CHAPTER I

INTRODUCTION

1.1 General Introduction

Wood is known as an important material that human use for a long time, because it has numerous benefits including high strength, aesthetically pleasing characters, low cost, renewable nature, biodegradability, and nontoxicity (Wu et al., 1999; Qiu et al., 2005; Jubsile et al., 2006). Nowadays, the demands for using timbers are increased. Current statistics show that the timber trade in the world market has exceeded 1,500 million m^3. In Thailand, such a huge demand leads to the vast destruction of natural forest and thus natural disasters including devastated flooding. The development of other materials that can substitute wood is, therefore, increasingly essential. Fiber reinforced plastic composites are an alternative for replacing natural wood (Saheb and Jog, 1999; Lee et al., 2004; Sombatsompop et al., 2004). A composite material can be defined as a macroscopic combination of two or more distinct materials, having a recognizable interface between them. The definition can be restricted to include only materials that contain a reinforcing material (such as fibers or particles) supported by a binder (matrix) material (Reinhart and Clements, 1987).

Since the 1970s, many researchers had been focused on the development of new wood-substituted materials (Lee et al., 2004), which use natural fiber as a reinforcing filler. The main reasons to develop these new materials are to obtain a material with specific properties, or characteristics, with low manufacturing cost (Albano et al., 2001). Wood plastic composites (WPCs) are normally produced by mixing wood flour as a filler with polymer as well as an addition of a compatibilizer into the composites (Sombatsompop et al., 2004). The compound will then undergo, pressing or molding under high pressure and temperature. It has been commercialized as outdoor decking materials, interior door panels, window molding, interior automobile parts, and a large variety of the molded products (Sombatsompop et al., 2004; Sombatsompop et al., 2005). WPCs have several advantages over natural wood such as low water absorption, lower thickness swell, and more durability against biodeterioration. The most commonly used matrices for WPC manufacture are thermoplastics such as polyethylene (PE), polypropylene (PP), polyvinyl-chloride (PVC), etc (Albano et al., 2001). Polypropylene is attractive matrix thanks to its wide industrial applications, cheapness, low density, low moisture absorption, excellent chemical resistance, highest melting point compared with the family of olefins, excellent mechanical properties, and ease of processing (Reyes, et al., 2001). In addition, polypropylene shows better thermal stability than polyethylene; therefore, it can be processed at high temperature and sustain high temperature application. Furthermore, it is more environmentally friendly than polyvinyl-chloride.

Rubber wood, *Hevea brasiliensis,* is a commercial plant that is widely grown in the South of Thailand. Typical rubber wood has the harvesting age of approximately 25 years. It will be cut down and a new grown tree will replace the old one. The rubber wood of 1 rai can provide timbers of about 40 m^3 and the remaining part is sawdust having the quantity about 11.25% (www.doa.go.th). In this study, woodflour from rubber wood was used as filler in WPC manufactures. Natural fiber or woodflour is inexpensive, acceptable specific strength properties, low density, high toughness, good thermal properties, nonabrasiveness that shows flexibility during the pressing with no damage of processing equipment (Zhang et al., 2005). For the woodflour filled thermoplastics, the filler is intended for two main purposes i.e. to increase the final product volume to reduce cost of material, as well as to modify mechanical properties of the composites. However, disadvantages associated with using woodflour as reinforcing filler in thermoplastics are a lack of interfacial adhesion with common thermoplastics and a poor resistance to humidity. Woodflour is hydrophilic in nature while thermoplastics such as PP and PE are hydrophobic in nature (Albano et al., 2001-2002). Interfacial adhesion between the woodflour and the thermoplastic matrix can be improved by two major methods. The first method is physical treatment such as corona or plasma discharges and the other treatment is chemical method that is a pretreatment of fiber surfaces by using a compatibilizer such as silanes and isocyanates, and/or modification of matrix by grafting with reactive moieties such as acrylic acid, acrylic esters, maleic anhydride, etc (Qiu et al., 2005). However, the drawback in the chemical method is the additional cost of the treatment process.

The radioactive treatment is the technique that introduces high-energy into a material to generate favorable changes in its structure by molecular cross-linking, grafting and chain scission reaction. It has also been applied for improving the interfacial adhesion between the woodflour filler and polypropylene matrix (Albano, et al., 2001-2002; Reyes, et al., 2001; Al-Maadeed, et al., 2006). The most important aspect of this technique is an ability to control the rate of polymerization of the polymer matrix without the generation of heat in the woodflour. Therefore the thermal degradation behavior of woodflour is minimized occur. Moreover, this technique can be performed under normal temperature and pressure (Punyahlek, 1989) as well as it is inexpensive and easy to use than using a compatibilizer or silane. The method was useful to modify the mechanical properties such as modulus, strength and creep properties of thermoplastic wood (Albano, et al., 2002; Reyes, et al., 2001). In recently years, the presence gamma rays at low radiation dose can sufficiently improve an adhesion and mechanical properties of wood-plastic composites (Albano et al., 2001; Reyes et al., 2001; Albano et al., 2002). However, gamma radiation alone was found to exhibit a limited capability on improving mechanical properties of wood composites. In this investigation, we will systematically investigate the combined effect of gamma radiation and compatibilizer on improving interfacial property of polypropylene matrix and woodflour filler. Maleic anhydride grafted polypropylene (PP-g-MA) is selected for this wood composite system.

1.2 Objectives of the Present Study

This present study is aimed.

1. To investigate the effects of gamma irradiation conditions on polypropylene (PP) and PP wood composites.
2. To compare the effects of gamma irradiation and the use of a compatibilizer, maleic anhydride grafted polypropylene (PP-g-MA), on the resulting PP wood composite

1.3 Scopes of the Present Study

1. Preparing the PP/*Heavea brasiliensis* wood flour at a ratio of 60:40 by weight using an average particle size of 250-300 microns.
2. Comparing the gamma irradiation of PP/wood flour in air, oxygen, and nitrogen atmosphere at various irradiation doses of at 5, 10, 20, and 30 KGy.
3. Investigating the optimal radiation dose suitable for the wood composite application based on thermal and mechanical characterization i.e. thermal stability, flexural and creep test.
4. Determining the effect of PP-g-MA compatibilizer on the wood flour composites with and without gamma irradiation.