International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 128-138 www.ijaem.net ISSN: 2395-5252

Design, Fabrication and Performance Evaluation of Desiccant Wheel Dehumdifier

Dr. J P Yadav[1],Dr. DevendraKumar[2],Pratyush[3] and DevendraSingh[4]

[1,2] Professor, Faculty of AgrilEngg& Tech, (C.S.A. Univ of Agri & Tech, Kanpur) Campus Etawah, U.P.
[4] Faculty, Faculty of AgrilEngg& Tech, (C.S.A. Univ of Agri & Tech, Kanpur) Campus Etawah, U.P.
[3] Faculty, Department Civil Engineering, Kamla Nehru Institute of Technology, Sultanpur, U.P.

Submitted: 01-04-2022 Revised: 06-04-2022 Accepted: 11-04-2022

ABSTRACT: A desiccant cooling method that utilizes desiccant dehumidification and evaporative cooling technologies. The desiccant dehumidifier, unlike CFCs, uses low-grade thermal energy to control humidity and temperature separately. For evaporative coolers and desiccant dehumidifiers, the variation of psychometric parameters like humidity levels and moisture concentration inside an air-conditioned space is researched and analysed in this work. Traditional vapour compression air conditioning units and cooling desiccant dehumidification systems have been compared (DDS). DDS conserves energy by isolating humidity control from control of temperature and, as a good filter, enhances indoor air quality. Desiccant substances like silica gel are employed in this study.On a psychometric chart, a solid desiccant dehumidifier and evaporating cooling are developed and studied for desiccant dehumidification system optimization in tandem with an evaporative cooler.

KEYWORDS: Desiccant Wheel, silica gel, Evaporative cooler.

I. INTRODUCTION

Desiccant cooling systems are made up of three parts: a regeneration heat origin, a dehumidifier (desiccant materials), and an evaporative cooler. A standard air conditioner, an evaporative cooler, or a cold coil evaporator are examples of cooling units. The cooling unit is responsible for handling the sensitive load, while the desiccant is responsible for removing the latent load. A dehumidifier wheel is frequently used in conjunction with a desiccant wheel system to chill the dry and warm air stream before it is further cooled by an evaporative cooling system.The thermal energy required to pull out the moist that the desiccant absorbed it during adsorption stage is provided by the regeneration source of heat. Different potential sources of energy can be used because a thermal source of energy is necessary. Solar electricity, waste heat, and natural gas warming are all options, but heating coils are used in such a situation.

II. DESICCANT COOLING SYSTEM VS. HVAC SYSTEM

Figure 1.1 depicts the process diagrams for conventional HVAC and desiccant cooling air conditioning, while Figure 2.2 depicts the thermal processes on psychrometric charts.
Fresh air carries solely the burden of latent heatin the serving room in these two air-conditioning systems. In a traditional refrigerant vapour compression system, the fresh air at point 1 transports the heat/mass exchanger to point 2, where it is allowed to cool underneath the dew point to point 3, condensing the excess moisture, and then energy is required to heat up it to add sufficient point 4, which mixes with indoor air at point 5.

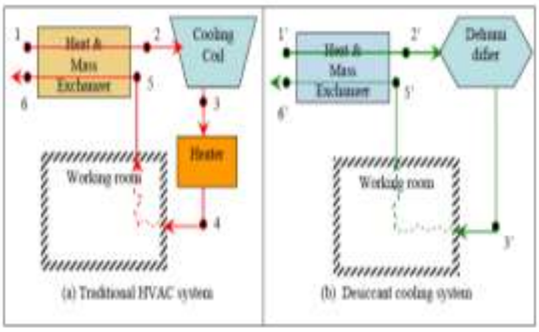

Fig. 1.1 (a) HVAC system (b) Desiccant cooling system

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 128-138 www.ijaem.net ISSN: 2395-5252

