Experimental And Comparative Analysis of Different Cooling Media In Evaporative Cooling System

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Abstract –In this paper compare all cooling pad materials at .045 m thick cooling pad the maximum saturation efficiency is 6090 cellulose (92.70%) and jute minimum saturation efficiency (68.18%) at air velocity 1.0m/s . At air velocity, it was concluded that the cooling efficiency at a high air velocity of 1.0 m / s was 92.70% cellulose 6090 compared to other cooling pad materials, Jute of cellulose (70.14%), aspen (85.40%), and khus (78.83%). The cooling capacity of different cooling pad maximum value for cellulose 6090 maximum cooling capacity 44323kg/KJ and minimum 7955kg/KJ, for jute maximum 42980kg/KJ and minimum 7285kg/KJ ,for khus maximum cooing capacity 36443kg/kJ and minimum 8047kg/KJ and for aspen material maximum cooling capacity 42980kg/KJ and minimum cooling capacity 7788kg/kJ. The leaving air temperature is minimum and maximum 27.3 to30.5^{0}c for cellulose 6090 pad ,minimum 29.3 and maximum 31.3 c for jute, for aspen 28.3 minimum and 30.7˚c maximum and for khus 30.3 minimum and maximum31.79 c

Keywords – ECS, cellulose pad, cooling efficiency, air velocity, jute khus, aspen.

1. INTRODUCTION

If India's energy and environmental scenario is concerned, there is a pressing need of energy conservation and environment preservation. The conventional evaporative cooling system (e.g. water cooler) is used for the cooling purposes in the dry and hot regions. This type of system gives the sufficient cooling, but the increased humidity of the air gives the feeling of discomfort. The other way to overcome the problem of increased humidity is use of indirect evaporative cooling system. This system though handles the humidity properly, but the cooling obtained with the said system is less. On the other hand, vapour compression refrigeration systems consume more electricity and some of the systems carry the potential to pollute the environment. Also cost of such systems is on the higher side.

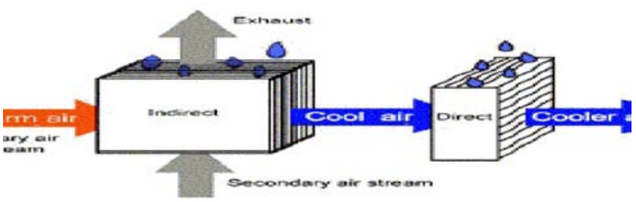


Figure1.3 Direct and indirect Evaporative Cooling[1]

2. PREVIOUS WORK

Rajesh Maurya*, et al [1] [2014] Three types of cooling pad made of a cellulose, aspen fiber, and coconut coir were comparatively studied. This study is performed in summer and based on weather conditions, maximum dry bulb temperature of air 41.2 ˚C and 26.1 ˚C wet bulb temperature. The relative humidity of 31.1 % is carried out from online psychrometric calculator. The primary air velocity considered varies between 0.5 m/s to 3.0 m/s and the performance of the cooling pads are analyzed based on the saturation efficiency, leaving air temperature, specific humidity, relative humidity, cooling capacity and water consumption.

Krishna Shrivastava1, et al[2014][2] The coconut coir fiber pad was analyzed and compared with those of a commercial Aspen wood (wood wool) pad. Results show that the coconut coir fiber pad had similar saturation (cooling) effectiveness of near about 60% while the Relative humidity drop was observed from 80-85% of Aspen wood pad to 50-60% of Coconut coir pad. Also the water consumption rate for coconut coir fiber pad is less than aspen wood pad.

R. Boukhanouf, H. G. Ibrahim, A. Alharbi, and M. Kanzari [2014][3] Three new evaporative cooling pads represented by Cryperus Alopecuroides Rottb (Samar), Cyerus Alternifolius (Purdy) and Cyperus Rotundus l (Nut-grass or Se'd) were adapted and evaluated. Three pad face air velocities ranged between 0.45 and 1.01 m s-1 and two thicknesses of 10 and 15 cm were used in the investigation of the cooling performance criteria. Results showed that the proposed **R. K. Kulkarni1 and S. P. S. Rajput [2013][5The** most common evaporative cooling system uses a wetted pad through which air passed at uniform rate to make it saturated. Pads can be wetted by dripping water on upper side with the help of a re circulating pump. Such a system is called direct evaporative cooling (DEC). If the incoming air is having low humidity, then large quantity of water can be evaporated and large reduction in temperature can be obtained.

A.M. Alklaibi[2013][6] The internal two-stage evaporative cooler is studied by experimentally comparing its performance with direct evaporative cooler and theoretically with direct and external two-stage evaporative coolers.

J.T. Libertya*, B.O. Ugwuishiwua[7] [2013] Evaporative cooler works on the principle of cooling resulting from evaporation of water from the surface of the structure. The cooling achieved by this device also results in high relative humidity of the air in the cooling chamber from which the evaporation takes place relative to ambient air.

