REVIEW AND DESIGN OF DIFFERENT SOLID DESICCANT DEHUMIDIFIER

Patel D.Hemil[1], Patel R.Dhananjay[2], Pola K. Parth[3], Bhavin K. Shah[4]

[1] *Student, Mechanical, Vadodara institute of engineering, Gujarat, India*
[2] *Student, Mechanical, Vadodara institute of engineering, Gujarat, India*
[3] *Student, Mechanical, Vadodara institute of engineering, Gujarat, India*
[4] *Assistant Professor, Vadodara institute of engineering, Gujarat, India*

ABSTRACT

The Desiccant dehumidifiers are used for dehumidification at very low cost. As Conventional dehumidifier uses very low condensing temperature so it is requires overcooling which is eliminated by desiccant dehumidifier. Desiccant dehumidifier uses desiccant materials either in solid form of liquid form. Air passes over the desiccant material, and moisture absorb by the desiccant and air is dehumidify. If cooling is required than evaporator or any cooling element can also be attached with dehumidifier.

Keyword: - *Desiccant dehumidifier, desiccant material.*

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1. INTRODUCTION

The Heating, Ventilation, and Air Conditioning (HVAC) industry is facing many challenges in the 1990s, including a decrease of energy resources, an increase in energy demand due to overpopulation, and new regulatory policies of government. To respond to these challenges, more energy-efficient heating, cooling, ventilation, and dehumidification technologies are needed.

There are a number of methods for formation of energy-efficient HVAC technologies; among them there are two ways chlorofluorocarbons (CFCs) and hydrochloro-fluorocarbons (HCFCs) technology. These technologies uses chemical which increases in ventilation rates for buildings because of concerns regarding indoor air quality and occupant health. The higher ventilation rates converts into greater cooling loads in particular seasons. Greater latent loads require during cooling seasons like summer when the relative humidity within a building must be kept sufficiently low to reduce the growth of micro-organisms that cause health problems and also may damage building materials.

Therefore Dehumidification has become a very important part of the HVAC function. Apart from above two technology Desiccant dehumidification and cooling technology can provide energy-efficient solutions for the industry.

Now take some examples of Industrial/ Manufacturing units along with their effects of humidity control as explain by industry are:

1) To prevent corrosion and improve production of lithium batteries.
2) To prevent condensation and corrosion on metal surface of electrical equipments.
3) To prevent deterioration of products in pharmaceutical packing.
4) To optimize seed moisture level and minimize microbiological growth in grain storage houses.
5) To improve the product by preventing condensation on the mould surfaces.

Desiccant dehumidification technology has a successfully work over more than 60 years for industrial applications such as product drying and neglect corrosion. It has also been used for several years in clean rooms, hospitals, museums, and other special places requiring highly controlled humidity levels.

Now days the use of desiccants for dehumidification in air-conditioning applications has been on the rise and their capital cost has been on the decline. The supermarket industry was the first to realize the capacity of desiccant dehumidification, and there are currently more than 500supermarkets that use desiccant dehumidification system integrated with electric-driven refrigeration systems.

In these integrated designs, the desiccant system works as a pre-conditioner for outside (ventilation) air to remove the latent load. Other applications of desiccant dehumidification are in hotels and motels, office buildings, full-service and fast food restaurants, laboratories, and retirement homes. The advantage of desiccant dehumidification is better humidity control, more efficient latent load removal, and reduction in electric demands. In regions of the country where the electric utilities are having problem servicing their peak air-conditioning loads, this energy-efficient technology can assist in meeting that demand.
For the last few years cooling based dehumidification and compression based dehumidification have been used. In the cooling based dehumidification method- vapor compression refrigeration system, the dry air is produced by cooling the atmospheric air below the dew point temperature. In other words below the dew point temperature, water vapor gets condensed and separated from the air.
This method has various advantages which are as follows:

1) Light weight and Compact size.
2) Independent of whether condition.
3) Suitable for low quantity dry air.
4) Easy handling of operation and installation.

Though this system has many advantages, it has drawbacks also like it cools below due point temperature so it consumes more electricity. This system uses HFC and HCFCs material which harmful to environment. This system requires compressor and other mechanical elements so it would increase the cost of entire system.

2. LITERATURE REVIEW

There are hot and humid environment present in many parts of India. It is necessary to produce the dry air for such environment. Beside refrigeration, vapor compression system is also used to produce dry air but it leads to the environmental issues. For many domestic and industrial purposes, dry air is produced by using solid desiccants like silica gel, activated alumina and activated charcoal. These methods have low operating and maintenance cost and also these methods are environment friendly. For using these desiccants again, we have to regenerate them. In this review paper the methods have been studied to regenerate the desiccants for further use.

Recent years we have seen public interest in issue related to energy saving and concern for the environment. Due to the problem associated with the use of fossil fuel, alternative source of energy have became important and relevant in this cut throat competition. These sources, such as the sun, wind, ocean wave can never be exhausted and are so called them renewable energy source. They also have known as non convectional sources of energy because it cause very less emission and are available locally. They are viable sources of clean and limitless energy. The approach was to consider various aspects ranging from the analysis of the current energy consumption and the state of possible installation of a solar parabolic dish collector and their different uses. Also purely reduction in energy consumption and the optimization of current energy consuming equipment. It is commonly assumed that dish type solar pressure cooker save energy and make a nutrient rich food. The energy concentration of dish solar collector has rarely been analyzed including their embodied energy. The energy provided by the dish collector has never integrated with regeneration of desiccant. The approach has been used to develop a parabolic dish collector integrated with the regeneration of desiccant material.

