DESIGN AND THERMAL ANALYSIS OF ATMOSPHERIC THERMAL PANEL

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Abstract

In Today’s world, the usage of Electrical Energy in very high and essential for the development of various Product that could enhance the human life at a low cost. In order to achieve this, we have designed Atmospheric thermal Panel to satisfy this need. The atmospheric thermal panel concentrates on the area renewable resource that deals with energy production by Temperature difference. The paper proposes one such approach in gaining the electric energy by the usage of scattered thermal energy in an open or closed atmosphere. Atmospheric thermal panel is a simple tool by view but complex by working. It creates an electrons discharge by transmission from higher potential area to the lower potential area of the panel. However, major renewable energy that are available now has their own kind of inefficient in some conditions, for example: the solar panel does not produce current in night or when cloudy, the wind mill does not provide energy when there is no wind, the tidal energy mechanism does not provide energy when there is no tide similarly 80% renewable resource has their own way of inefficient. On the other hand gloom box provide energy 24*7 but requires a lot of space. But atmospheric thermal panel is designed in a way that can produce power 24*7 and a compact design that only requires a 5% of the usage area. The objective of this project is to utilize the scattered and wasted thermal energy in the atmosphere and to develop a renewable energy producing product that can produce energy 24*7 in compact size.

IndexTerms: Atmospheric Thermal Panel, ANSYS, Damper

I. Introduction

The idea of atmospheric thermal panel was inspired from the solar panel, a renewable energy and the bloom energy that can produce electricity 24*7. In 1839, solar panel was founded by a French physicist named Edmond Becquerel, only 19 years old at the time, discovered that there is a creation of voltage when a material is exposed to light. Little did he know that his discovery would lay the foundation for solar power.Later by 1883 (and as far back as 700 BC), humans knew that sunlight could be harnessed as an energy source. But how could we capture that energy?

Finally, American inventor Charles Fritts came up with a simple design using selenium on a thin layer of gold to form a device producing a modest, but nonetheless ground-breaking, 1 per cent efficiency.

In 1954, David Chapin, Calvin Fuller and Gerald Pearson of Bell Labs in the United States are credited with the world’s first photovoltaic solar cell. More specifically, these are the men that made the first device that converted sunlight into electrical power. They later pushed the conversion efficiency from 4 per cent to 11 per cent.In 1920, A technological breakthrough utilizing ‘flat-plate collectors’ makes solar hot water viable in southern parts of the United States including Florida and California. In 1955, A company called Hoffman Electrics produces solar cells at 10 per cent efficiency and sells them commercially at $25 per cell. At this price, a modern solar system would cost over 4 million dollars!.In 2001, it was now clear that solar power was Australia’s optimal energy source for the future. Roofs around the country started housing solar power systems as the market opened up with feed-in tariffs as high as 60c/kWh.In 2015, The solar power industry in Australia undergoes rapid growth during this period. As the cost of fossil fuels continues to rise, solar energy drops to record lows, as does the cost of rooftop installation.Almost every gizmo, gadget and environment is capable of harnessing the power of the sun's unlimited resources, from luxury cars, to aero planes and, in some cases, entire states and countries!.In 2015, solar power's future is brighter than ever. And while it's clear that so much has already been achieved, we know that solar's greatest achievements are still yet to come.And Bloom Energy traces its roots to work performed by K.R. Sridhar in connection with creating a technology to convert Martian atmospheric gases to oxygen for propulsion and life support. Sridhar and his team built an electrochemical cell for NASA capable of producing air and fuel from electricity generated by a solar panel.

Bloom Energy produces solid oxide fuel cell power generators called Bloom Energy Servers that use natural gas or biogas as fuel. According to The New York Times, solid oxide fuel cells are "considered the most efficient but most technologically challenging fuel-cell technology. Instead of precious metals, Bloom Energy's fuel cells use wafers made from sand that are stained with proprietary ink. As fuel passes over the sand wafers, it mixes with oxygen, creating a chemical reaction that produces electricity. The chemical reaction takes place at about 1,500 degrees Fahrenheit.

Atmospheric thermal panel has inspired by the simplicity of solar panel and the reliability of bloom energy. The concept of atmospheric panel requires only a small space and can produce the power 24*7. It works by transmitting the electrons from one junction to another by the thermal difference from the higher junction to the lower junction.

