In order to achieve good interaction with polymers, hydrophilic clay has to be modified with surfactant (e.g. alkylammonium ions) to convert its surface to be organophilic clay, which are generally achieved by ion exchange reactions between organic molecules with a cation group and sodium ions of clay [11-14]. This type of clay is generally called organoclay.

Polymer/clay nanocomposites are formed mainly by three techniques which are solution method [3], *in situ* polymerization [15] and melt processing [16]. Among these techniques, melt processing technique is particularly the most attractive method because of its low cost, versatility, high productivity and compatibility with current polymer processing techniques for commercial applications. The degree of clay dispersion (intercalation and exfoliation) strongly affects the properties of polymer/clay nanocomposites [17]. The exfoliated polymer/clay nanocomposites are especially desirable for improved properties because of the high aspect ratio, homogeneous dispersion of clay and large interfacial area between polymer and clay [18].

Taking advantage of clay being an effective filler that can generate polymer nanocomposites with superior properties, this research aims to investigate the effect of organoclay addition on the mechanical properties and thermal properties of the polypropylene composites reinforced with glass fibers, the conventional fillers. Isotactic-polypropylene (iPP) is chosen in this investigation because it is one of the commodity plastics that are commonly used in many industrial applications. It is anticipated that the incorporation of the organoclay into the iPP composites reinforced with the glass fibers should yield the iPP composites with comparably good mechanical properties to the iPP composites which are solely reinforced by the glass fibers. This should help reducing the quantity of fiber glasses used in the melt processing currently used in industries.

## 1.2 Objectives

To investigate mechanical properties and thermal properties of polypropylene composites reinforced with organoclay and glass fibers.

## 1.3 Scopes of the investigation

The stepwise investigation was carried out as follows:

1. Literature review.
2. Preparation of iPP/glass fiber composite and iPP/organoclay nanocomposite using twin screw extruder.
3. Preparation of blended composites between iPP/glass fiber composite and iPP/organoclay nanocomposite.
4. Characterization of all composites for
   a) Morphological properties
      - X-Ray Diffractometer
      - Scanning Electron Microscopy (SEM)

- Transmission Electron Microscopy (TEM)

b) Thermal properties

- Differential Scanning Calorimeter (DSC)

c) Mechanical properties

- Tensile strength ASTM D638
- Yield strength ASTM D638
- Elongation at break ASTM D638

5. Summarizing the results and writing the thesis.