DESIGN AND FABRICATION OF PHOTO VOLTAIC REFRIGERATION SYSTEM FOR MUSHROOM CULTIVATION

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ABSTRACT

In this paper the thermal comfort condition for mushroom cultivation was studied. In addition to this the design and fabrication of photo voltaic refrigeration system for mushroom cultivation was determined. Mushroom cultivation was done by so many peoples in the hot and dry climatic places. In the cold places the yield of mushroom was more compared with the cold climatic places this is due to thermal comfort condition needed for mushroom cultivation. There aremany difficulties faced by the peoples. It does not cultivatein the upstairs of houses. The solution for even yield in dry and cold climatic condition is to bring the thermal comfort condition at dry places by means of a refrigeration system. To design a refrigeration system cooling load calculation is necessary that is taken as 0.75 tons of refrigeration from the literature review. In this paper design and fabrication of photo voltaic refrigeration of mushroom cultivation was studied.

Keywords: photo voltaic refrigeration system; cooling load; mushroom cultivation;prototype; Thermal comfort.

INTRODUCTION

During Solar heat conversion, waste heat dissipation is an extremely large factor. To keep away from these problem four pilot installations between 7 kW and 90 kW nominal cooling capacities were equipped with concealed heat storages between 80 kWh and 240 kWh energy content. It results in a seasonal energy efficiency ratio (SEER) for cooling up to 11.4. Furthermore simulation results under different climatic conditions indicate raising efficiency up to 64% compared to a system with solely dry re-cooling.[1] Many influence contributing to a result can affect the operating performances and the design of the indirect air cooling system of power plant. A study has been hold up by developing a physical mathematical model describe the thermo flow characteristics of air cooling tower for indirect air cooling system. C ++ is used to develop a program for the indirect air-cooled tower optimization. By this program better tower structure is attain by effort which is used to conduct thermal analysis of the influences of ambient temperature, wind speed, and saturated exhaust flow rate on back pressure of turbine. [2] Aclosed loop thermal cycle with loop thermal cycle containing cylindrical heat pipes integrated within a roof-mounted circular wind tower is used to achieve internal comfort. By using inlet wind speeds varying from 1 m/s to 5 m/s, the results of the study showed that the proposed cooling system was competent of meeting the regulatory fresh air intake requirements per occupant of 10L/s. Refrigeration is concerned with the absorption of heat from where it is objectionable plus its transfer to and rejection at a place where it is unobjectionable. In addition, the results showed that a passive cooling capacity ranging between 6K and 15K depending on the operating configuration. [3] TPV(Thermal Photo Voltaic) systems are increased by three developments like diffused junction GaSb cell that responds out to 1.8 microns producing over 1 W/cm^2 electric given an IR emitter temperature of 1200 C. High power density along with a simple diffused junction cell makes an array cost of $0.5 per Watt possible. IR emitters and filters that put 75% of the radiant energy in the cell convertible band. Ceramic radiant tube burners that operate at up to 1250 C. Herein, we describe a 1.5 kW TPV generator / furnace incorporating these new characteristics of a thing. This TPV generator / furnace are designed to replace the residential furnace for combined heat and power (CHP) for the home [4].A systematic inquiry is carried out to check the potential of producing liquid spawn of an edible mushroom, Pleurotus pulmonary (grey oyster) by submerged fermentation in a 2-L stirred-tank bioreactor under controlled conditions also to evaluate its ability to colonize rubber wood sawdust substrate for sporophore production. It contains 20 g L−1 of brown sugar, 4 g L−1 of rice bran, 4 g L−1 of malt extract, and 4 g L−1 of yeast extract (BRMY) with initial pH of 5.5 and incubated at 28◦C with agitation speed of 250 rpm and oxygen partial pressure of 30–40%. Maximum P. pulmonary dry biomass production of 11.72 ± 5.26 g L−1 was achieved after 3 days of fermentation. It produces higher yield of sporophores compared to normal used grain spawn. [5] To recycle agro-industrial wastes into food production a new species named genus Gymnopilus is used to find out the optimal condition needed to cultivate G. pompanos, to evaluate its biological efficiency and to determine the biodegradation of substrate. Strain ICFC 748/12 produces the highest biological efficiency on Populus sawdust reaching a mean of 70.67%. G. pompano has a strong capacity to degrade Eucalyptus and Populous. This mushroom has the ability to decompose cellulose and to decay lignin, thus being white rot fungi [6].

CFC-12 is replaced in order to investigate behavior of R134a refrigerant. This includes performance and efficiency variations when it replaces R12 in an existing system as well as changes involved in maintaining the system charged with R134a[7]. AIRCOND a system composed of three sub systems: the heating loop, the ejector cycle and the cold storage-air handling units: heating loop is composed of a solar array of 60 square meters evacuated tube solar collectors; installed at a tilt angle of 45° and facing to south, a 3000 L tank is used as hot water storage in order to cover energy by the ejector cycle. The cold water produced by the ejector cycle then transferred in a 900L cold storage tank filled with 800L micro-encapsulated phase change material (MEPCM) for cold storage designed to meet dynamic cooling load. This study is carried out to achieve air-conditioning in Mediterranean countries. [8]

DETAILS OF DESIGN AND CONSTRUCTION

SELECTION OF COMPRESSOR

Compressor specifications

Motor H.P=1/8 H.P Speed= 640 r.p.m

Cylinder specifications

No of cylinders = 1 Bore, diameter = 63.5mm, Stroke length = 762 mm, Displacement = 4825 cm³

DETAILS OF DESIGN EVAPORATOR

The selected evaporator for the design is natural convection bare tube, Dry Expansion, Shell and tube Evaporators. Heat reaches the Evaporator by all three methods of heat transfer and conduction and radiation.

