

Determination of Thermal Properties and Numerical Analysis of Heat Transfer Characteristics for the Novel Wooden Porous Green Building Material

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Abstract

The green building receives more and more attentions, and will grow continuously in amount with 10% rate per year. Among the different kinds of green building materials, the wooden green building material is very friendly towards the environment. Therefore, the demand of the wooden green building material will increase sharply. This paper proposes a kind of wooden porous material packed by wooden beads or piece fibers with open cell porosities. The outer layers of this wooden porous material are the perforation wooden plates and the inner layer is the wooden porous medium. Coupling with fans, this wooden porous material can insulate the heat, provide the wood fragrance, absorb the moisture and deodorize. Consequently, the competitive advantage and added value of the product will be promoted much more. This work investigates the design of the wooden porous green building material, as well as the corresponding fluid flow and heat transfer characteristics. Firstly, the effects of the structure and ingredient on the properties of

the wooden porous material are explored experimentally. The relevant empirical formulas are also built. Hence, the measured properties of the wooden porous material can be substituted into the numerical model and then the numerical simulation can be performance. This work numerically investigates the flow-resistance, temperature-drop and wood fragrance-providing performances. The results indicate that the kinds and lengths of the wooden porous materials influence the relevant performances strongly. Finally, the research finds can be the important base of design for the relevant products.

Keywords: Green building materials, wooden porous material, flow-resistance, temperature-drop, wood fragrance.

一、前言

依據歐洲建築師協會估計[1-3]，全球建築產業約消耗地球一半的能源，一半的水資源，同時產生 50% 的空氣汙染、42% 的溫室氣體以及 50% 的水汙染，建築業儼然為一高汙染的產業。從 2005 年《京都議定書》生效至 2009 年底哥本哈根會議，各國已開始正視環保綠能的重要性。2008 年美國綠建材產業約達 570 億美元，專家預估在美國綠建材市場每年約可成長 7.2%，預計到 2013 年美國綠建材市場將逾 800 億美元，全球綠建材的產值將高達 5,710 億美元。台灣建築產業二氧化碳排放量約佔每年全國總排放量的 30%，其中建材生產部分佔全國總排放量的 9.31%，足見建築業對於台灣環境劇烈的影響。2004 年我國政府開始推動「綠建材標章」，然相較於日本及歐美先進國家大量使用綠建材，台灣綠建材市場仍有相當大的成長空間。以臺灣為例，目前主要的木質綠建材為再生粒片纖維板與再生塑木 (如圖 1)。

(a) 再生粒片纖維板：再生粒片纖維板使用的再生原料以木質營建廢棄物為主。其產製流程是先將回收廢棄木質成份經過粉碎、篩選除異物等處理過程，取約 1~2 cm 之木質粒片纖維為再生原料，經過乾燥處理後，在混練機中分別添加膠合劑，充份混拌後，經過鋪裝與熱壓塑合成型，即可完成粒片纖維板材料，而且，粒片纖維板還可以回收重覆再生製作。