RM. A. Helmy, Mohamed A. Eltawil[2013][8]Three pad face air velocities ranged between 0.45 and 1.01 m/s and two thicknesses of 10 and 15 cm were The daily average cooling efficiencies of 88.4, 83.1 and 79.6% were obtained for celdek, Purdy and Samar, respectively during testing days inside celdek, the combined system at 15 cm pad thickness and 0.45 m s-1 pad face air velocity. The celdek pad material showed the highest efficiency as compared to other pad materials and could because as an alternative pad mate.

Seth I. Manuwa1 & Simon O. Odey[2012][9] cooling pads, and shapes for constructing evaporative coolers. Materials investigated include jute, latex foam, charcoal and wood shavings. Shapes of cooling systems considered were of hexagonal and square cross-sections. The average cooling or saturation efficiency for hexagonal cooler was 93.5% (jute), 91.4% (latex foam), 91.3% (charcoal) and 91.9% (wood shavings). The maximum temperatures observed were 6.4 (jute pad), 4.9 (latex foam pad), 5.2 (charcoal pad) and 3.6 degree Celsius. The results of this study will assist researchers in their selection of pad materials in the study of evaporative cooling systems.

Zainab Hasson Hassan[2012][10] The air flow rate is assumed to vary between 0.069 to 0.209 kg/s with constant water flow rate of 0.03 kg/s in the heat exchanger. The performance is reported in terms of effectiveness of DEC, saturation efficiency of DEC, outlet temperature of air and cooling capacity.

Vivek W. Khond[2011][11] The performance of Desert Cooler using four different pad materials in terms of cooling efficiency, water consumption and air velocity. Pads of Stainless steel wire mesh, coconut coir, Khus and Wood wool were fabricated and tested using a laboratory-scale experimental arrangement.**Abdollah Malli , Hamid Reza Sey [2011][12]** thermal performance of two types of cellulosic pads (5090 and 7090) which were made from corrugated papers has been studied experimentally. Samples were tested in a sub sonic wind tunnel made from polyethylene. The pads areas are 0.5 ×.5 m^2 with 75, 100 and 150 mm thicknesses. Pressure drop, humidity variation, evaporated water and effectiveness have been investigated for several inlet air velocities. The results show that overall pressure drop and amount of evaporated water increase by increasing the inlet air velocity and thickness in both types of pads. On the other hand, effectiveness and humidity variation decrease by increasing inlet air velocity.

Xiaoli Haoa, Cangzhou Zhua[2012][13] To maximize the energy saving potential of an evaporative air-cooled chiller (EACC), which composes of an evaporative air cooler and a conventional air-cooled chiller, a mathematical model was developed and a new index, increase of seasonal energy efficiency ratio (ISEER), was proposed to evaluate the energy saving potential of the evaporative air-cooled chiller.

J.K. Jain , D.A. Hindoliya [2011] [14] Evaporative cooling pads are commonly made from aspen and khus fibers.Air flow rate was kept constant. Evaporative cooling effectiveness was obtained and compared with that of aspen and khus pads. The effectiveness of pad with palash fibers was found to be 13.2% and 26.31% more than that of aspen and khus pads respectively. Whereas effectiveness of coconut fibers was found to be 8.15% more than that of khus and comparable with that of aspen pad.

Egbal MohammedAhmed et al.[2011][15] This study was conducted in Date Palm Technology Company Limited, Shambat, Khartoum State. To evaluate performance of three types of evaporative cooling pads for greenhouses (celdek pads, straw pads and sliced wood pads), as compared to the conditions outside the greenhouses (control), for pads. Performance evaluation includes environmental parameters (temperature and relative humidity at 8 am, 1 pm and 6 pm) and crop parameters (length and stem diameter, leaves number and width, fruit length and diameter, fruit weight and dry matter and yield). The results obtained for the temperature at 8 am showed that there was no significant difference (0.05) inside the greenhouses.

Abdollah Malli a, Hamid Reza Seyf[2011][16] thermal performance of two types of cellulosic pads (5090 and 7090) which were made from corrugated papers has been studied experimentally. Samples were tested in a sub sonic wind tunnel made from polyethylene. The pads areas are 0.5 × 0.5 m^2 with 75, 100 and 150 mm thicknesses. Pressure drop, humidity variation, evaporated water and effectiveness have been investigated for several inlet air velocities. The results show that overall pressure drop and amount of evaporated water increase by increasing the inlet air velocity and thickness in both types of pads. On the other hand, effectiveness and humidity variation decrease by increasing inlet air velocity.

A. Fouda' Z. Melikyanb [17] [2010] heat and mass transfer, process in direct evaporative cooler is discussed. A simplified mathematical model is developed to describe the heat and mass transfer between air and water in a direct evaporative cooler. The influences of the inlet frontal air velocity, pad thickness, inlet air dry-bulb temperature on the cooling efficiency of the evaporative cooler are calculated and analyzed. The predicted results show validity of simple mathematical model to design the direct evaporative cooler, and that the direct evaporative cooler with high performance pad material may be well applied for air conditioning systems.

