



A comprehensive review on utilization of waste materials in wood plastic composite

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ABSTRACT

Wood plastic composite (WPC) is a composite material that consists of a matrix phase of plastic and wood as its reinforcement. The transition from virgin plastic (VP) to recycled plastic (RP) has gained popularity due to the increasing amount of plastic waste generated. Increasing in global demand for timber has resulted in a worldwide shortage of forests and rise environmental awareness. The use of RP and natural fiber (NF) in WPC manufacturing is an effective way to reduce environmental impact of conventional WPC, while enhancing the eco-efficiency of the products. This article reviews the basic principle such as definitions and classifications of WPC from plastics waste and lignocellulosic fiber (LCF). Raw materials, additives and resulting properties of the WPCs are briefly discussed. In addition, recent study of WPC is highlighted. Finally, important conclusions and outlook have been mentioned at the end of this article.

1. Introduction

Wood plastic composite (WPC) is a type of composite materials made from plastic (thermoset or thermoplastic) as its continuous phase/matrix and wood as its dispersed phase/reinforcement [1–3]. WPCs are commonly manufactured through extrusion and injection or extrusion and compression processes. These methods allow for the efficient production of a wide range of WPC products. Wood contents in WPC may vary to more than 80% [4,5]. Additives such as coupling agent, lubricants, stabilizers etc. Are moderately important material added in WPC to achieve target applications [6,7]. WPC combines the properties of plastic material and wood, which lead to perform uniqueness in manufacturing technology, mechanism, performance, and material structure, [8]. Their properties such as light weight, excellent dimensional stability, anti-corrosion, high environmental durability, antibacterial, recyclability, low price and easy processing [9], make it useful to develop in various field such as automotive, home, construction building, packaging materials and electronic devices [10–12]. Physical and mechanical properties of WPC is depending on many parameters such as wood type, polymer type, processing condition and material composition [13,14].

WPC are commonly made from virgin plastics such as polypropylene (PP), polyethylene (PE) and poly vinyl chloride (PVC) as matrix. Among the plastics, virgin PE is the most commonly used, accounting for

approximately 83% of market share followed by PVC, 9% and PP, 7% [15]. Wood particle (WP) or flour from timber was used as reinforcement in conventional WPC, influencing the production cost of WPC. WP are referring to ground solid woods [16], rough and irregular shapes [17], considered masters of all plant fibers due to their strong structures and excellent mechanical properties [18]. The trend to replace virgin plastic (VP) with recycle plastic (RP) has become popular due to the amount of waste plastics produced [19]. Furthermore, RP could result in savings of 20–50% compared to the cost of using VP [20]. WPCs based on RPs are emphasizing the utilization of either a single plastic type, a mixture of VP and RP, or recycle plastic blends. The resulting composites can alleviate global environmental pollution, address the shortage of petroleum resources, and improve the utilization of renewable materials [21]. However, plastics undergo chemical degradation during recycling process, therefore, the fundamental and elemental structures of RP is needed to understand deeply [22]. Some researchers have incorporated reinforcing materials, such as mineral/inorganic fillers, into the formulation to enhance mechanical strength of WPC such as impact strength and tensile properties [23–26].

The increasing global demand for timber has led to a worldwide shortage of forests and raised environmental consciousness. Therefore, research and development on suitable materials to replace WP from timber is actively conducted. Nowadays, a lot of study utilized recycle plastic and natural fiber (NF) to reduce manufacturing cost of WPC,

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