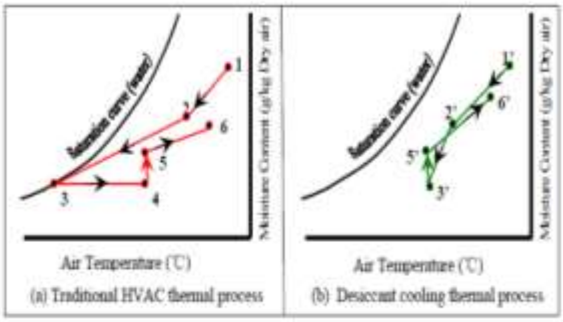

Fig. 1.2 Psychometrics chart of traditional air condition system and desiccant cooling system

Overcooling and reheating energy is squandered in the process, and additional CO_2 by-product is generated. The fresh air from point 1' efficiently releases the heat/mass to the discharging air to point 2', from whence it is cooled and dehumidified by the cold desiccant supplied to point 3' in the proposed effective heat recovery/desiccant cooling system. The interior cooling and dehumidification demand is moved to point 5', where some air escapes and fresh air arrives to point 6', by treated fresh air.It's a novel air treatment cycle that consumes less energy while maintaining the same level of air conditioning. Desiccant cooling systems also employ customised desiccant-soaked fibre heat/mass exchangers for improved recovery efficiency. As a result, during the last two decades, adsorption and absorption techniques have been developed and deployed to dehumidify humid air.It is vital to verify that the moisture-absorbing silica gel in the desiccant dehumidifier system will not cause any harm and will effectively remove moisture. Adsorption/sorption units are nearly as efficient at low load (at the same dry bulb temperature) as they are at high load. Variations in load are achieved by regulating the quantity of moisture released to the desiccant wheel or by altering the dry bulb temperature without affecting the load.

III. DESICCANTS AND ITS PHYSICAL PROPERTIES

Desiccants are compounds that, when exposed to wet air at moderate temperatures, have a strong attraction for water vapour. Desiccants used for space conditioning, on the other hand, must be able to store a lot of water. Solid desiccant materials used commercially may store up to 50% of their weight in water. Commercial solid desiccants include silica gel, molecular sieve, and activated carbon. Desiccants in liquid form can absorb significantly more moisture. Lithium chloride is a typical liquid desiccant that has long been used in dehumidification. The following table lists the features of typical commercial desiccants.

Because liquid desiccant dehumidification equipment is significantly more sophisticated than solid desiccant dehumidification equipment, and because using a liquid desiccant technology in construction applications is problematic, only solid desiccant is studied in this study. Solid desiccants are materials with a large surface area and very tiny pores. Desiccants have a strong attraction for water due to their porous structure. During their useful life, desiccants can be exposed to thousands of adsorption/desorption cycles. Simultaneous adsorption and adsorption include the transfer of heat and mass between wet air and desiccants.Silica gel is an amorphous, granular type of silica made from sodium silicate and sulfuric acid. The main component of activated silica gel used as an adsorbent is partly hydrated silicon dioxide. Amorphous silicon dioxide is used to make silica gel, which is chemically inert and non-toxic. The material has a porous structure and is exceedingly durable. Silica gel comes in a variety of grades.It features an interior network of small holes that join together to provide a contact area of 700–800 square metres per gramme. The size of the silica granules in each grade varies. Commercial silica gel absorbs up to 40% of its dry weight in water. By using vacuum, heating the gel, or returning the lotion to its initial state, the absorbed water may be readily removed.

The silica gel isotherm is seen in Figure 1.3. The word isotherm comes from the fact that each curve reflects a state of "equilibrium" at a fixed temperature. It's worth noting that the absorption of silica gel (and other desiccants in general) increases with rising water vapour pressure and decreases with increasing temperature. The moisture loading of a wet desiccant as a function of temperature and the water vapour pressure of the air in contact with the desiccant is expressed by the adsorption isotherm.