Metin Dağtekin1 , Cengiz Karaca[2010][18] to determine the relationship between air velocity, cooling efficiency and decrease of the temperature of the air passing the pad, at a cellulose based evaporative cooling pad and to gain handy information for the persons working on this subject. As for the velocity of air passing through the pad 0.5, 1.0 and 2.0 ms-1 values were selected. It can be said that according to statistical data, optimal air velocity for the Mediterranean climatic conditions should be between 0.5 and 1.0 ms-1, among the selected air velocities.

Rawangkul R, Khedari J, Hirunlabh J, Zeghmati B[2008][19] The results show that overall pressure drop and amount of evaporated water increase by increasing the inlet air velocity and thickness in both types of pads. On the other hand, effectiveness and humidity variation decrease by increasing inlet air velocity.

FalehAl-Sulaiman[2002][20]. The results show that the average cooling efficiency is highest for jute at 62.1%, compared to 55.1% for luffa fibers, 49.9% for the reference commercial pad and 38.9% for date palm fiber. it would provide the best alternative.

4. METHODOLOGY

A suction fan is mounted in a end and the cooling pad is designed box type sliding in the other section of the box chamber. A water input tray is mounted on the top of the cooling box. Several small holes arranged in the tray to ensure uniform distribution of water. A drain hole is also present in the bottom of the stuffing box. Two digital thermometers are used on each side of the pad to measure the inlet and outlet air temperature several other devices are used, for example an anemometer to measure the air velocities and the electronic controller for controlling the speed of the fan to secure the air speed. A specific test procedure is implemented in this study. The experiments were performed for each type of pad. In this experiment, the average readings are recoded. The relative humidity of the ambient air is calculated online.

Figure 3.1(b) shows the rectangular pad with its orientation and direction of air flow. This is the classic form that is used by most of evaporative coolers. flows horizontally through the pad entering one side and leaving the other air. The lateral sides of the form are assumed to be closed to say, the air moves in one direction. Four rigid cellulose packing materials, jute, Khus and aspen with surfaces of 385m^2, width and height of the pad are taken as 0.35 m and 0.40 m giving pad face area of three pads are 0.385 m^2. At the maximum speed value of 3.0 m / s, the volume flow of air is obtained as 48.6 cm. pad thickness is taken as 0.045 m.Figure3.2 shows the rectangular plates arranged on 3 sides and the air being pulled to one side. This type of device is commonly used in commercial refrigerators, but the thickness of pad used is very less. The analysis for one side is applicable to all three sides. Air will enter with the same efficiency saturating three sides and the overall rate of mass flow of air will be three times that of single side

3.1 Ambient condition

The experiment was usually performed in the peak time of the summer April and May month. The inlet and outlet temperature are noted down though the thermometer reading, and wet bulb temperature (Twb1) is from the sling psychrometer reading. The experiment was carried out on the average ambient temperature is 40^0c and wet bulb temperature is 26.3^0c (Twb1) and relative humidity 31.8

Specific volume (*Vs*) = 0.9113 (calculated by online psychrometric calculator) [21].

$\rho = \frac{1}{Vs}$ kg/m^3 …..(i)

Where *Vs* is 0.9113 m^3 /k,

C_{pa} = 1007 J/kgK ,

Figure 3.1(a) systematic diagram of experimental evaporating cooling system

Figure 3.1(b) systematic diagram of experimental evaporating cooling system

3.2 Air mass flow rate

The inlet and outlet velocities of air through the pad are measured and Volume flow rates are calculated by considering the density at selected ambient condition. The velocities of air through the cooling pad are taken 0.5, 1.0, 1.5, 2.0, and 2.5 in m/s. The mass flow rate of air is calculated by the formula on the basis of the frontal area of the pad, velocity of air and density.

$M_{air} = \rho \times V_f$…….. (ii)

3.3 Geometrical parameters

Four different types of pads are considered in this experimental study. The position of pad is in such a way that air passes across the pad horizontally. In this position of pad only one dimensional cross flow of air takes place. The thickness of the pads are considered 0.1 m. Face area is taken as the area of the pad through which air enters the pad and is calculated by using equation

$Afi = W \times H$ …..(3)

Volume of the pad is given by

$V_{pad} = W \times H \times l$ …..(4)

Volume flow rate of air

$V_f\, air = Vi \times A_{fi}$…..(v)

In this study inlet and outlet velocities are same, so volume flow rate at inlet and outlet of the pad will be same.