DESIGN OF EVAPOURATOR

Inlet temperature of the evaporator coil (T_1) = -1.6°C

Outlet temperature of evaporator coil (T_2) = 3.4°C

Temperature difference between inside and outside of the evaporator = (3.4)+(1.6)

= 5

The overall heat transfer, co-efficient "U" factor from data tables for copper = 400kcal/m^2-hr-°C

Load taken by the evaporator = AU ΔTi.e. Refrigerating capacity ` = AU ΔT

Refrigerating capacity = load taken by Evaporator

= 2268 = AU ΔT

A = 2268/ U ΔT = 2268/ (400 x 5)

= 1.4 m^2

Diameter of the coil (D) = 5mm A = πDL

Length of the coil (L) = A/πD = 1.4/(π x 0.005) = 89.2 m^2

Length of coil in one turn = 2(40+20) = 180 cm

Number of turns in the tank = 4950/180 = 27.4 turns, say 28 turns

Provide 10 cm gap between each turn of the coil. The evaporator coil should be arranged the side of the tank that will be easy for periodic cleaning.

SELECTION OF CONDENSER

The condenser load can be calculated by the following equation:

Heat transfer Q = m Cpl (T_3-T_2)

Load on the condenser = m Cpl (T_3-T_4)

Q = heat absorbed in evaporator + heat of compressor.

Heat absorbed in evaporator = 2268 k cal/h

Heat of compressor = v x 1 = 200 x 3 = 640w

= 640 x 0.86 = 550.4 kcal.

Q = 2267 + 550.4 = 2818 k cal

Q = UA ΔT A = 2818/ 400 x 22 = 0.320
Area of the coil = Πdl
Diameter of the coil = 5mm
Length of coil (L) = 0.320 / 0.005×3.14 = 20.38m
Length in one turn = (40 + 40) = 80cm
Number of turns required = 20.38 / 0.80 = 25.5 = 26

PV PANNEL DESIGN:

Step 1: Load estimation and inverter rating and system voltage

Estimate the daily AC load in terms of Watt-h is 800 Wh. Consider the efficiency of charge controller and divide the estimate Watt-h load by efficiency to get the corrected load. The corrected load was 1000 watts here 80% charge controller efficiency. Decide the system voltage- this is a choice that system designer has to make DC systems voltage, usually 12 V to 96 V in steps of 12 Here the system voltage was 24V.Estimate the total daily Amp-h load or Ah load for AC loads; this is obtained by dividing the Wh by system voltage here 33 Amp-h.

Step 2: Sizing of batteries

Total daily Amp-h load per day required to be supplied from solar array (take it from Steps 1). Number of days of autonomy .This is the choice that the designer needs to make based on the reliability requirement of the system. But higher reliability adds to the cost. Put the number in days here one day. Estimate total Amp-h required including autonomy here 67 Amp-h. If daily requirement is X then total Amp-h including n days of autonomy is X+(n×X). The value of n can vary from 0 to 7 days or more.Consider for the useful battery charge capacity as given in terms of depth of discharge (DOD); the DOD can vary from 20% DOD to 80%. It depends on the type of batteries of higher DOD should to used.Effective Amp-h required after considering the DOD here DOD is 0.8. Choose battery capacity. Depending on the size of the load small or big batteries can be chosen. Typical battery capacities are 12 Ah, 50 Ah, 100 Ah, 150 Ah, and 200Ah, 250 Ah etc. Here take the 12 V 8 Ah batteries. For number of batteries required in parallel. Divide the effective Amp-hr.required by the Battery capacity. To get the number of batteries that should be connected in parallel to obtain the desired Amp-h from batteries here 11 batteries needed to be connect with it. Divide system voltage (24V) by battery voltage (12V). This will give the number of batteries need to connect in series in order to obtain the desired system voltage here 22 batteries needed..

Step 3: Sizing of PV module

Normally battery efficiency is in the range of 70% to 90% Losses from PV module due to higher temperature. This loss depends on ambient temperature. It can vary approximately from 0% to 30%.Total losses (battery loss + loss due to temperature + any other losses, e.g., due to dust).From the Calculation the total loss factor as 1.1.

In Tirunelveli region the total sunshine hours per day was 5hr. The PV module selected has The peak power of 75Wp, peak current 5Amp. Peak voltage 15 from the calculations total number of PVPanel required was 4. For more details on PV design refer [9].

FABRICATION

Figure 1 Fabricated model

This system fabricated according to the above designed values. This is shown in figure 1.

CONCLUSIONS

If use this fabricated model, it can absorb solar irradiation by Photo Voltaic panel and converted into electrical energy which will be power the motor of the refrigerator compressor . So the cooling effect will be produced. Here we use the thermostat which will be sense the temperature inside the cultivation cabin. If it attains it will be cutoff the refrigerator working. So thermal comfort condition for cultivation is achieved and the power also saved.

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