CHAPTER 1

INTRODUCTION

1.1 Background of The Study

Wood plastic composite (WPC) can be defined as composite material lumber made up from wood and plastic. The most distinct properties of WPC are their ability to resist against degradation in outdoor environment which make WPC as a suitable material for outdoor application than untreated lumber product. Examples products from WPC material are deck, kitchen cabinets, indoor furniture, benches, railings and fences. Previously, only virgin thermoplastic polymers such as polyethylene (PE), polypropylene (PP) and poly vinyl chloride (PVC) are used in WPC manufacturing. The composition between wood and plastic in WPC affect the properties of finished product. For instance, the resultant product of WPC that contain too low or too high ratio of plastic to wood might produce product with undesirable visual appearance and characteristics. As the result, the cost to manufacture WPC is quite high due to expensive virgin plastic materials used. Hence, recycled plastic has started to be used in the production of WPC instead of virgin plastic since 1990 and the usage has increase significantly in recent years. Principia Partners (Ashori, 2008) state that the largest supplier of wood-plastic composite lumber, Trex has purchases an average of over 227,000 kg of plastic scrap each day and Power (as cited in Winandy et al., 2004) found CorrectDeck have uses about half virgin plastic and the other half (20 percent) is obtained from recycled grocery bags and used pallet wrap. Moreover, Winandy et al. (2004) also have listed few products of recycle WPC produced commercially in the USA. The main components in WPC are plastic and wood. There are many types of wood that can be used to manufacture WPC such as Kenaf and Radiata pinus. Kenaf is an annual herbaceous plant that can grow in wide range of weather condition. Kenaf
usually will grow from 1.5 to 3.5 m with a woody base. Recently, Kenaf have attracted a lot of attention due to their high rate of production. They are able to grow in shorter time which is 4 to 6 months when compare to trees that need 10 to 25 years before being used for industry purpose. Kenaf have several components such as stalks, leaves and seeds. The stalk is made up of woody core and fibrous bark. The fibrous of kenaf has excellent flexural strength and superior tensile strength. WPC is produced by mixing wood particle, molten plastic and other additives together. The mixture is then processed by compression, injection molding or extrusion to form composite material.

Worldwide plastic production has continued to rise since the first mass production of plastic in 1950s. Stastically, in 2014 worldwide plastic production was reported approximately 311 million metric tons, which emphasize increment of plastic production around 4 percent over 2013. This phenomena show more resources are being used in order to meet the increased demand of plastic and more plastic waste is being produced. Besides, the property of plastic itself as not biodegradable material worsen the situation which result plastics waste becoming a major stream in solid waste. Hence, it would be rewarding if plastic waste can be reused in everyday application in order to improve material properties such as the impact strength and the hardness, besides able to use into new products (Jayaraman and Halliwell, 2009).

Previous researcher has realized the important to recycle these non-biodegradable wastes and have taken initiative to study the properties of recycle plastic and compare it to virgin plastic. The uses of recycle plastic in application have generated controversial debate. Research by Pattanakul et al. (1991) and Achilias et al. (2007) have support that properties of recycle plastic not too different with virgin. Pattanakul et al. (1991) which investigate the properties of recycled high density polyethylene (HDPE) from milk bottles have reported the properties recycle HDPE recover from milk bottles was not too different from those of virgin resin. Studies by Achilias et al. (2007) also found the mechanical properties of recycled product is almost identical to the virgin polymer. However, many research and studied have argued this statement. According to Aurrekoetxea et al. (2001), although recycled polypropylene have greater crystallization rate, higher crystallinity and equilibrium
melting temperature than those measured for virgin polypropylene, however elongation at break and fracture toughness of recycle polypropylene decrease. Despite conflict and different opinion in research, recycle plastic have been used in many applications due to lower cost production especially in China. Stastically, from 2006 to 2012, plastic waste imports to China rise from 5.9 metric tons to 8.9 metric tons for industrial purpose such as in manufacturing of desk, flower vases, and tables. Besides, recycle plastic are also popular in wood plastic composite manufactured (Kazemi Najafi, 2013).

WPC made from recycle plastic waste however suffers from some drawbacks. Reinforce material such as coupling agent and mineral filler needs to be added in wood recycle plastic composite (WrPC) manufacturing in order to improve the mechanical properties. Mineral filler are synonym in plastic molding compound. Mineral filler such as calcium carbonate, clay, talc, silica and wollastonite are blended with plastic resin in order to reduce the costs and thermal expansion. It also enhances the plastic’s moldability and stability. Other additive in WPC is coupling agent. Coupling agent is chemical or substances that are used in order to treat a surface so that chemical bridge could happen between materials. They link between two surfaces by covalent, polymer entanglement or strong secondary mechanism such as hydrogen bond. Coupling agent can be categorized into two types which are bonding agent and surfactants. By adding these additives, the mechanical strength of WrPC could be improved (Cui, 2008).

1.2 Problem Statement

Generally, the cost of WPC should be cheaper than wood material since it is lighter. However, according Consumer Reports magazine (as cited in Klyosov, 2007), the cost of WPC in market is relatively high as a result from expensive cost of plastics, wood, fillers, and additives (Chanda and Roy, 2006). Hence, development of WPC material by using recycle plastic is very appealing since it will lower the cost production and able to utilize the recycle plastics which are largely generated globally. Accordingly, recycle 95% PP/ 5% PE (rPP/rPE) has been used in this study to prepare WrPC on the basis of kenaf. Combination of rPP and rPE were used to imitate real life plastic wastes which are usually from mixture of different types polymer. Additional