IV. BACKGROUND OF RESEARCH

Several layouts of desiccant-vapor compression hybrid cooling devices have been presented by different researchers, resulting in varying COPs and system efficacy. Air conditioning and refrigeration equipment consume around 15% of global electric power, while air conditioning and water heating systems consume 59 percent of the energy consumed in commercial and home facilities

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 128-138 www.ijaem.net ISSN: 2395-5252

(Building Energy Data Book, 2011). Traditional air conditioning systems that use a vapour compression refrigeration system (VCRS) are notorious for causing thermal pollution and energy waste in the form of condensate heat released into the environment. Other downsides of (VCRS) include the fact that they run on energy generated by burning natural resources, which contributes to the greenhouse effect and pollution. Second, if the refrigerant used in VCRS leaks, it might deplete the ozone layer (Zhong et al., 2015). To conserve the environment and high-grade energy, the VCRS-based cooling system should be replaced with an environmentally friendly alternative (Berardi et al., 2017). Thermoelectric (TE) modules can be utilised as thermoelectric coolers (TEC) and power generators (Xi et al., 2007). (Luo et al., 2019). In comparison to traditional VCRS-based systems, TEC has no moving parts or working fluid, making it a pollution-free coolTE modules are widely used in a variety of applications in aerospace, cooling, and military, among others, due to benefits such as reliability, light weight, and easy replicability (Sofrata H., 1984, Cheng et al., 2011, Wang, R.Z. & Dai, Y.J. 2001). TEC systems may be used to successfully lower CPU temperature (Naphon P. &Wiriyasart, S., 2009). TEC systems have been employed in automobile seats and small area cooling requirements in buildings because to its noiseless and movement-free functioning (Choi et al., 2007 &Gillott et al., 2010). TE systems may be divided into two types: integrated systems and nonintegrated systems (Zuazua-Ros et al., 2019). PV cells may also be combined with TE systems, in which the electricity generated by the PV cell is utilised to power the TE system for cooling and heating (Luo et al., 2019).Power operated groundnut decorticator has been Design and Fabrication by Yadav et al., 2022. Paddy Thresher has been also designed by Yadav et al. 2022.

Table 1 Properties of common commercial desiccants

Desiccants	Internal porosity, X	Bulk density	Average pore diameter	Surface area	Adsorptive capacity
	%	kg/ m^3	nm	km^2/kg	kg H_2O/kg
Alumina Desiccant	30	910	4.5	0.2	0.22
Molecular sieves type 4A	32	610-670	0.4	0.7	0.22-0.26
Silica gel Drying Separation	38-48	700-820	2-5	0.6-0.8	0.35-0.50

