

# Review on Solar Air Conditioning with Desiccant Wheel

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**Abstract**— Making progress toward eco-friendly and checking anyway much essentialness as could sensibly be normal has transformed into the purpose of assembly as per the world. In this paper we give evaluate working and principals of sun controlled cooling. There are various source of essentially available to us that will direct our regular resources and cut down on risky transmissions that are eliminate climate condition. Various moving powers and by open to individuals and organizations who execute the usage of these earth very much arranged source of essentials. Our arrangement and improvement of a sun situated desiccant atmosphere control framework is another decision to cooling that uses far less power and moreover uses imperatives from the sun to run the system. We set out to make an atmosphere control framework that does not make any dangerous outpourings and wipes out the power cost to a home loan holder. The solar desiccant constrained air framework uses sun-based power as the essential imperatives source to help in the thermodynamic warmth trade process similarly as warmth trade models to change over including air into cool air. With our created structure we have seen temperature similarly as moisture level drops all through the desiccant cooling system.

**Index Terms**— Air-conditioner, solid desiccant wheel, desiccant cooling system, Absorption and regeneration.

## I. INTRODUCTION

Highlight The interest for cooling is expanding because of the impact of environmental change and a worldwide temperature alteration. On the off chance that despite everything we depend on the traditional electric cooling however power is produced from non-renewable energy sources, the ozone depleting substance outflow would ceaselessly decline a worldwide temperature alteration,

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thusly, the interest of cooling would be additionally expanded. In subtropical urban communities, cooling is a standard arrangement for structures. Nonetheless, cooling would generally take up half of structure power utilization.

## II. LITERATURE REVIEW

Factor H M (1977)<sup>[1]</sup> this paper describes the design of a liquid desiccant air conditioning system using low grade heat resource which employs environmental friendly, ozone safe working substance. The main advantage of this air conditioning is that it can driven by low grade heat sources such as solar energy this research shows that a growing number of air conditioning , particularly in hot and humid climates such as south china, requires large amount of electric energy. The energy system encounters peak loads in hot summer days and often faces with brown out situations, which indicates it is barely capable of meeting the demand. At last it concludes that the system can handle both latent and sensible heat load for a room without any other refrigeration method. It is practically favorable for efficient utilization of heat source with varying temperature such as solar energy.

YellottJL(1984)<sup>[2]</sup> this has been conducted into the application of indirect evaporative cooling in fulfillment of variable cooling load of typical Iraqi dwelling. Indirect evaporative cooling is good suited for dry temperate climates. In this filed Australians have been the most innovative designer of successful indirect evaporative air force. This review paper shoes that in order to meeting the cooling load by ventilation only outdoor air temperature must be lower than the design indoor temperature of 25.5C. this review paper conclude that the peak load and daily total load of house were least when the long side of the building were facing north and south, with pick load occurring in the late afternoon regardless of the house orientation . system operation which provide a lower variation in the supply of air temperature result in a lower variation in the supply of air demand over the day .

Khalid A.(2000)<sup>[3]</sup> the present study has been conducted into the application of the indirect evaporative cooling in filled of the variable cooling load of a typical Iraqi dwelling. The results showed that indirect evaporative cooling would result in a comfortable indoor condition for most periods of system operation. Also, the results have shown that the coincident of performance tends to be very high because the system consumes only fan and water pumping power. This review concludes that the peak load and daily total load of the house were least when the long sides of the building were facing

north and south, with the peak load occurring in the late afternoon regardless of the house orientation. The profile of the supply air demand follows the same trend as the cooling load profile. The corresponding times of the minimum and maximum points in the two profile are coincident with each other.

S.P. Halliday(2002)<sup>[4]</sup> they developed the first desiccant cooling cycle in Sweden. In that the mostly pointed the feasibility of using the solar study to desiccant cooling cycle. The desiccant wheel can be utilized both to cool and dehumidify the air. In that setup solar collector arranged for regenerative coil. Suppose in system air are supply through the wheel like 23 C and its gives cooled output supply are reducing i.e. 17 C. It reduce framework working expenses roughly 20% of the arrival air flow by-passes the recovering loop and the desiccant wheel. The result shown that by experimentally, in summer time 23 C temperature is achieved by using minimum external cooling coil and heat energy. And mainly 23% gas energy resources are saving. After that same experimental result are taken by 12 months, in that maximum 70% are reeducation gas utilized by solar energy sources. So that solar energy is mostly capable for both climates, mostly the heat is required for winter season and more capable this energy in summer times.