The principles underlying the operation of desiccant cooling systems are recalled and their actual technological applications are discussed. Through a literature review, the feasibility of the desiccant cooling in different climates is proven and the advantages it can offer in terms energy and cost savings are underscored. Some commented examples are presented to illustrate how the desiccant cooling can be a perfective supplement to other cooling systems such as traditional vapour compression air conditioning system, the evaporative cooling, and the chilled-ceiling radiant cooling. It is notably shown that the desiccant materials, when associated with evaporative cooling or chilled-ceiling radiant cooling, can render them applicable under a diversity of climatic conditions.

The study investigated the solid desiccant cooling systems. The system is regenerated by solar energy and electricity heater. This work assesses the energy saving possible from developing solar assisted desiccant air conditioning system and makes recommendations for further research on the concept. This system is designed to satisfy space cooling demand. In this paper simulation/ theoretical analysis and experimental analysis of this component is presented, with particular attention to the variation of the performance as a function of the process and regeneration air flow rates. The experimental results were comparable with the results obtained from the theoretical. The experimental results obtained by the authors and data provided by the simulation have been used to calculate some performance parameter, and a satisfactory agreement has been obtained. The experimental results indicated that the average thermal COP cycle is 0.6 and the cooling capacity in the range of 5.6 kW under hot and humid ambient conditions. The results show that higher influence on the dehumidification process is due to the regeneration of temperature rather than to the regeneration of air flow rate.

The objective of this study is to investigate the feasibility of using desiccant cooling system as an alternative HVAC solution in buildings to achieve thermal comfort. This solution is more attractive when the solar energy is used to regenerate the desiccant wheel. An extensive experimental study has been performed in Tohoku University in Japan. A TRNSYS model of the desiccant cooling system combined with the heat wheel and heat source has been simulated and compared with the experimental data. The results of the simulation show that such system is feasible for cooling building in hot-humid climates.

Experimental investigations on several commercially available and newly fabricated rotors are conducted in two different laboratories to evaluate performance trends. Experimental uncertainties are analyzed and the parameters determining the rotor performance are investigated. It is found that the optimal rotation speed is lower for lithium chloride or compound rotors than for silica gel rotors. Higher regeneration air temperatures lead to higher dehumidification potentials at almost equal dehumidification efficiencies, but with increasing regeneration specific heat input and enthalpy changes of the process air. The influence of the regeneration air humidity was also notable and low relative humidity increase the dehumidification potential. Finally, the measurements show that rising water content in the ambient air causes the dehumidification capacity to rise, while the dehumidification efficiency is not much affected and both specific regeneration heat input and latent heat change of the process air decrease. For desiccant cooling applications in humid climates this is a positive trend.

3. DESIGN MODEL OF PROTOTYPE.

Design of various components of desiccant dehumidifier carried out on the bases of data available from the review paper for optimum analysis of performance parameters. Here geometry of model given for the reference purpose.

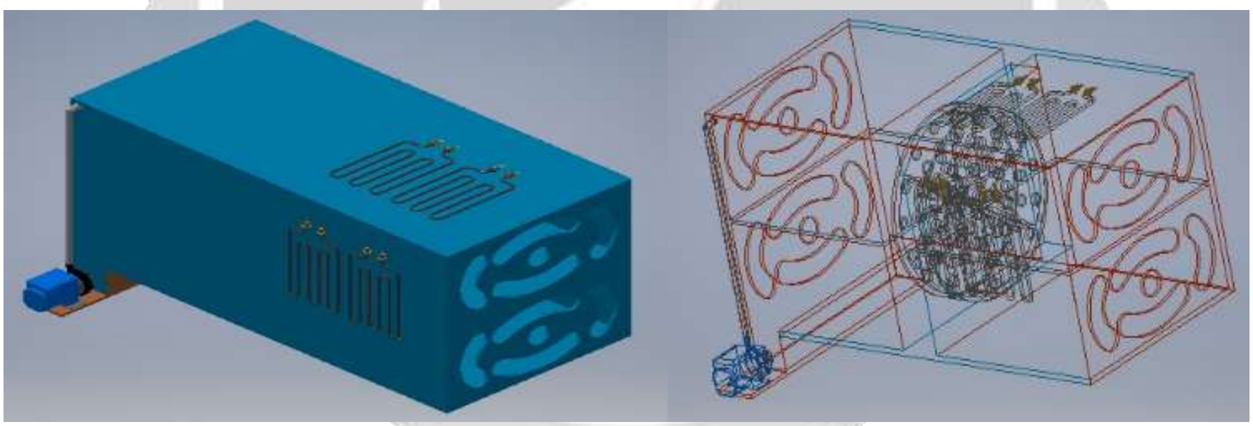

Fig. 1 Design model of prototype.

4. CONCLUSIONS

The performance characteristics and comparison of different parameters can be conducted by using diverse desiccant materials in dehumidifier. By performing the experiment analysis decision can be predicted for the efficiency of the desiccant material for the better dehumidification.

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