International Journal of Engineering Research ISSN:2319-6890)(online),2347-5013(print)
Volume No.3, Issue No.4, pp : 265-266 01 April 2014

A Review of Solar Desiccant Air Conditioner

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Abstract— ***This paper represents a detailed study and description of a new solar-based air-conditioning technique. It uses solar energy to produce cold or hot air. This technology can be used to reduce the energy consumption and environmental impact of mechanical cooling system. The use of Desiccant cooling is used to perform air dehumidification operation by utilizing low grade heat source. The solar desiccant air conditioner uses solar power as the main energy source to help in the thermodynamic heat transfer process as well as heat transfer principles to convert ambient air into cooling air. With our constructed design we have seen temperature as well as humidity level drops throughout the desiccant cooling system. A significant advantage of this system is, it have no moving parts consequently they are noiseless, non-corrosive, cheap to maintain, long lasting in addition to being environmentally friendly with zero ozone depletion as well as zero global warming potentials.***

Keywords— **Desiccant Cooling; Desiccant Wheel; Heat exchanger; Relative Humidity; Evaporative Cooler**

I. Introduction

In current years, the increased usage of air conditioning systems in hot/humid climates has resulted in a significant increase in demand during summer months. There is a tremendous pressure on the air conditioning industries of following the norms and conditions of economics and environment. Solar air conditioner is one which use solar energy to produce cold or hot air and do not pollute the environment. A solar cooling installation consists of a typical solar thermal system that has solar collectors, storage tank, control unit, pipes and pumps with a thermally driven cooling machine. In solar cooling systems, solar heat is used to drive the thermally driven cooling machines, such as absorption, adsorption chiller and desiccant cooling systems. In solar desiccant cooling cycle, solar energy is used to regenerate a desiccant that dehumidifies moist air, the resulting dry air is cooled in heat recovery wheel and then in an evaporative cooler. The technique uses water as refrigerant and solar energy; electricity is only used in the auxiliaries, so the technique is environmentally friendly. The desiccant air conditioning system utilizes the capability of desiccant materials in removing the air moisture content by adsorption process. All materials that attract moisture at different capacities are called desiccant. The removal of the moisture from the desiccant wheel can be done by heating. The solid-based system uses solid desiccant materials in the removal of air moisture content. There are several kinds of solid desiccant materials: silica-gel, titanium silicates, calcium chloride, activated alumina, zeolite (natural and synthetic), lithium chloride, organic-based desiccant. The sorption process in the solid material is done by absorption or adsorption. The desiccant wheel is regenerated by heat. The air after passing the desiccant wheel is dry and hot due to the conversion of air latent energy to sensible energy. To reduce the air temperature a evaporative cooler is used. Recently several researchers have used solar energy to regenerate the desiccant wheel. Over a number of years several authors have investigated the design and operation of such systems. The result shows that the system is efficient compared to the conventional system.

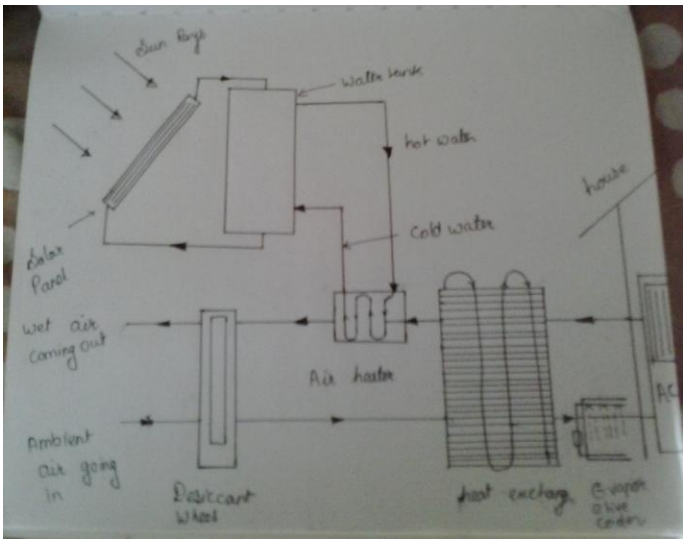

Fig.1 Schematic diagram of basic desiccant cooling system

II. Methodology

The project begins by researching different ways to create an air conditioner that would mainly use the sun as an energy source. We designed a solar adsorption cooling system that extracts the heat from the air by means of dehumidification and heat exchange. The output of cold air is to serve a conditioned room. The cooling system design is made up of a desiccant wheel, a regeneration wheel, two fans, evaporative cooler, and a heat exchanger. There are two separate air heat transfer processes that take place in the system. One air process heats the air and the other cools the air. In the hot air process, the heat exchanger takes hot water that was heated from our evacuated tube solar collector and transfers the heat to air passing through the system. That hot air is then used to add moisture to the desiccant wheel in order to return it to its normal state. The desiccant wheel is made of mixture of wood wool and fevicol desiccant material which is enclosed in a wheel made of aluminium and is held in by a netting material. When ambient air is passed through the desiccant wheel, the humidity level decreases and the temperature increases slightly. In the cool air process, ambient air is first sent through the desiccant wheel where the humidity decreases then it is sent to air heater where the total moisture is absorbed. After that air is sent through the heat exchanger where

heat transfer takes place and turns the air into cooler air. The air is again sent to the evaporative cooler where the air gets cooler. This cooled air is then passed throughout in the house. The warm air in surrounding of the room is sent out through the exhaust fan to the heat exchanger, which decreases the moisture content of the air making it completely dry. This dry air is passed through the air heater where the temperature of the air increases. This hot air when passes through the desiccant wheel, leaves the wheel completely dry. We tested our system to verify our theory that the temperature would decrease after the desiccant cooling process took place. We believe that with further testing on a warmer day the temperature change would be greater .

III. Conclusion

Most of the air conditioning systems are electrically driven. The human comfort relies heavily on the air conditioning. But time has come to look for an alternative solution for electric power and solar energy is the best one. Solar desiccant air conditioner from the review study is a simple technology which can be joined to other technologies to improve the efficiency. Lowering the cost of desiccant dehumidification systems and improving their performance will clearly provide more opportunities for desiccant dehumidification technology. The desiccant cooling system presented in this paper can be a suitable solution for hot-humid climate .The effect of different operating parameters on the performance of desiccant cooling system analyzed and presented minimum running cost. The desiccant wheel based evaporative cooling system offers a promising alternative to conventional air-conditioning systems using vapour compression refrigeration especially under conditions involving high latent load .So, the review is made for the recent trends and technologies in the solar air conditioning for the further work in this field.

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