J.R. Camargo, (2005)<sup>[5]</sup>In this review paper evaporative cooling operates using water and air working fluid. This paper aims to analyze the influence of some operation parameters, such as the reactivation temperature of the absorbent, and relationship between reactivation air flow and the process air flow (R/P) on the performance of the system. New technology using desiccant dehumidification applied to evaporative cooling system for human thermal comfort have been developed .A typical configuration uses a rotary desiccant wheel that moves slowly and continuously between two crosswise air fluxes. This paper presents an air conditioning system that couples a desiccant dehumidification equipment to indirect and direct evaporative coolers. In this system occurs a dehumidification by adsorption in a counter flow rotary heat exchanger following the evaporate cooling of the air using direct and indirect evaporative coolers.

A.E. Kabeel (2007)<sup>[6]</sup> studied the honeycomb desiccant turning wheel is developed and is used for the recovery and ingestion forms. And air flow and solar radiation effect on the system of absorption process. By using the empirical equation determined by wheel effectiveness for regeneration and absorption process. In that supplement for desiccant is conventional vapor compression system are used. In that through latent heat removed and for high loading of latent heat control humidify in better as compare to vapor compression system. In that performance of the regenerator expanded as the airflow rate also increments. The result shown that, the humidity difference is higher in regeneration process compared with the absorption process its value approximately equals twice the original value. The wheel effectiveness is higher for absorption process compared with regeneration process. They concluded that the system is highly effective in the regeneration process for all flow rates compared with the absorption process. And the cooling

impact approach esteems were gotten at various air flow rate and solar based radiation power.

Cun\_Nan Li,(2007)<sup>[7]</sup>This paper describe Design of Liquid Desiccant Wheel has following Advantages, One of the main advantages is that it can be driven by low grade heat sources, such as waste heat, solar energy, etc. Another advantage lies in the fact that the liquid desiccant system is able to capture and remove airborne microorganisms, so it can improve the indoor air quality. The liquid desiccant air conditioning system described in this paper can handle both latent and sensible heat load of the conditioned space without any other auxiliary refrigeration methods. This result in the system can handle both latent and sensible heat load for the room without any other refrigeration method. The Coefficient of the Performance (COP) of the device can be up to 0.8 when the heat source temperature reaches 70°C.

A. Khalid, M. Mahmood(2009)<sup>[8]</sup> they conducted the experiment in TRNSYS for Pre-cooled hybrid desiccant cooling system in Pakistan. In that hybrid desiccant wheel for heat and working for the performance of cycle. In that experimental setup two ducts connecting for ventilation and fans are used for regeneration airstream pass. The following mistake in the determined coefficient of execution dependent on essential vitality utilization, COP relied upon the blunder or vulnerability in the individual essential estimated amounts. The result shown that, indirect regenerative cooler temperature dropped by 15% in regenerative temperature. It concludes that direct evaporative are replaced by indirect evaporative it found that 15% dropped by regenerative temperature and while the decrease in dehumidification was only 6%.

H. Parmar (2012)<sup>[9]</sup> proposed that desiccant wheel is the best option for the alternative cooling system and for that DCS using 80% effective of ECW in a warm and humid climate. In that DCS inner surface are honeycomb structure and its temperature range of 80 C to 90 C. The ratio of the regeneration air flow to process air flow increased when the regeneration power also increased. In that DCS silica gel material are used for the best cooling parameter. The specific humidity increases when the regeneration of desiccant wheel power decreases. In that condition, the 21.39% of specific humidity decreases in Mumbai and it was observed that best climate condition for India. In that conclude that the R/P ratio are optimum for better performance for DCS and due to that regenerative of heat also increases.