Table 1. Geometrical parameters of the cooling pad

s.no	Parameter	dimension
1	Room area	10×10 ft^2
2	Blower/fan	fan
3	Fan diameter	26 cm
4	Wattage230/50 Hz	185
5	Tank capacity	30 liter
6	Cooling media	Cellulose, jute, aspen and khus

Table 2 Geometrical parameter of the evaporating cooling system

S.no.	Parameter	Dimension in meter
1	W	0.40m
2	H	0.35m
3	I	0.045m
4	A(3sides of pad)	0.385m^2

a)Cellulose pad

b) jute pad

c) Aspen pad

d) khus

3.4 parameter of cooling pad

The inlet temperature of air t_1 *is* is 40˚c and wet bulb temperature of air t_w the saturation efficiency of cooling pad is calculated based on the following relation [3]

$\eta_{sat} = \frac{t1-t2}{t1-tw} \times 100$ …..(vi)

η_{sat} = Saturation efficiency, t_1 = Ambient temperature, t_2 = outlet temperature from pad, t_w = bet bulb temperature of outside air.

As the evaporating cooling proceeds, along a constant wet bulb line, it means that the wet bulb temperature of inlet and outlet air is same i.e. 26.3^{0}c.

Relative and specific humidity of the leaving air is determined by the online psychrometric calculator [24]

3.5 Cooling capacity of evaporative cooling pad

$Q_c = M_A \times C_{pa} \times [t_1 - t_2] \times 3.6$ …..(vii)

First we take the cellulose pad cooling pad 6090 and speed at the in rpm and with control of speed regulator for different air velocity 0.5,1.0,1.5,2.0,2.5 m/sec. and find the different parameters ambient temperature, duct temperature , wet bulb temperature ,saturation efficiency ,volume flow rate ,mass flow rate and cooling capacity of ECS.

Table 3. Geometrical parameters of the cellulose 6090 cooling media

s.no	velocity vi m/sec	Volume flow rate of air V_f (m^3/s)	Duct temperature (T2) in ^{0}c	Efficiency η	Mass flow rate M_{air} Kg/s	Cooling capacity Q_c KJ/hr
1	0.5	0.231	30.5	69.34	0.2467	7955
2	1	0.462	27.3	92.7	0.4934	21270
3	1.5	0.693	29.1	79.56	0.7401	27383
4	2	0.924	29.4	77.37	0.9868	35506
5	2.5	1.235	30.1	72.26	1.235	44323

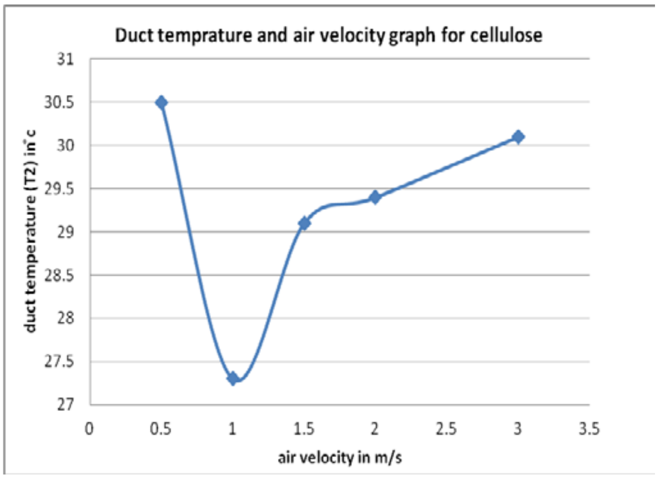


Figure 4.1Grpah between leaving air temperature and air velocity for cellulose pad

we take the cellulose as a media pad and regulate the speed at various rpm with the help of speed control regulator. From the above graph we observed that at velocity 1m/s the maximum drop of temperature. Maximum temperature drop is from 40˚C to 27.3˚C at contant wet bulb line after this point temerature slowly increases.

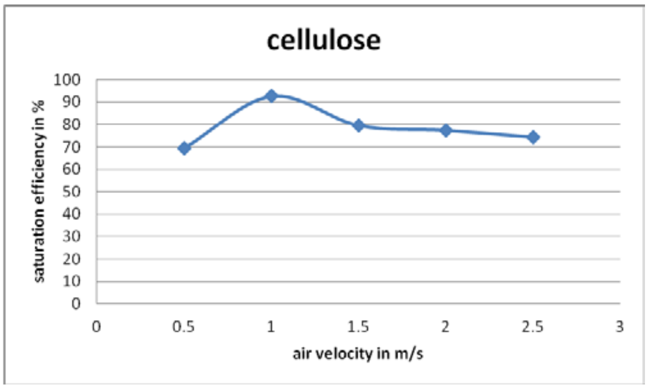


Figure 4.2Grpah between saturation efficiency and air velocity for cellulose pad.

The graph is plotted between various air velocity and Cellulose gives the maximum efficiency 92.70% and minimum 69.34%.this graph show the with increases air velocity the saturation efficiency slowly decreases. The maximum efficiency of cellulose 6090 obtained at velocity 1.0 m/s.

