Instruction of Solar CCHP (Combined Cooling, Heating and Power) Appliance

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Abstract. This appliance falls in CCHP, generating electricity, heating and refrigerating by photo-electronic effect and photo-thermal effect of solar energy.

This appliance consist of butterfly mirror, terminal emitting optical fiber, surface light emitting fiber, thermosyphon, water-cooling system, solar cooker, spotlight system, heating system and cooling system.

Sunlight gathered by butterfly mirrors will be transmitted through terminal emitting optical fiber to an airtight system made by four solar panels. The thermosyphon and water cooling system will absorb the heat produced when solar batteries work as well as light and heat that are not utilized by panels. That is how IPCE of solar energy becomes more effective -- the temperature of solar panels decrease. The bottom lays water-cooled blocks to heat water by absorbing unutilized optical energy. After that, temperature of cool water increases to 80 to 100 degrees. And this heated water will be transmitted into lithium bromide refrigerator and heating system. Electric heater, gas furnace and other heating sources may be combined with this system.

Compared to conventional way to use solar panels, the way mentioned above utilizes thermal energy effectively. This appliance transfer and solar energy to electric energy and thermal energy, and make use of them. Should it be frequently utilized in DHC, electricity consumed by compression-refrigeration equipment is saved, and heating is achieved meanwhile, writing a new chapter in utilizing solar energy.

1.Introduction

Just as its name indicates, CCHP system refrigerates for manufacturing and individual living by absorption chiller, which is heated by vapor or hot water, and finally combines heating, cooling and power together. CCHP system consists of thermal course, prior pipe network, exchanging station, secondary pipe network and customers'facilities, following the principle of energy cascade use. Chart I shows the brief structure of a CCHP system in a thermal power plant.

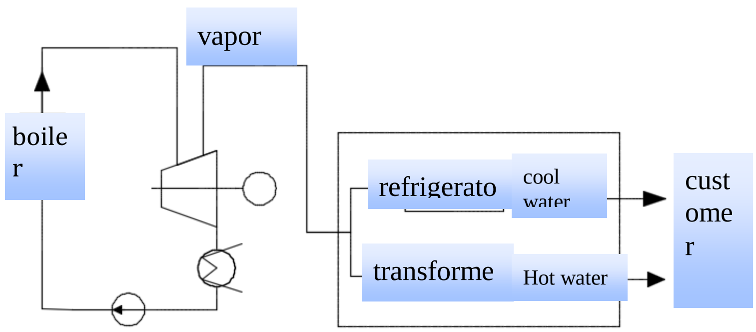

Chart I. CCHP system in a thermal power plant.

Solar IPSE transfers radiant power of sun to electricity partly and thermal energy mostly, which arises heat on solar panels and impedes their outcome. Solar panels receive radiant power that increases linearly and produce more heat as the light becomes stronger. Under this circumstance, good heat dissipation is a crucial prerequisite for panel's effectiveness. At the same time, it provides preferential condition for studying CCHP.

2.Body of Paper

2.1 Purpose of Utilizing CCHP System

In order to save electricity for collective refrigeration in summer, level off negative effect of unfriendly environment on solar panels, reduce the cost of solar energy system as a whole and achieve heating, cooling and generating electricity independently.

2.2 Theoretical Basis

Condenser System

The sun goes from east to west daily and the solar altitude changes with different seasons annually. This CCHP system takes advantage of butterfly mirrors to condense by adjusting the angle of mirrors from time to time in order to ensure that sunlight always gathers at terminal emitting optical fiber, so that solar energy is generated continuously.

Photo-voltaic Power Generation System (PV System)

Light on condenser system passes through terminal emitting optical fiber to surface light emitting fiber, then scatters from the side in an orderly and balanced way to solar panels around, and finally a part of the light is absorbed by them for PV electricity generation.