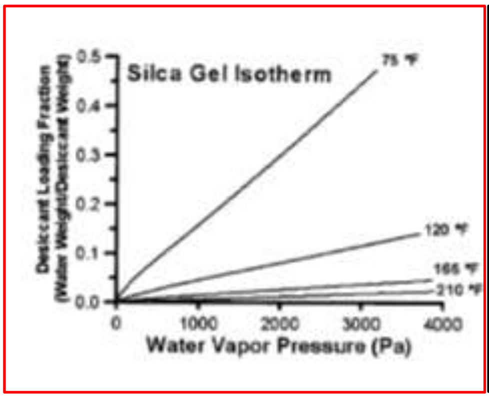

Fig. 1.3 Isotherms of Silica Gel

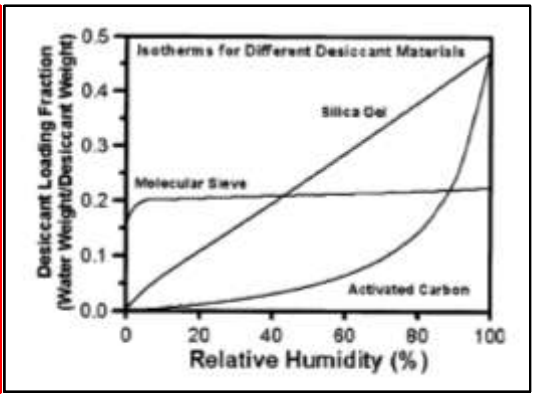

Fig. 1.4 Isotherms of Different desiccant

Desiccant-based air conditioning systems (DBACS) have also caught the attention of researchers as an approach to environmentally friendly air conditioning systems. A DBACS may function on low-grade heat energy that can be easily harvested from the sun, reducing the need for high-grade electricity. In humid regions, DBACS have the potential to be employed as air conditioning systems (Kodama et al., 2001, Steven Brown, j. &Domanski, P.A., 2014). Solid desiccants, such as silica gel and zeolite, are easier to handle than liquid desiccants (Al-Alili et al., 2015 & Ge et al., 2009). One of the most significant components of solid DBACS is a honeycomb wheel base filled with desiccant material. Adsorption (dehumidification) and

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 128-138 www.ijaem.net ISSN: 2395-5252

desorption are the two fundamental functioning stages of the system (regeneration). In the first step, wet air is dehumidified by passing it through a low-rpm desiccant wheel, and this dehumidified air must then be cooled by another system before being given to the room, as the temperature rises owing to adsorption heat. The desiccant wheel in the second phase is regenerated by passing high-temperature air that is normally expelled outdoors (Li H. et al., 2013). For outdoor settings, a DBACS is simulated and tested using an evaporator, and the inlet humidity ratio, regeneration temperature, COP, energy intake, and energy saving rates are given (Shahzad et al., 2018 & Ying et al., 2015). For outdoor temperatures greater than 40 °C, hybrid desiccant cooling systems offer much higher COP than direct and indirect evaporative cooling systems (Lee et al., 2021).

V. DESICCANT DEHUMDIFICATION SYSTEM EXPERIMENTAL SETUP

The experimental set up consists of three components, viz. Regeneration heat sources, dehumidifiers, and evaporator-coolers designed, manufactured, and required parts and fittings such as fans, aspen pads, pipes, water tanks, desiccant wheels, motors, desiccant (silica gel), heating coils, grills, pumps, nuts and the bolts, wiring and switches were assembled on the frame according to the given specifications.

VI. RESULT AND DISCUSSION

Dry Bulb Temperature:Dry bulb temperature varies under different conditions such as dry bulb temperature at room temperature, under evaporative cooling conditions and dehumidification conditions. The dry bulb temperature is 23-26^{O}C and the dry bulb temperature is 25-30^{O}C under the condition of cooling and dehumidification. The comfort zone in the summer season is 25-30^{O}C which is found under cooling and dehumidification conditions.

Relative Humidity: The variation of relative humidity under different conditions is analyzed. The comfort zone of relative humidity in summer is 50-60%, which is attainable under cooling and dehumidification conditions. Furthermore, it is analyzed that the readings with the help of hygrometer device at room temperature are found to have a dry bulb temperature of 30-40^{O}C high and the relative humidity 40-66% lower.When readings are taken with the switch on, it is found that the dry bulb temperature is lower than the room temperature but the relative humidity rises to 70-80%.Thus, the humidity in the room is higher than the normal relative humidity. But when we turn on the evaporative cooler the dry bulb temperature drops a bit. With respect to DBT, the relative humidity also increases that is not in the comfort zone. So, when switched on the parameters of both the evaporative cooling and the desiccant dehumidifier are within the comfort zone. Three different temperature parameter conditions are taken in the table, which read as follows-

a) Room temperature conditions in the table mean psychometric parameters such as DBT, RH, WBT, W, DPT, H, VP, V without any cooling device.
b) The evaporative cooling condition means that at a certain time, the evaporative cooler cooling coil is on and the water pump along with the cooler fan is on.
c) Evaporative cooling + desiccant dehumidifier condition means to turn on at a certain time.