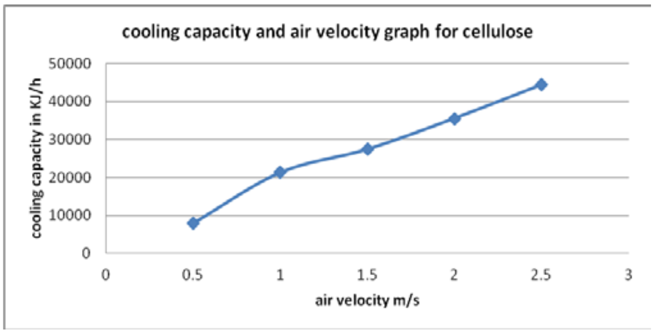


Figure 4.3Grpah between cooling capacity and air velocity for cellulose pad

Table 3. Geometrical parameters of the jute cooling media

S.no.	Air velocity vi(m/sec)	Volume flow rate of air V_f	Duct temperature (T2)In ^{0}c	Efficiency η In %	Mass flow rate M_{ai} Kg/s	Cooling capacity Q_c KJ/hr
1	0.5	0.231	30.67	68.10	0.2467	7285
2	1.0	0.462	30.30	70.14	0.4934	18088
3	1.5	0.693	31.18	64.30	0.7401	23866
4	2.0	0.924	31.60	59.92	0.9868	30817
5	2.5	1.235	31.79	59.41	1.235	42980

After that we take the Jute as a media pad and regulate the speed at various rpm with the help of speed control regulator. From the above graph we observed that at the air velocity 1m/s the maximum drop of temperature. Maximum temperature drop is fro40˚C to 30.3˚C and contant wet bulb line after this point temerature slowly increases.

ISSN: 2395-2946

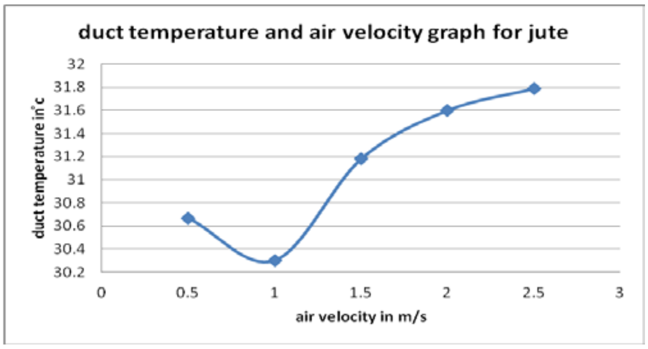


Figure 4.4Grpah between leaving air temperature and air velocity for jute.

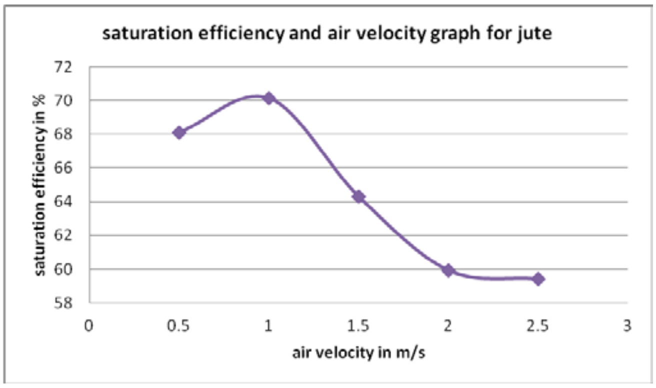


Figure 4.5Grpah between saturation efficiency and air velocity for jute

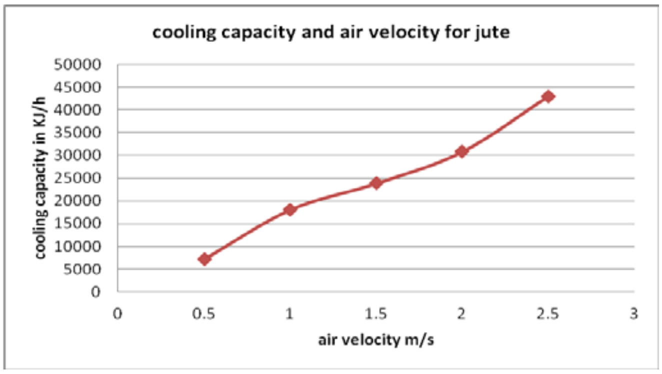


Figure 4.6Grpah between cooling capacity and air velocity for jute

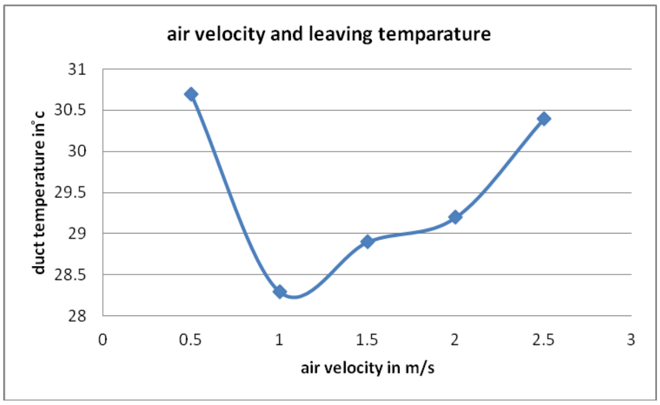


Figure 4.7Grpah between duct temperature and air velocity for aspen

The graph is plotted between various air velocity and jute gives the maximum efficiency 70.14% and minimum 59.41 %.this graph show the with increases air velocity the saturation efficiency slowly decreases. The maximum efficiency of jute obtained at velocity 1.0 m/s.