II. Design of Thermal panel

2.1 ATMOSPHEREIC THERMAL PANEL (DESIGN -1)

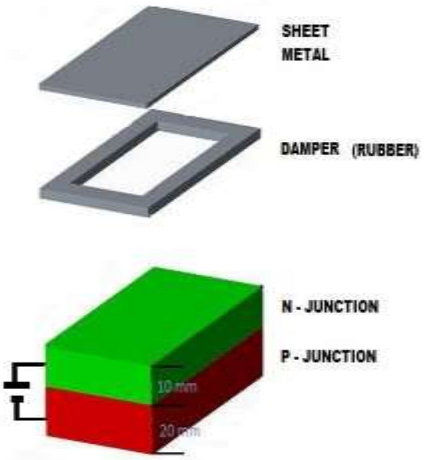


Fig.1 AT PANEL (DESIGN 1)

COMPONENTS OF ATMOSPHERIC THERMAL PANEL

- N junction of poly silicate crystal with phosphorus doped (5 valance electron)
- P junction of poly silicate crystal with boron doped (3 valance electron)
- Damper (Rubber)
- Sheet metal (aluminum)
- Connecting junctions
- Connecting wires

2.2 DUTY OF COMPONENTS:

N Junction:

- It is a poly silicate crystal with phosphorus doped, that has 5 valance electrons.
- The N-Junction act as a positive to pass the electrons to the negative (P junction).

P Junction:

- It is a poly silicate crystal with boron doped, that has 3 valance electrons.

- The P-Junction act as a negative that receive electrons from positive (N junction).

DAMPER:

- DAMPER allows you to place the sheet metal on the P-N junction.
- DAMPER reduces the direct conduction between the junctions and the sheet metal, by giving space between them.

SHEET METAL:

- SHEET METAL: It allows you to store and produce heat to the junction through convection.
- SHEET METAL: It allows you to maintain potential difference of heat between the junctions

2.3 THEORITICAL WORKING OF AT PANEL (DESIGN-1):

- AT PANEL utilizes the heat difference between the room and outside the room, creating a potential difference of heat, between the two junctions of the panel, that the heat in N-JUNCTION accelerates the electron
- Due to it, a depletion region is created between the junctions, the cause's number of holes and electrons.
- Creating a flow of electron from N-junction to P- junction.
- Thus produces the current flow.

2.4**FAILURE OF (DESIGN -1):**

After many practical testing with the panel, the design has failed to produce the electrical output.

2.5 REASON FOR FAILURE:

- **REASON 1 : (conduction between the two panel is high)**

  When the n junction is heated, due to direct contact the p junction simultaneously heat up and causes zero thermal difference, so due to the zero thermal difference the electron doesn't pass from one junction to another.
- **REASON 2 : (Imbalance pressure that restrict electron flow)**

  The n junction has +1 electron and p junction has -1 electron. When the n junction is heated the electron at the n junction accelerate and passes to p junction and occupies the hole, and there is no high pressure to push the electron from p junction to n junction, so the p junction restricts the flow of electrons, thus failed in producing the electrical output.

2.6 ATMOSPHERIC THERMAL PANEL (DESIGN-2)

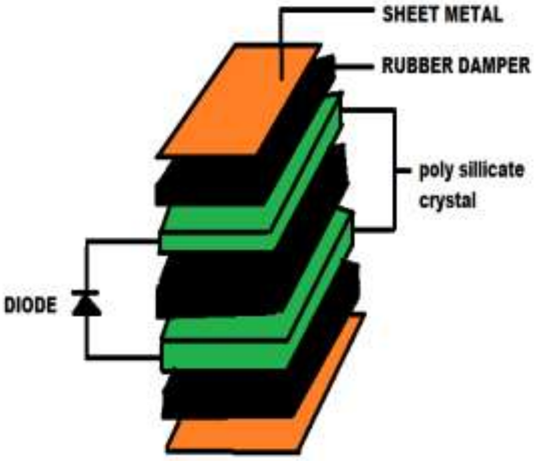


Fig.2 AT PANEL DESIGN 2

2.7 PARAMETERS INCLUDED WHILE DESIGINING:

In the Previous design, the design has failed due direct conduction between the junction, and failure in creating pressure in the lower junction. The design D2 is analyzed and designed to overcome the previous failures.