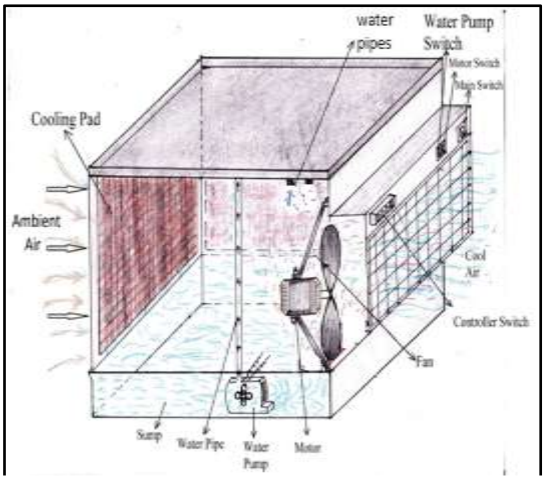

Fig. 2a: Evaporating cooler

Fig 2b: Desiccant dehumidifier system cooling

Table 2: Specification of components/ parts

Sl. No.	Nomenclature	Specification
1	Evaporative cooler (Height of upper body x width x length)	0.76 x 0.61 x 0.52 m - The pad media determines the effectiveness of direct cooling. - A good quality stiff pad can give up to 90% efficiency, whereas a loose wood pad can only provide about 50% efficiency.
2.	Duct (L x W x H)	0.46 x 0.30 x 0.46 m
3.	Fan/exhaust / heating coil - using an electric motor to rotate thin, rigid vanes in order to move air for cooling. Fan consisting of vanes radiating from a central hub	-Fan/exhaust/ heating coil -Water pump used to take up the water and spread it on the cooling pad. -heating coil converts electricity into heat through the process of resistive electric current. It brings the air to the designed dry bulb temperature and relative humidity.
4.	Switch	-interrupting the current or diverting it from one conductor to another.
5.	Hygrometer	-used to measure dry bulb and relative humidity simultaneously.
6.	Desiccant wheel	-is identical to a thermal wheel, but has a coating placed only for the objective of dehumidifying or 'drying' the air stream. -desiccant is normally Silica Gel. -Desiccant goes through entering air where moisture is absorbed and through a "regenerating" zone where desiccant is dried and moisture is released as the wheel revolves. The adsorption process is repeated while the wheel proceeds to revolve. -The usage of a heating coil is commonly used for regeneration.

Table 3.1

Day 1	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C
6-7 AM	28	59	24.10	24.3	65	21.34	24	56	20.34
9-10 AM	29.6	58	25.41	26.2	64	22.97	25.5	54	21.44
12-1 PM	31.2	60	27.02	26.4	66	23.34	26	57	22.15
3-4 PM	32.6	62	28.46	25	65	21.98	24.2	58	20.65
6-7 PM	30	56	25.55	24.6	63	21.44	24	53	20.04

Table 3.2

Day 2	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C	DBT 0C	RH %	WBT ^{0}C
6-7 AM	29.3	58	25.14	27.6	62	24.04	27.2	56	23.11
9-10 AM	29.2	59	25.16	24.6	60	21.18	24.3	54	20.39
12-1 PM	30.3	60	26.23	26.9	65	23.69	26.2	58	22.42
3-4 PM	29.9	59	25.77	27.6	61	23.94	27.3	55	23.10
6-7 PM	29.8	51	24.85	28.6	62	24,93	28	54	23.61

Table 3.3

Day 3	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C
6-7 AM	25.6	58	21.89	24.1	60	20	23.3	55	19.60
9-10 AM	27.5	59	23.66	25.3	66	22.34	24.1	57	20.47
12-1 PM	33.7	66	29.85	29.5	70	26.54	28.6	58	24.53
3-4 PM	31.3	58	26.81	28.6	63	25.03	27.3	54	23.00
6-7 PM	30.6	54	25.85	25.2	57	21.44	24.6	53	20.56

Table 3.4

Day 4	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT⁰ C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C
6-7 AM	29.6	55	25.10	26.8	59	23.04	26	50	21.50
9-10 AM	31.9	60	27.64	29.5	65	26.02	26.9	56	22.84
12-1 PM	34	65	29.99	25.1	68	22.33	24.8	58	21.18
3-4 PM	32.6	62	28.46	26.3	67	23.34	26.1	56	22.14
6-7 PM	29	59	24.98	24.3	63	21.17	24	55	20.21

