Solar Cooler with Summer and Winter Application

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Abstract— Energy - demand is one the major need for our country. Finding solutions, to meet the "Energy - demand" is the great challenge for Social Scientist, Engineers, Entrepreneurs and Industrialist of our Country. Applications of Nonconventional energy are the only alternate solution for conventional energy demand. Our basic motive is to regulate the operating power in solar cooler. This project presents the results of an experimental investigation carried out to minimize the power consumption of a solar cooler running at various speeds. The experiments have been carried out for a total of three speeds that is low, medium and high. We carried out speed control by minimizing the input current at multiple speeds with the help of resistors. For high speed, we have connected a couple of resistors in series whereas for medium speed a couple of resistors were connected in parallel and for low speed a single resistor was used. We have replaced DC motor which is traditional coolers with Permanent Magnet DC motor. PM DC motor is highly efficient since no electrical energy is used or losses incurred for developing or maintaining motor's magnetic field. Its size is more compact and a better dynamic performance can be expected due to higher magnetic flux density in air gap.PM DC motor has an essentially simplified construction and it is maintenance free. We even tried to replace the concept of pump by including cotton to the cooler setup. Water is made to flow from a higher potential to lower potential making the grass and cotton wet. Even if the potential of water becomes lower, it does not create any hindrance to the function of cooler. Elimination of pump reduces the expenses in addition to lowering the overheads caused while lifting the water.

Key words: Solar Cooler, PM DC Motor

I. INTRODUCTION

Our project "Solar Cooler" is based on the concept of harvesting solar energy.

It is easily interpretable from the name of the project that it is based on the solar energy for satisfying its need of power source. The functionality of Solar Cooler is dissimilar as that of the traditional coolers. The solar energy is harvested and stored in a battery. This battery is in turn connected to the solar cooler for the power source.

The concept of solar cooler sounds good and economical hence almost every class of our society can bear its expenses. The best part is that, it can be used even in rural areas where there will be no supply of electricity. In the last two decades, the demand for residential cooling has skyrocketed, creating an increasingly large demand on the electricity grid during the summer months. Between 1990 and 2008, the total cooled residential floor space in Canada has almost tripled from 267 million square meters to 749 million square meters, while the total energy consumed for space cooling has more than doubled in the same time period. This has subsequently caused the amount of greenhouse gases released, as a result of the production of the required energy to meet the residential cooling demand, to double.

II. CURRENT RESEARCH

A study conducted by Florides et al. looked at the performance of a domestic absorption chiller installed in Cyprus that consisted of a solar collector, a storage tank, a back-up boiler and a lithium bromide-water absorption chiller [28]. The heat transfer coefficients of the absorption chiller were obtained experimentally, and the entire system was modelled using the TRNSYS simulation program varying the collector array size, orientation and type, as well as the thermal storage capacity of the system. The optimal system configuration for the 11 kW absorption chiller was found to have a 15 m2 compound parabolic trough collector and a 600 L hot water storage tank. A paper produced by Wang et al. looked at the various methods for solar cooling including absorption, adsorption and desiccant cooling and their applicability to small scale residential applications [29]. This paper outlines the advantages and disadvantages of each of the different systems as they could be applied on a residential scale. The main challenges inhibiting the wide spread implementation of these systems are the initial cost of the system and the required on-going maintenance required. Finally, the authors list five recommended system configurations that they believe have the most potential for integration into a residential dwelling. The authors also conclude that for optimal cooling performance, it is important to incorporate thermal storage system to allow for continuous (around the clock) cooling. Mateus and Oliveira conducted a study to evaluate the performance of a solar absorption cooler for use in different building types and climatic locations in Europe. Through the use of TRNSYS simulation software, the performance of an absorption heating and cooling system was evaluated for three building types: a residential building, an office building, and a hotel. In addition, each of these simulations were 502 Christopher Baldwin and Cynthia A. Cruickshank / Energy Procedia 30 (2012) 495 – 504 conducted for Berlin, Lisbon and Rome climate regions. It was found that for all three locations, the annual costs were lower when compared to standard cooling system, but a 60% solar fraction only accounted for an annual saving of 35%-45% due to the increase in maintenance costs and an increase in water consumption. It was also found that at the current cost of energy and the current start-up costs of a solar cooling system, the lifetime cost of the system (including capital investment, annual costs and maintenance) would be higher compared to conventional cooling system even when used over many years and for prolonged periods of time. To date, most research conducted in the area of small scale solar assisted cooling has been in Europe. Limited work has been conducted in this area in North America. A recent Canadian study conducted by Edwards looked at the performance of an absorption chiller in Ontario, Canada [31]. The study used an ESP-r model to determine the optimal system

configuration comprised of solar collectors, a cooling tower, hot and cold thermal storages and a 35 kW absorption chiller. Experimental data was used to first create a custom component in TRNSYS to perform preliminary system sizing, and then the data was subsequently used to create a custom plant network in ESP-r to model the absorption chiller as part of a house [32]. From this study, it was determined that a collector array of 50 m2 , a hot storage tank of 0.5 m3 and a cold storage tank of 1.5 m3 would be required to meet the cooling loads of a typical residential home in an Ontario climate. Although both of these storage volumes are quite large, they can be accommodated by larger houses in Canada. It was also determined within this study that the implementation of a solar cooling system in a house in Ontario would reduce the amount of greenhouse gases released in the generation of the electricity consumed by the house by approximately 12% and would reduce the amount of peak loading on the electricity grid during the summer months

III. CONSTRUCTION DETAILS & SPECIFICATIONS

Components of solar cooler equipment

- Solar panel
- Centrifugal pump
- Batteries
- PMDC MOTOR
- Wiring
- Cooler Body
- Humidifer
- Switch & Toggle
- Charging circuit

- Cooler body is made up of iron.
- Cooler body includes fan, water storage tank and aspen pads
- Aspen pads are soaked in the water making the air cooler

Fig. : Solar cooler with summer and winter application

IV. ADVANTAGES

- Low cost
- High reliable
- Low maintenance
- Higher torque and power density.
- That are more predictable.
- Linear torque speed charcteristics.
- More compact size.

V. LIMITATIONS

- The main limitation is that the intensity of solar radiation is weather dependent. On cloudy day, the intensity of radiation is very low which is further affected by the dust, fog and smoke. There for it cannot work properly in cloudy days.
- It covers only small area.
- The initial cost of the system is quite high.

VI. CONCLUSIONS AND FUTURE SCOPE

- In traditional coolers a chopper is used for reduction of speed whereas in our cooler we have used resistors which reduce the power consumed along with the variation in speed
- The DC motor has been replaced with the highly efficient PMDC motor, which is maintenance free and simplified in construction.
- Though our intent to replace the concept of pump was unsuccessful, it leaves a lot of scope for future batches to find out a way for eliminating the defects of pump's usage by using an alternative that works in a better way than the cotton.

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