Table 4. Geometrical parameters of the aspen cooling media

S.no.	Air velocity vi (m/sec)	Volume flow rate of air V_f	Duct temperature (T2) In ^{0}c	Efficiency η in %	Mass flow rate M_{air} kg/s	Cooling capacity Q_c KJ/hr
1	0.5	0.231	30.70	67.88	0.2467	7788
2	1.0	0.462	28.30	85.40	0.4934	19595
3	1.5	0.693	28.90	81.02	0.7401	27886
4	2.0	0.924	29.20	78.83	0.9868	36176
5	2.5	1.235	30.40	70.07	1.235	42980

After that we take the aspen pad and regulate the speed at various rpm with the help of speed control regulator. From the above graph we observed that at the velocity 1.0 m/s the maximum drop of temperature. Maximum temperature drop is from 40˚C to 28.30˚C .At contant wet bulb line after increasing velocity duct temperature slowly decreases.

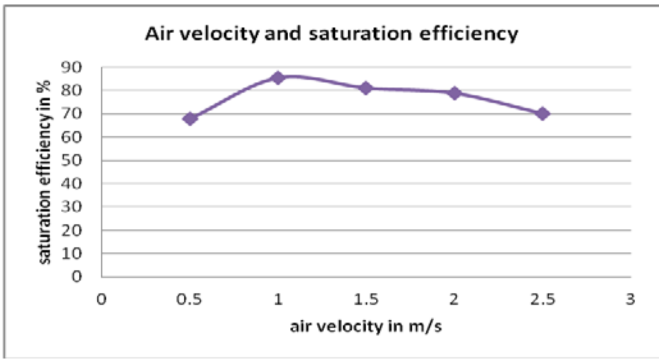


Figure 4.8 Graph between saturation efficiency and air velocity for aspen pad

Table 5. Geometrical parameters of the khus cooling media

S.no.	Air velocity vi in m/s	Duct Temparature T2 in ˚C	Efficiency in %	Volume flow rate of air Vf	Mass flow rate Mair kg/s	Cooling capacity Q_c
1	0.5	31.3	63.5	0.2695	0.2878	8594
2	1	29.2	78.83	0.539	0.5956	16688
3	1.5	30.4	70	0.8085	0.8934	23664
4	2	30.6	67.15	1.078	1.1513	30300
5	2.5	31.8	70	1.3475	1.4391	36757

The graph is plotted between various air velocity and aspen gives the maximum efficiency 85.7% and minimum 67.8 %.this graph show the with increases air velocity the saturation efficiency slowly decreases. The maximum efficiency of jute obtained at velocity 1.0 m/s.

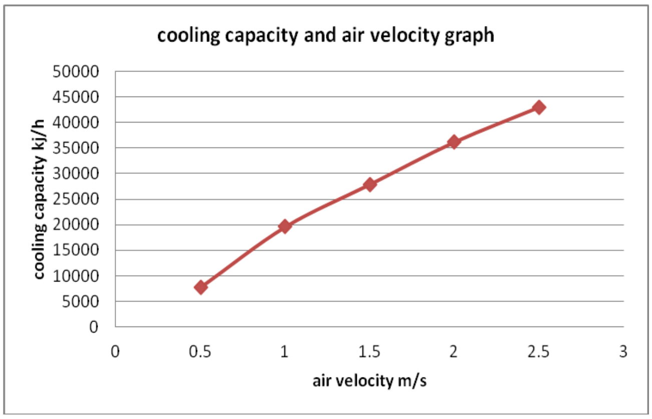


Figure 4.9 Graph between cooling capacity and air velocity for aspen.

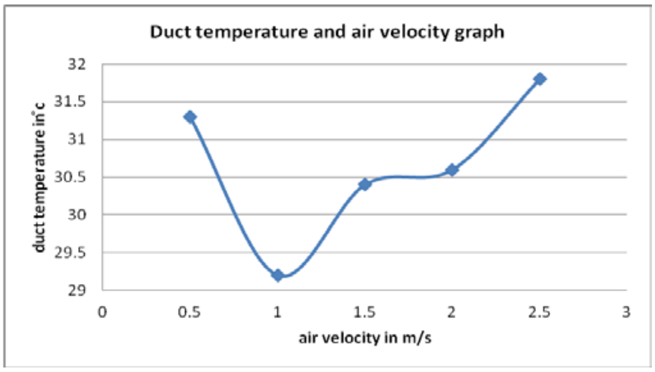


Figure 4.10 duct temperatures and air velocity graph for khus pad

After that we take the khus pad and regulate the speed at various rpm with the help of speed control regulator. From the above graph we observed that at the celocity 1.0 m/s the maximum drop of temperature. Maximum temperature drop is from 40˚C to 29.20˚C .At contant wet bulb line after increasing velocity duct temperature slowly decreases.