Mario El Hourani,(2014)<sup>[10]</sup> This study examines the design and operation of air conditioning system that uses 100% fresh air and integrates solid desiccants dehumidification system with two stage System. in this system small amount of power required for to operate fan. it uses desiccant wheel for outdoor air dehumidification. in building sector major contributor to energy consumption worldwide.it uses 41.1% of total energy consumption originate from two main sources,the supply and exhaust variable speed fans that require electrical energy to operate.Auxiliary heater that require gas thermal energy to heat the water flowing from the storage tank in case

of solar energy deficiency. From this review we conclude that the two-stage evaporative cooling system is feasible for Lebanese office. Also, it requires lower running cost.

Ravi Gugulothu (2015)<sup>[11]</sup> In this paper it is said that solar energy is more and more attention in the world. It is observed that the energy and water are basic need for all of us to lead normal life on this earth. Solar energy technology and its uses are very important and useful for the developing and under developing country to sustain their energy lead the main motivation for solar cooling system by renewable heat sources that is low grade heat from solar collectors. Solar cooling is good example of addressing climate change.

Zouaoui Ahlem, (2015)<sup>[12]</sup> Camargo studied a typical configuration of a desiccant evaporative cooling system using a rotating desiccant wheel where the process air is dehumidified then it is cooled in an indirect evaporative cooling and in a direct evaporative cooling to be introduced to the conditioned room in thermal conditions for human thermal comfort. The adsorbent utilized is silica gel with a low regeneration temperature (varying from 70 to 150°C). In this study, an exergetics manufacturing cost method (EMC) is used. Hybrid air conditioning system using 100% fresh air and integrating a silica gel solid desiccant dehumidification system with a two-stage evaporative cooling system was examined recently. The system was installed in an office space in Beirut. The two-stage system realized a 16.15% reduction in energy consumption and a 26.93% reduction in water consumption in comparison with a single-stage evaporative cooling system at the same condition of thermal comfort.

Yi Chen, Weichen (2017)<sup>[13]</sup> in subtropical areas, such as Hong Kong, the cooling season is long. Energy consumption of the air conditioning system accounted for about 54% and 23% of total building energy consumption in Hong-Kong in office and building. The desiccant enhanced evaporative cooling system is proposed. As promising energy saving air conditioning as well as environmentally friendly from this review it is seen that moisture removal rate of fresh air increase from 0 to 12 gm/kg with solar collector area increase from 0 to 50 m<sup>2</sup>.

Yasser Abbassi, (2017)<sup>[14]</sup> In this review paper the COP of single stage system is higher than double stage solar assisted cooling system is an attractive and cost-effective process. As well as environmentally friendly. Desiccant wheel has attracted more attention because of it required less space from these review paper we conclude that by increasing regenerative temp and inlet flow rate if the desiccant material absorb ambient moisture sufficient it would be more beneficial to utilize single stage configuration double stage required more energy. In most cases constant cooling load COP of the system decreases when both ambient temp and humidity ratio increases.

Ali Alahmer (2019)<sup>[15]</sup> In these the result shows that the emission of CO<sub>2</sub> saved 44% of the primary energy consumption in typical office in Hong Kong. It was found that among the various desiccant material silica gel 3A and silica gel RD perform better than other material. Silica gel

desiccant is preferred when greater moisture removal is required at low inlet humidity higher regenerative air temp leads to an improvement of a dehumidification and reduction of thermal COP desiccant wheel has better moisture removal with low process volume flow rate with the wheel rotation the moisture removal increases up to the maximum value at rotation speed 14 rpm and then it decreases.

### III. CONCLUSION

From the literature review, we can observe that the main source of energy is solar energy and its mostly usage & developing for new technologies. Solar energy is observed that renewable source energy. Solar energy is an incentive for the solar cooling system is the replacement of electricity.

This paper analyzes mainly the desiccant wheel and its thermodynamics conditions. Such way that other parameter also observed like R/P ration relationship, evaporative cooler temperature, a process of air flows, a coefficient of performance (COP), a different temperature at various climate condition such as DBT, WBT, relative humidity, air velocity, humidification & dehumidification.

An analyze result and discussion shows that solar cooling is the best example for any climate conditions and take care of environmental conditions. The system is supplied for best human thermal comfort for both climates such as summer time and winter. It is observed that used for long term practice and alternative for the conventional solar cooling system. So solar energy is cost-effective, best renewable and eco-friendly.

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