Table 3.5

Day 5	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C
6-7 AM	28.8	48	23.69	26.2	50	21.67	26	46	21.13
9-10 AM	30.6	58	26.28	27.2	60	23.49	26.9	54	22.65
12-1 PM	32	59	27.62	27.6	62	24.04	27.3	56	23.19
3-4 PM	33	61	28.68	28	65	24.69	27.5	58	23.56
6-7 PM	30.9	59	26.65	26.6	61	23.05	26.4	55	22.31

Table 3.6

Day 6	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WB ⁰C
6-7 AM	28	56	23.81	24.9	59	21.36	24.6	54	20.65
9-10 AM	30.3	58	26.02	27	65	23.78	26.3	56	22.32
12-1 PM	32.4	60	28.06	27.8	64	24.41	27.3	58	23.39
3-4 PM	30.2	59	26.04	26.8	62	23.32	26	56	22.06
6-7 PM	29.4	58	25.23	26.2	61	22.69	25.3	54	21.26

Table 3.7

Day 7	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C	DBT ⁰C	RH %	WBT ⁰C
6-7 AM	29	55	24.58	24.2	58	20.65	24	50	19.78

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 128-138 www.ijaem.net ISSN: 2395-5252

9-10 AM	31.2	58	26.81	27.6	63	24.13	27.4	55	23.18
12-1 PM	33.1	60	28.65	28.8	68	25.70	28	58	24.00
3-4 PM	34	62	29.64	26.4	64	23.15	26.3	54	22.13
6-7 PM	30	61	26.07	26.8	65	23.60	26.2	52	21.86

Table 3.8

Day 8	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C
6-7 AM	26	58	22.24	24.3	60	20.91	24.1	55	20.30
9-10 AM	29	56	24.68	26.4	59	22.69	26	54	21.87
12-1 PM	30.6	60	26.49	28.6	62	24.93	28.2	56	23.98
3-4 PM	31	62	27.06	27.6	66	23.42	27.3	57	23.29
6-7 PM	29.8	59	25.69	26.4	61	22.87	26.2	56	22.23

Table 3.9

Day 9	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ^{0}C	RH %	WBT^0 C	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C
6-7 AM	25.4	56	21.53	24.3	59	20.83	24.1	54	20.21
9-10 AM	29.6	59	25.25	26.3	65	23.15	26	57	22.15
12-1 PM	30.1	58	25.84	27.6	64	24.23	27	55	22.84
3-4 PM	31.2	58	26.81	27	63	23.60	26.3	56	22.32
6-7 PM	29.2	57	24.95	26.2	61	22.69	25	54	21.00

Table 3.10

Day 10	Condition of the Room			Desiccant-free evaporative cooling			Dehumidification and Evaporative cooling with desiccant		
Time	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C
6-7 AM	26	58	22.24	25.3	62	21.98	25	56	21.18
9-10 AM	29.8	56	25.37	26.6	61	23.05	26.3	54	22.13
12-1 PM	32.1	58	27.59	28.1	61	24.3	27.6	54	23.26
3-4 PM	31.5	60	27.29	26.9	67	23.88	26.4	57	22.50
6-7 PM	31	59	26.74	25.6	64	22.43	25.1	53	21.00

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 4 Apr 2022, pp: 128-138 www.ijaem.net ISSN: 2395-5252

Table 3.11: Desiccant dehumidifier and air conditioning system psychrometric properties

	Air conditioning System			Desiccant dehumidification system		
Conditions	DBT ^{0}C	RH %	WBT ^{0}C	DBT ^{0}C	RH %	WBT ^{0}C
Condition 1	24.2	55	20.393	24.9	54	20.18
Condition 2	25.3	54	21.266	26.2	53	21.957
Condition 3	26	56	22.061	26.3	55	22.23
Condition 4	26.4	55	22.318	27	54	22.745
Condition 5	27	54	22.745	27.4	53	22.995