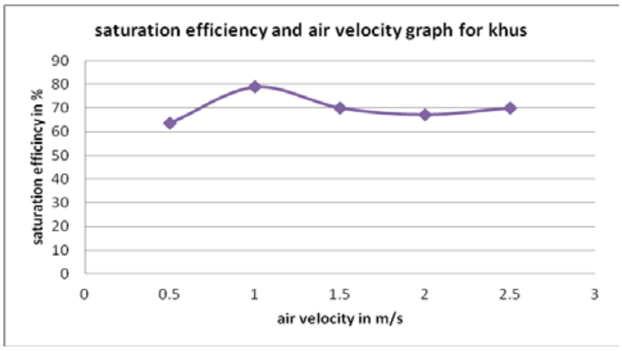


Figure 4.11Grpah between saturation efficiency and air velocity for khus

The graph is plotted between various air velocity and khus gives the maximum efficiency 78.83% and minimum 63.5 %.this graph show the with increases air velocity the saturation efficiency slowly decreases. The maximum efficiency of jute obtained at velocity 1.0 m/s.

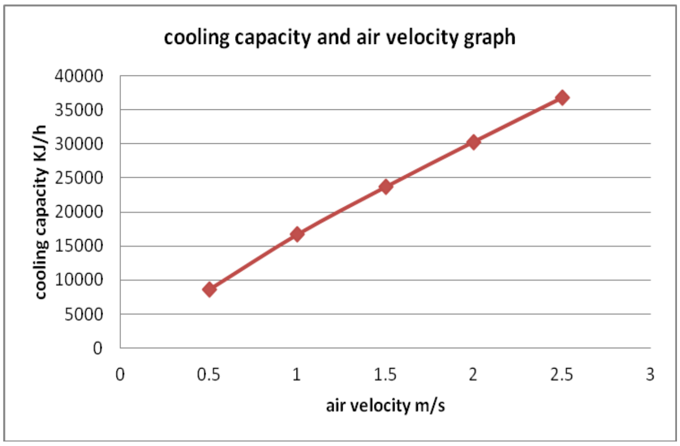


Figure 4.12Grpah between cooling capacity and air velocity for khus pad

4.1 Saturation efficiency

Comparative saturation efficiency of different cooling materials

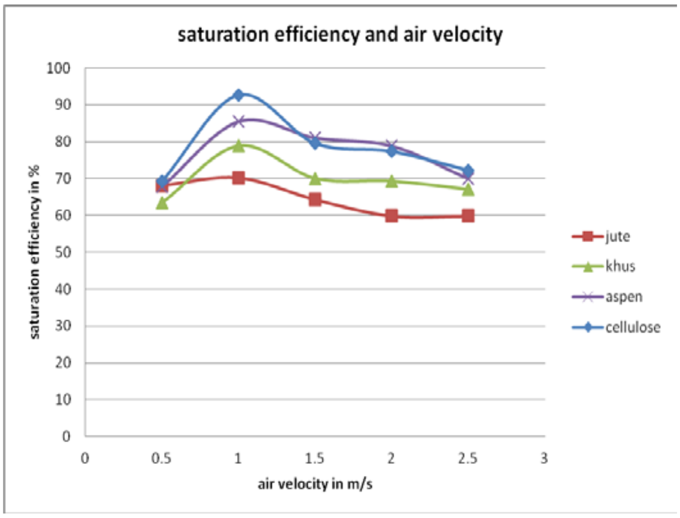


Figure 4.13 Graph between saturation efficiency and air velocity for different material.

This graph represents the various air velocity and cooling efficiency for different materials in different temperature the maximum cooling efficiency for cellulose pad material 92.70.% and minimum 63.34% ,the maximum efficiency for jute 70.14 % and minimum 59.90% for khus 78.83maximum and minimum 63.50 % and for aspen 85.40 % and 67.88% and . So maximum cooling efficiency 92.70% for cellulose fiber and minimum cooling efficiency 59.90% of jute fiber.

4.2 Cooling capacity

The cooling capacity with different velocity as shown in graph. If velocity increases the mass flow rate of water also increases.

This graph represent the cooling capacity of different cooling pad maximum value for cellulose 6090 maximum cooling capacity 44323kg/hr and minimum 7955kg/hr, for jute maximum 42980kg/hr and minimum 7285kg/hr ,for khus maximum cooing capacity 36443kg/hr and minimum 8047kg/hr and for aspen material maximum cooling capacity 42980kg/hr and minimum cooling capacity 7788kg/hr.

