中文摘要

本研究概述測試程序及描述蒸發式水牆性能如何受水牆厚度及材質影響，並將測試結果與前人研究比較。而受測式水牆包括一種商用白楊木纖維製水牆（5、10 及 15cm 厚）及二種替代水牆材質分別由不織布孔式及棕簑材料製成。並針對各種不同厚度之商用水牆介質進行風洞實驗，以求得蒸發過程中熱與質傳係數。針對白楊木纖維剛性水牆材料所導出一無因次工作方程式： 其中 為熱傳係數， 為質傳係數， 為空氣密度， 為空氣比熱， 則為 Lewis 數。利用所導出之方程式可篩選出蒸發降溫式水牆之設計尺寸。另針對不同厚度(5、10 及 15cm)之不織布孔式及棕簑材料水牆介質亦進行風洞實驗以決定其降溫效率，並導出水牆效率與通風速度及靜壓差間之關係。對 15cm 厚水牆在操作空氣速度 2.0 至 3.0m/s 時，棕簑材料介質其靜壓差為 60 至 130Pa，而效率則為 89.69 至 92.86%；不織布孔式水牆介質其靜壓差為 48 至 108Pa，而效率則為 81.19 至 81.89%。針對棕簑材料水牆介質亦分析其降溫效率與濕空氣性質之參數間關係。研究結果指出在各種通風率下(0.5 ~ 4.0 m/s)，降溫效率會隨著濕球降及水蒸氣飽和氣壓與其分壓差呈線性遞增。當濕度改變時，降溫效率會隨著濕度增加而呈遞減現象。

關鍵詞：蒸發冷卻；水牆；熱與質傳；風洞

Abstract

This research outlines the test procedure and describes how pad performance is affected by pad thickness and pad materials, and compares test results with those of previous researchers. Many experimental pads were tested including one design currently on the market (5, 10 and 15 cm rigid impregnated cellulose pads), one made of unwoven fabric perforated pad, and the other made of coir material. A wind tunnel experiment was performed to obtain equations for heat and mass transfer coefficients for the evaporative process through various thickness of rigid cellulose pad media. Heat and mass transfer coefficients are nondimensionalized and curve fitted to yield a working equation: for the rigid impregnated cellulose pads ： , where is heat transfer coefficient, is mass transfer coefficient, is air density, is specific heat of air and is Lewis number, An implementation of sizing a rigid cellulose evaporative cooling pad using the derived equations then can be applied . A determination for cooling efficiency in a wind tunnel system is also developed to relate efficiency, face velocity, and static pressure drop across pads for alternative unwoven fabric perforated pad and cooling efficiencies varied from 60 to 130 Pa and 89.69 to 92.86%, while 48 to 108 Pa and 81.19 to 81.89 % for coir material pads respectively under operating air velocities of 2.0 to 3.0 m/s . Evaporative cooling efficiency was related to psychometric parameters for coir material pads . Results show that efficiency increased linearly with wet-bulb depression and difference in partial vapor pressure and ventilation rates were varied. When temperature and humidity vary independently, efficiency decreases with increasing humidity.

Keywords：Evaporative cooling; Pad and fan; Heat/mass transfer; Wind tunnel