2.8 COMPONENTS OF ATMOSPHERIC THERMAL PANEL (D2)

- Two N junction of poly silicate crystal with phosphorus doped (5 valance electron)
- Damper (Rubber)
- Sheet metal (aluminum)
- Connecting junctions
- Connecting wires

2.9 DUTY OF COMPONENTS:

N Junction:

- It is a poly silicate crystal with phosphorus doped, that has 5 valance electrons.
- The N-Junction the top act as a higher junction to pass the electrons to the lower junction (another N junction) to produce current.

DAMPER:

- DAMPER allows you to place the sheet metal on the N-N junction.
- DAMPER reduces the direct conduction between the junctions and the sheet metal, by giving space between them.

SHEET METAL:

- SHEET METAL: It allows you to store and produce heat to the junction through convection.
- SHEET METAL: It allows you to maintain potential difference of heat between the junctions
-

2.10 THEORITICAL WORKING OF AT PANEL (DESIGN-1):

- AT PANEL utilizes the heat difference between the room and outside the room, creating a potential difference of heat, between the two junctions of the panel, that the heat in N-JUNCTION accelerates the electron
- Due to it, the accelerate electron passes to another N junctions.
- The n junction already has one free electron, then accelerated electron joins with the free electron in the lower junction creating a high pressure, push an electron towards the higher junction.
- Creating a flow of electron from N-junction to N- junction.
- Thus produces the current flow of 9 volt and 0.3amp.

III. RESULTS AND DISCUSSION

3.1 THERMAL ANALYSIS OF ATMOSPHERIC THERMAL PANEL

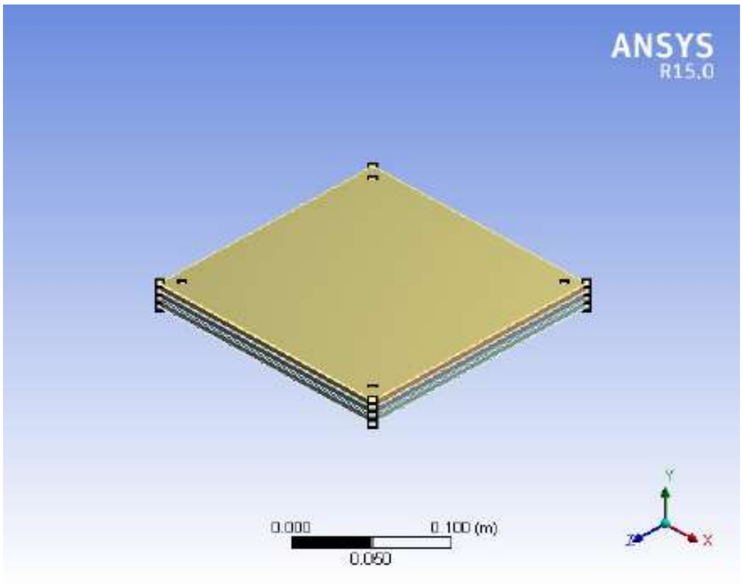


Fig.3 AT PANEL IN ANYSIS VIEW

Atmospheric thermal panel is analyzed using ANYSIS 15.0

3.2 THERMAL ANALYSIS:

- First in order to analysis the Atmospheric thermal panel, it is required to find the required parameters (i.e.) Heat Flux.
- Heat Flux is calculated by heat produced due to fall of sunrays on the outer surface of the AT panel and thus heat gets transferred into AT panel.

3.3 CALCULATION: (ESTIMATION OF CLEAR SKY RADIATION)

TO FIND HEAT FLUX:

Hear, Altitude = 10.7 m

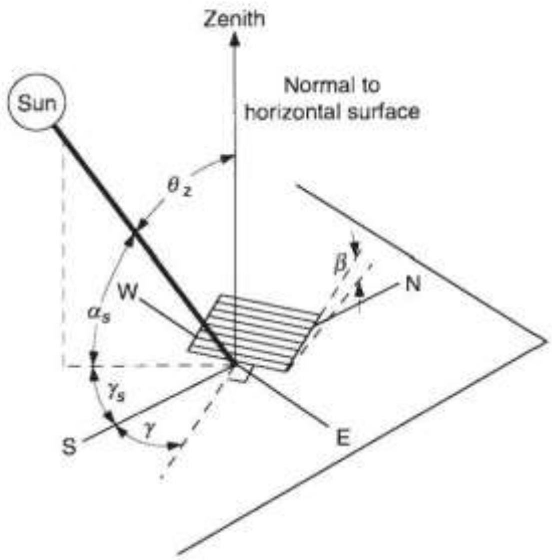
On 18th March, we need to calculate the transmittance for beam radiation on the AT panel.