Heating and Refrigerating System

First,solar energy that has not been converted will be absorbed converted to thermal energy by solar panels and endothermic coating on the bottom. Solar panels also produce thermal energy during the processing. Second, thermosyphon absorb and homogenize the thermal energy, and heat the cool water by water-cooling blocks. The thermosyphon on the bottom like a blackbody.A blackbody is radiate energy according to the Stefan-Boltzmann law.Third, the heated water passes through the endothermic coating, acquiring thermal energy, gets heated to qualified temperature by solar cooker and enters lithium bromide refrigerator and heating system. Unlike compression refrigerator, lithium-bromide refrigerator runs with low-grade heat and fewer vulnerable parts and without other components. The refrigerant, water, is environmental friendly. All these characteristics make CCHP system more reliable, handy and capable of working in under-load mode. Meanwhile, CCHP system can refrigerate with the power of over 5000k, in favor of collective heating. Single-effect libr absorption unit is energy-conserved in terms of energy grade.

Distribution of Solar Radiant

Solar radiant passes through atmosphere to the ground partly and becomes direct solar radiant; the other is absorbed, scattered and reflected by dust and vapor. A part of scattered solar radiant returns to the space, and some other goes to the ground, called scattered solar radiant. Direct and scattered solar radiant are called global radiant altogether. After radiant passes through the atmosphere, the intensity and spectral energy distribution experience changes: intensity to the ground is much less stronger than one at upper atmosphere, energy distribution in UV spectral region is nearly nothing and decreases to 40% in visible region but increases to 60% in infrared spectral region. Chart II shows the solar radiant arriving to the ground

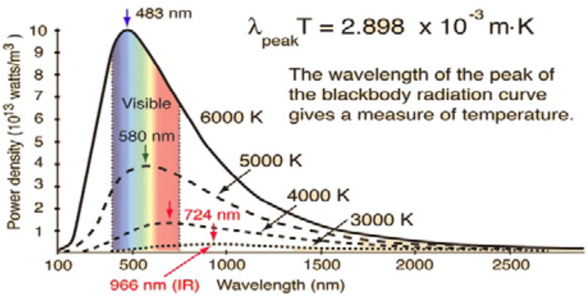

Chart II. Solar Radiant Arriving to the Ground

From Chart II we can see that after radiant passes through the atmosphere, the intensity and spectral energy distribution experience changes: intensity to the ground is much less stronger than one at upper atmosphere, energy distribution in UV spectral region is nearly nothing and decreases to 40% in visible region but increases to 60% in infrared spectral region. Chart II shows the solar radiant arriving to the ground.

Temperature and light intensity features of IPSE solar panels:

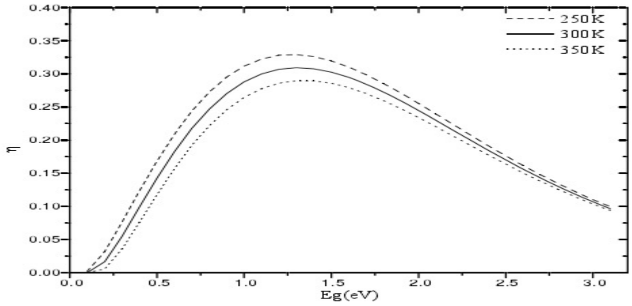

Chart III. Relation between band gap and converting efficiency with different temperatures

From Chart III can we tell that converting efficiency decreases as temperature increases. That is because radiative recombination is dependent to temperature -- open-circuit voltage decreases more under this circumstance so that converting efficiency goes down.

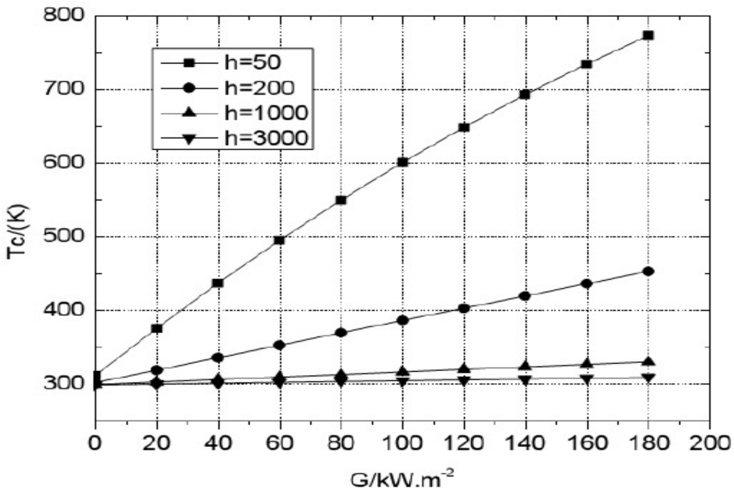

Chart IV. Relation of Panels' Temperature and Light Intensity

Chart IV tells that with a fixed coefficient of heat exchange, working temperature of panels increases nearly in linear as light intensity goes up.

