Experimental Performance Evaluation of The Evaporative Cooling Pads Made from Cellulose Paper, Cotton Strips and Jute Strips.

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***Abstract*: In this paper practical performance of evaporative cooling pad made from Jute and cotton strips material is discussed for different air velocity at the exit of the duct, different inlet temperature condition. The performance is compared with commercially available evaporative cooling pad material for the same exit air velocity. It was found that the jute evaporative cooling pad is having higher cooling efficiency.**

Keywords: Jute Coolingpad, Cellulose paper pad, cotton strips evaporative, DEC.

I. INTRODUCTION

Along with the aggravation of global energy shortage, the increasing energy cost and the recently recognized environmental issues, the interest in direct evaporative cooling (DEC) has revived. Direct evaporative cooling offers a low-cost alternative to typical refrigeration units. It consumes a relatively small amount of specific energy and does not require common environmentally aggressive refrigerants. The running costs are significantly reduced, and direct evaporative cooling may have a smaller initial cost compare to the mechanical vapor compression (MVC) system, 2009 [1]. Hirst Eric, 1973 [2] pointed out that in the proper climate, a DEC (Direct Evaporative Cooling) can save up to 80% of energy costs. Evaporative cooling is an energy efficient and sustainable cooling method because it uses only the water as the working fluid. Moreover, since it is also economically feasible Sheng and Nnanna [3] have carried out the theoretical evaporative cooling can be used in various areas of not only the building air conditioning but also the industrials.

They had carried out experimental studies in which Three parameters were tested for their impact on efficiency and other crucial system properties: the velocity of the frontal air, the temperature of the frontal air, and the temperature of the inlet water, by conducting multiple tests for each parameter using incremental velocities/temperatures and by plotting these increments against efficiency. An empirical correlation between frontal air velocity and cooling efficiency within a certain velocity range was established and compared with theoretical calculation. It was determined that lower velocities, lower cooling water temperatures, and higher heating unit temperatures all result in higher efficiencies.

A. Fouda, and Z. Melikyan[a] have carried out test and verify the adequacy of the suggested mathematical model and program, the theoretical results from the mathematical model was compared with the experimental data carried out by J.M. Wu, X. Huang, H. Zhang.[5], to make sure that the results of the mathematical model program are accurate because the authors were not able to arrange a proper experimental installation. In the experimental work by J.M. Wu, X. Huang, H. Zhang, [5], was used the same type of direct evaporative cooler as it was modelled by A. Fouda[a], and Z. Melikyan[a]. The comparison of data received by present model with experimental data received in [5], were represented in the paper (Table 1). The data presented in paper are for: direct evaporative cooler using GLASdek as pad material with thickness of 138 mm and an inlet frontal velocity of 2 m/s [5]. The comparison shows that theoretical results are very close to the results obtained by experiments in [5].

J.M. Wua,b, X. Huang b, H. Zhang b [6], have carried out the numerical investigation of heat and mass transfer in direct evaporative coolers. They have developed a set of simplified governing equations by introducing other physical models to describe the heat and moisture transfer between water and air in the evaporative cooler. The models and methods are validated by comparing the numerical results with those of experiment for the same evaporative cooler. The influences of the inlet frontal air velocity, pad thickness, inlet air dry-bulb and wet-bulb temperature on the cooling efficiency of the evaporative cooler are calculated and analysed. The cooling effects of the direct evaporative cooler are predicted for use in four different regions in northwest China using the present numerical method based on the local weather data for air conditioning design.

S. Elmetenania,*, M.L. Yousfia, L. Merabetia, Z. Belgrouna [7], have carried out an Investigation of an evaporative air cooler using solar energy under Algerian climate The paper presents a simulation and systematic study related to direct evaporative air cooler applied to Bechar city. Also, they have presented a method to evaluate the feasibility of evaporative cooling systems for human thermal comfort.

The evaporative cooler is needed in this region because it cool and humidify the ambient air. They have concluded that Bechar city is well suited site to the implementation of this technology as well as many others cities whose are under 24°C design wet bulb temperature. Because of their lower power consumption, these systems can be powered by solar photovoltaic panels in regions where there is lack of electricity or electric network is not available. They also concluded that evaporative air cooling systems can be an excellent alternative to the conventional air conditioning systems in hot and dry climates.

II. EVAPORATIVE COOLING PAD MADE FRO JUTE AND COTTON STRIPS MATERIAL.

The evaporative cooling pad were made to evaluate the performance of the Jute and cotton strips material.

