

Passive and Climatic Design

PERFORMANCE COMPARISON OF HEAT EXCHANGER USING WATER AND SAND FOR THE EVAPORATIVE COOLING ROOF: AN EXPERIMENTAL RESEARCH

Jefrey I. Kindangen* and Markus K. Umboh**

*Architectural Engineering Department, Sam Ratulangi University, Kampus Unsrat Manado 95115, Indonesia

** Mechanical Engineering Department, Sam Ratulangi University, Kampus Unsrat Manado 95115, Indonesia

Abstract

This study aims to investigate and compare the performance of the heat exchanger that uses water and sand as a cooling medium to cool the water used after being sprayed on the roof surface. Spraying water on the surface of the roof intended to lower the surface temperature of which, when integrated with appropriate space cooling strategies will get the desired effect. Spraying the surface of the roof as a roof evaporative cooling is done automatically by installing a control device consisting of a microcontroller, sensors and an actuator; where spraying will automatically take place when the surface temperature will reach $\geq 38^{\circ}\text{C}$. The water after sprayed will be hotter, it can economically be reused, but the technique needs to re-cool it namely a heat exchanger. Experiments have been taken for two types of cooling medium that is by water and sand. Water from the roof surface accommodated in the gutters which then flowed to the heat exchanger. The heat exchanger consists of copper pipes arranged and buried as deep as 10 cm in an acrylic container measuring 1 x 1 x 0.2 m, which also is filled with water and then filled with sand. The heat exchanger box is located in the shade and not exposed to direct sunlight. A thermohygrometer data logger placed at the inlet of the heat exchanger to measure the temperature of the water that gets into the heat exchanger; the other data logger is identified at the exit of the heat exchanger to measure its ability to bring down the water temperature; and other data logger is placed in a box heat exchanger to measure the temperature of the cooling medium of water and then sand. The comparison between the two shows that either water or sand cooling media has an insignificant different in getting down the temperature of the water used. The mean temperature of the water and sand as the cooling medium does not change a great deal from one another, each about 27.5°C . It is necessary to mention that the ability of the heat exchanger using either water or sand looks more effective in the morning until midday, while at noon ability is considered down, it is assumed that this is caused by the increasing temperature of the surface of the roof reaches its maximum at noon. Essentially, this system has demonstrated its usefulness and capacity as a passive cooling strategy for improving thermal comfort in the humid tropics.

Keywords: passive cooling, evaporative cooling roof, heat exchanger with water or sand, roof surface temperature