Table 3.12: Cost of Desiccant dehumidifier and Conventional air conditioning system

Sl. No.	Components	Approx. Cost (Rs)	Sl. No.	Components	Approx. Cost (Rs)
1.	Evaporativecooler frame	1500	1.	Compressor (for 1 tonne)	7600
2.	Desiccant wheel	1300	2.	Evaporator	2636
3.	Silica gel (1 kg)	400	3.	Condenser	3000
4.	Cooler fans	1500	4.	Expansion valve	1600
5.	Water tank with stand	2500	5.	Receiver	200
6.	Pump and motor	1000	6.	Copper pipe	2000
7.	Heating coil	100	7.	Blowers (evaporator, condenser)	1300
8.	Duct	500		Total cost.	18,336
9.	Switches, socket, wire & other	1250			
	Total cost.	10,050			

Analysis of Psychrometric Chart for 10 Days

In this analysis, when readings were taken at different times (6-7 a.m. to 6-7 p.m.) at room temperature for 10 days, it was found that different values of dry bulb temperature and relative humidity were not in the comfort zone.Now in evaporative cooling conditions at that time it is found that the dry bulb temperature is decreasing and the RH is increasing which is not even in the desired comfort zone.But when the desiccant dehumidifier system with evaporative cooler is turned on, it is found that the DBT is decreasing and the RH is alsodecreasing, which are in the comfort zone.

Economic Analysis

It has been analyzed that the total manufacturing cost of the desiccant dehumidifier system is lower than that of the conventional air conditioning system. The components of the two systems differ greatly as DDS uses evaporative coolers, desiccant wheels, ducts, heating-coils, etc., but conventional air conditioning systems use compressors, condensers, evaporators, expansion valves, receivers, etc.

VII. CONCLUSION

A desiccant dehumidifier system can be a good option when humidity levels are high. It has been experimentally proven that using a desiccant dehumidifier maintains the required temperature and relative humidity for comfort. Some of the results obtained from the performance appraisal are given below:

i. The surrounding (room) humidity is initially high. When evaporative coolers are utilized, it is discovered that the temperature declines and the relative humidity rises with time. The desiccant dehumidifier, on the other hand, reduces relative humidity while also lowering the temperature significantly.

ii. Desiccant dehumidifier system gives comparatively better readings as compared to air conditioning system with less input power.
iii. The performance for thermal comfort gets better as the desiccant material load increases.
iv. When the grain size of the desiccant material is increased, the performance of the desiccant dehumidifier is also improved.
v. Desiccant dehumidifier gives better results under low wheel speed.
vi. Higher loading showed increased latent capacity compared to lighter loading at lower desiccant wheel speed and regeneration temperature.

ACKNOWLEDGEMENT

The author is thankful to Er. Pankaj Sharma, Asstt. Prof. and B. Tech. students, viz. Ayush Patel, Ankit Singh, Sudhanshu kumar, Prashant Sharma, Parul Sharma, Pooja Maurya, and Himanshu Yadav, for their contribution in Designing and fabrication of Desiccant Wheel Dehumdifier system under my supervision.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