The main components in the assembly are:

1. Jute or Cotton Strips holder as shown in Fig 1.
2. Cooling pad Cabinet as shown in Fig.2

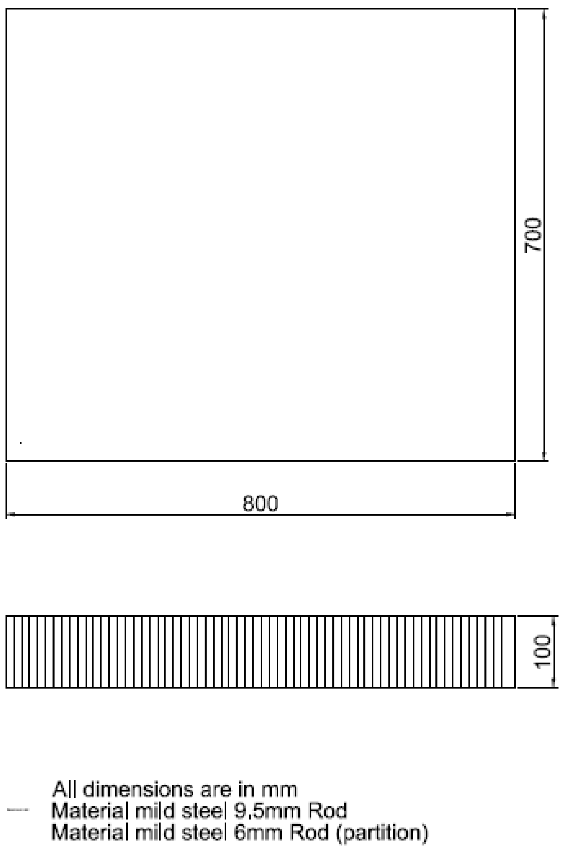

Fig.1 Drawing of Jute and Cottn strips holder.

The cotton strips holder was made from mild steel as per the dimensions shown in the Fig 1. at the top and bottm edges of the holder 124 120 mm mild steel rods of 6mm in diameter were welded so that strips can me hold vertical in the pad. The air will pass through the passage between the two strips. The water falling on the top of the cooling pad cabinet will fall o the strips through the holes drilled in the upper tank. The continuously falling water keeps the cooling strips saturated with water.

This strips holder is placed in the cooling pad cabinet which were made from stainless steel. This cabibet can hold the evaporative cooling pad u[to the thickness of 15cm and as per the dimension show in fig. 1.

Fig.2 shows the drawing of the cooling pad cabinet which were used to evaluate the performance of Cellulose paper pad, Jute strips Pad and Cotton strips Pad.

The experimental reading were taken for the cooling pad made from different material

Figure-3. shows the schematic diagram for the experimental set up.

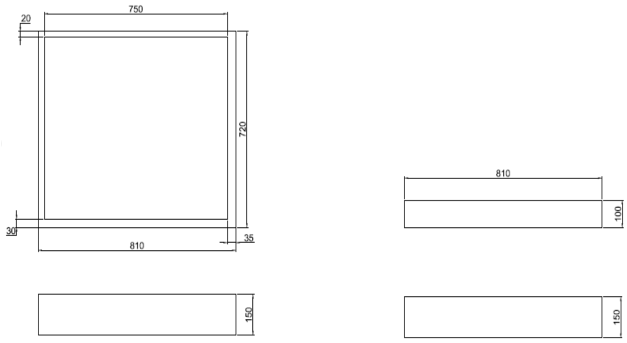

Figure 2. Cabinet made from stainless steel.

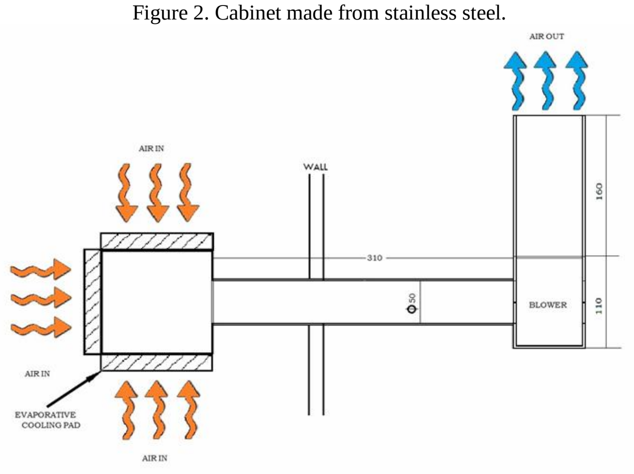

Figure-3. experimental set up to evaluate the performance of the evaporative cooling pad material.

The about six RTDs and a sling psychrometer was used to evaluate the performance of the evaporative cooling pad material.

The sling psychrometer was used at the inlet of the air which is outside of the experimental set up room.

Two RTDs weer placed at the exit of the blower exit duct where the air after passing through the cooling pad comes out. The focus was on the cooling pad made from cellulose material, Jute strips pad and cotton strips pad.

RESULT AND DISCUSSION

The performance of the cooling pad was evaluated based on the different experimental reading. The experimental reading for the cooling pad made from Cellulose paper, Jute strips and Cotton strips were taken at different inlet air velocity. The air velocity was changed by varying the blower speed. The temperature reading where taken by sling psychrometer, and six different RTDs.

The performance of the cellulose paper pad and Jute pad was observed higher. The cooling pad made from cotton strips was showing lower performance but at lower air velocity it was observed the it gives higher cooling efficiency.

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