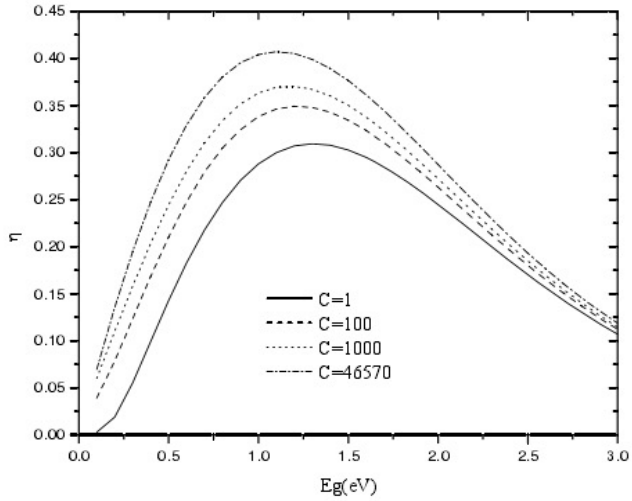

Chart V. Relation between converting efficiency and band gap with various concentration ratio

The limit of converting efficiency increases as concentration ratio increases.

In conclusion, a deviation to favorable working temperature reduces converting efficiency and larger concentration ratio leads to higher converting efficiency. Concentration and temperature changes in direct ratio. Therefore, effective heat dissipation is a prerequisite for panels'work.

IPSE Solar Panel:

IPSE solar panel mainly absorbs light with wavelength of 0.07～0.8μm. As mentioned above that intensity to the ground is much less stronger than one at upper atmosphere, energy distribution in UV spectral region is nearly nothing, so it is visible light with wavelength of 0.4～0.76μm that is absorbed by solar panels. Obviously, visible light (about 40% of sunlight) is absorbed by IPSE solar panel for electricity generation, yet infrared light accounting 60% of sunlight is still unutilized.

3.summary

1. The area of solar panels decreases by concentration so that cost goes down and the system generates electricity more effectively.
2. Efficiency of solar panel stays on an appropriate level with surface light emitting fiber homogenizing the light.
3. Efficiency of solar panel stays on an appropriate level with thermosyphon homogenizing the heat.
4. IPCE increases with water as refrigerant to cool the panels.
5. IPCE increases as solar insulation material converts optical energy to thermal energy.
6. Thanks to the airtight structure, solar energy is almost completely converted to electricity and heat.
7. The use of surplus heat of panel-cooling water for heating and refrigerating greatly save energy.
8. The arrangement of solar panels prevent panels from dust, so that this system is less susceptible of bad weather.
9. Full spectrum utilization is achieved.

Chart VI shows the structure of the system.

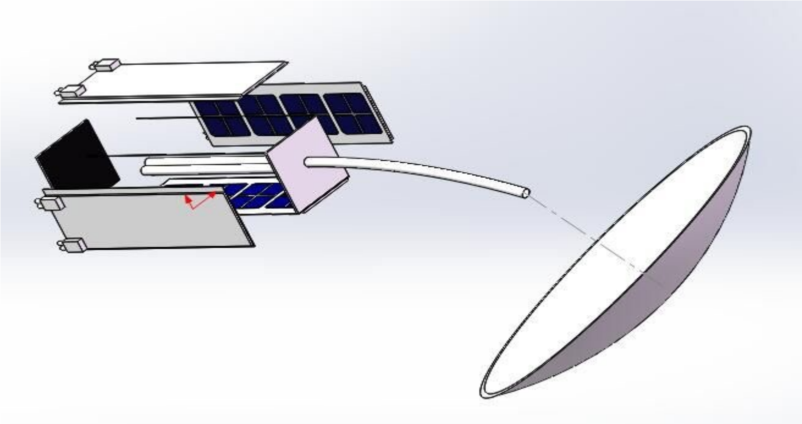

Chart VI. General Assembly Drawing

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