[1]. Al-Alili, A. Hwang, Y. &Radermacher, R. 2015. Performance of a desiccant wheel cycle utilizing new zeolite material: experimental investigation, energy. 81: 137–145.
[2]. Berardi, U., La, R. P. &Almodovar, J. M. 2017. Water-to-air-heat exchanger and indirect evaporative cooling in buildings with green roofs. Energy and Buildings 151: 406–417.
[3]. Building Energy Data Book 2011. US Department of Energy. 2012.
[4]. Cheng, T.-C., Cheng, C.-H. & Huang, Z.-Z. 2011. Development of an energy-saving module via combination of solar cells and thermoelectric coolers for green building applications. Energy 36 (1): 133–140.
[5]. Choi, H.-S., Yun, S. & Whang, K-il. 2007. Development of a temperature-controlled car- seat system utilizing thermoelectric device. Appl. Therm. Eng. 27: 2841-2849.
[6]. Ge, T.S., Li, Y., Wang, R.Z. & Dai, Y.J. 2009. Experimental study on a two-stage rotary desiccant cooling system. International Journal of Refrigeration. 32: 498–508.
[7]. Gillott, M., Jiang, L. &Riffat, S. 2010. An investigation of thermoelectric cooling devices for small-scale space conditioning applications in buildings. Int. J. Energy Res. 34: 776-786.
[8]. Kodama, A., Hirayama, T., Goto, M., Hirose, T. &Critoph, R.E. 2001. The use of psychometric charts for the optimisation of a thermal swing desiccant wheel. Appl. Therm. Eng. 21: 1657–1674.
[9]. Lee, Y., Park, S. and Kang, S., 2021. Performance analysis of a solid desiccant cooling system for a residential air conditioning system. Applied Thermal Engineering. 182: 116091.
[10]. Li, H., Dai, Y.J., Köhler, M. & Wang R.Z. 2013. Simulation and parameter analysis of a two-stage desiccant cooing/heating system driven by solar air collectors. Energy Convers. Manage. 67: 309–317.
[11]. Luo, D., Wang, R., Yu, W., Sun, Z, & Meng, X. 2019. Modelling and simulation study of a converging thermoelectric generator for engine waste heat recovery. Appl. Therm. Eng. 153: 837-847.
[12]. Luo, Y., Zhang, L., Bozlar, M., Liu, Z., Guo, H. & Meggers, F. 2019. Active building envelope systems toward renewable and sustainable energy. Renewable and Sustainable Energy Reviews 104: 470-91.
[13]. Naphon, P., &Wiriyasart, S. 2009. Liquid cooling in the mini-rectangular fin heat sink with and without thermoelectric for CPU. Int. Commun. Heat Mass Tran. 36: 166-171.
[14]. Shahzad, M. K., Chaudhary, G. Q., Ali M., Nadeem, Ahmed S., Khalil M.S. &Tanzeel U. R. 2018. Experimental evaluation of a solid desiccant system integrated with cross flow maisotsenko cycle evaporative cooler. Appl. Therm. Eng. 128: 1476–1487.
[15]. Steven Brown, j. &Domanski, P.A. 2014. Review of alternative cooling technologies. Appl. Therm. Eng. 64: (2014) 252–262.
[16]. Sofrata, H., 1984. Solar Thermoelectric Cooling System. In: S.W. James, B.H. Khoshaim, R. Mallory and A. Meiners, Editors: Solar Buildings. Missouri: Midwest Research Institute 59-76.
[17]. Wang, R.Z. & Dai, Y.J. 2001. Solar thermoelectric refrigerator. Patent No. 01239142, 2001;5, China.
[18]. Xi, H., Luo, L. &Fraisse, G. 2007. Development and applications of solar-based thermoelectric technologies 11(5): 923–936.
[19]. Yadav et al., 2022. Design, Fabrication and PerformanceEvaluation of Power Operated

GroundnutDecorticator, International Journal of Engineering Research & Technology, 11(03) 2278-0181.

[20]. Yadav et al., 2022.Design, Development and PerformanceEvaluation of Paddy Thresher, International Journal of Engineering Research & Technology, 11(03) 2278-0181.

[21]. Ying, S., Zhang, Y. & Ge, Z. 2015. Simulation and energy saving analysis of high temperature heat pump coupling to desiccant wheel air conditioning system. Energy 83: 583–596.

[22]. Zhong, B. L., Ling, Z., Guang, C. G., Yong, Q. L. & Fang, F. M. 2015. Experimental study and performance analysis of a solar thermoelectric air conditioner with hot water supply, Energy and Buildings 86: 619–625.

[23]. Zuazua-Ros, A., Martín-Gómez, C., Ibañez-Puy, E., Vidaurre-Arbizu, M. &Gelbstein, Y. 2019. Investigation of the thermoelectric potential for heating, cooling and ventilation in buildings: Characterization options and applications. Renewable Energy 131: 229-239.