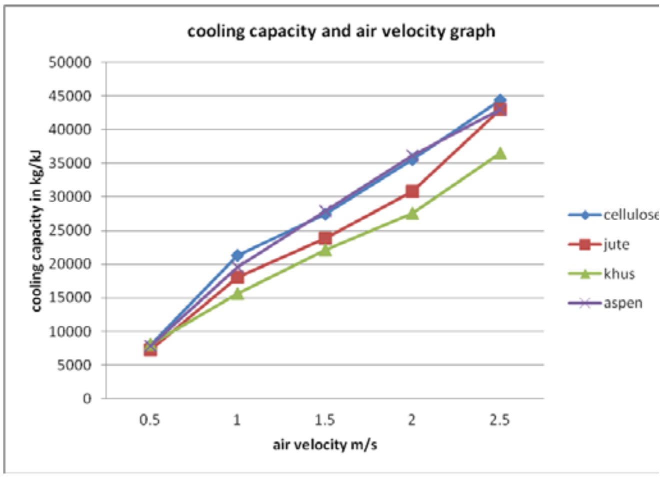
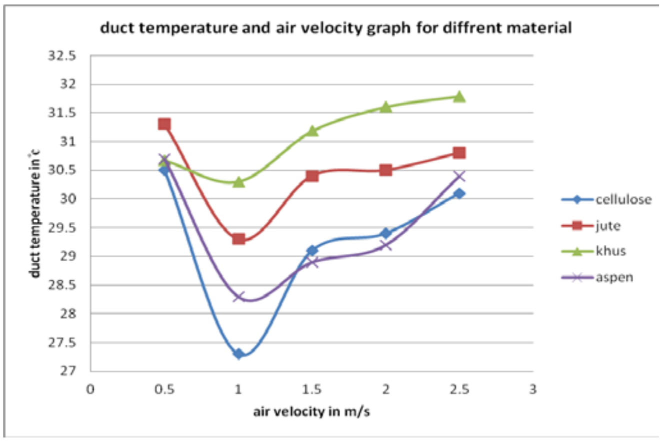


Figure 4.13 Graph between cooling capacity and air velocity for different material



Thus the maximum cooling capacity of cellulose 6090 cooling material 44323kg/hr and and minimum cooling capacity for jute cooling material 7285kg/hr

4.3 leaving air temperature

The duct temperature of air increases in air velocity. The efficiency and cooling capacity are depend upon difference of the ambient temperature and leaving air temperature.The leaving air temperature is minimum and maximum 27.3 to30.5^{0}c for cellulose 6090 pad ,minimum 29.3 and maximum 31.3 c for jute, for aspen 28.3 minimum and 30.7˚c maximum and for khus 30.3 minimum and maximum 31.79 c.

5.CONCLUSION

An experimental setup is designed to calculate the performance of the cooling efficiency mass flow rate and cooling capacity of four different cooling pad materials.

5.1 Saturation efficiency

The result shows that the cooling efficiency is the maximum average found at 1.0m / s air velocity for all cooling pad materials. It's also observe and compare all cooling pad materials at .045 m thick cooling pad the maximum saturation efficiency is 6090 cellulose (92.70%) and jute minimum saturation efficiency (68.18%) at air velocity 1.0m/s . At air velocity, it was concluded that the cooling efficiency at a high air velocity of 1.0 m / s was 92.70% cellulose 6090 compared to other cooling pad materials, Jute of cellulose (70.14%), aspen (85.40%), and khus (78.83%).

After concluding all the tables and graphic aspen and cellulose have better cooling efficiency at various speeds compared to other pad materials.

Its maximum efficiency is 92.70% to 59.9%. The drop in efficiency is not much lower than the maximum efficiency compared to other pad materials.

5.2 Cooling Capacity

The cooling capacity of different cooling pad maximum value for cellulose 6090 maximum cooling capacity 44323kg/hr and minimum 7955kg/hr, for jute maximum 42980kg/hr and minimum 7285kg/hr ,for khus maximum cooing capacity 36443kg/hr and minimum 8047kg/hr and for aspen material maximum cooling capacity 42980kg/hr and minimum cooling capacity 7788kg/hr.

Thus the maximum cooling capacity of cellulose 6090 cooling material 44323kg/hr and and The duct temperature of air increases in air velocity. The efficiency and cooling capacity are depend upon difference of the ambient temperature and leaving air temperature.

5.3 leaving air temperature

The leaving air temperature is minimum and maximum 27.3 to30.5^{0}c for cellulose 6090 pad ,minimum 29.3 and maximum 31.3 c for jute, for aspen 28.3 minimum and 30.7˚c maximum and for khus 30.3 minimum and maximum 31.79 c.minimum cooling capacity for jute cooling material 7285kg/kJ.

7. FUTURE SCOPES

As the number of energy resources are limited and primarly aim of the government is to reduce the consumption of electricity by promoting energy efficient equipments.Our project gives an effective alternative which consumes As no kind of C-F-C gases such as R-22,R12 are used which are one of the reason for ozone depletion layer thus the equipment is eniviroment friendly less electical energy.

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