Here, on 18/03/2020, n = 77, where n = year day.

Therefore, the Cooper Declination angle is given by

$$\delta = 23.45\, sin\, sin\, [\![360\left(\frac{284+n}{365}\right)]\!]$$

$$\delta = -1.6134°$$



Zenith angle of the sun θz is given by

$$cos\ cos\ \theta\ z = cos\ cos\emptyset\ cos\ cos\ \delta\ cos\ cos\omega + sin\ sin\emptyset\ sin\ sin\ \delta$$

Where, ω = Hour Angle = -30°

ϕ = Latitude = 13°N (At Chennai)

δ = Declination angle = -1.6134°

θz = Zenith Angle

$$cos\ cos\ \theta\ z = cos\ cos13\ \ cos\ cos - 1.6134°\ cos\ cos - 30° + sin\ sin13°\ sin\ sin - 1.6134°$$

$$cos\ cos\ \theta\ z = 0.8371$$

The Atmospheric transmittance for beam radiation equation :

$$\tau_b = a_0 + a_1 e^{(-k/coscos\theta_z)}$$

The constants a_0 , a_1 and k for the standard atmosphere with 23km visibility are found from a_0^* , a_1^* and k^*, which are given for altitudes less than 2.5km by

$$a_0^* = 0.4237 - 0.00821(6 - A)^2$$

$$a_1^* = 0.5055 + 0.00595(6.5 - A)^2$$

$$k^* = 0.2711 + 0.01858(2.5 - A)^2$$

Where A = Altitude in km (< 2.5 km) = 10.7 m = 0.0107 km.

Therefore, $a_0^* = 0.1381$

$$a_1^* = 0.7560$$

$$k^* = 0.3862$$

Correction Factor for climate types:

At Chennai, Climate Type is Tropical,

Therefore, $r_0 = 0.95$

$$r_1 = 0.98$$

$$r_k = 1.02$$

- ⇨ $a_0 = r_0 * a_0^* = 0.131195$
- ⇨ $a_1 = r_1 * a_1^* = 0.740880$
- ⇨ $k = r_k * k^* = 0.393924$

Therefore, Atmospheric transmittance is

$$\tau_b = a_0 + a_1 e^{(-k/coscos\theta_z)} = 0.131195 + 0.74088e^{(-\frac{0.393924}{0.8371})} = 0.5939$$

G_{on} is the extraterrestrial radiation incident on the plane normal to the radiation on the nth day of the year

$$G_{on} = G_{sc}\left\{1 + 0.033\ cos\ cos(360\left(\frac{n}{365}\right))\right\}$$

Where, $G_{sc} = Solar\ Constant = 1.361\ KW/m^2$

$$G_{on} = 1.361 * 10^3\left\{1 + 0.033\ cos\ cos(360\left(\frac{77}{365}\right))\right\}$$

$$G_{on} = 1371.907\ W/m^2$$

The beam radiation is then given by = $G_{on} * \tau_b$

$$= 1371.907 * 0.5939$$

$$= 814.775\ W/m^2$$

The component (Heat flux) on a horizontal plane is

= Beam radiation * $cos\ cos\theta z$

= 814.775 * 0.8371

= 682.048 W/m^2

Thus the heat flux is calculated as **682.048 W/m^2** in the direction from top to bottom surface of the AT panel.

3.4 Thermal analysis using Ansys

INPUT:

TABLE 4.1: MATERIAL USED

SI.NO	MATERIAL
1.	Aluminium
2.	PV material
3.	Rubber Damper

TABLE 4.2 GEOMETRICAL PROPERTIES:

OBJECT NAME	P junction	Damper (middle)	N junction	Damper 1	Damper 2	Sheet Metal 1	Sheet Metal 2
MATERIAL							
ASSIGNMENT	PV	RUBBER DAMPER	PV	RUBBER DAMPER		ALUMINIUM ALLOY	
BOUNDARY BOX							
Length X	0.19m						
Length Y	2.e-003 m	5.e-003 m	1.e-003 m	5.e-003 m		1.e-003 m	
Length Z	0.19m						
PROPERTIES							
Volume (m^3)	7.22e-005	1.805e-004	3.61e-005	3.6e-005		3.61e-005	
Mass (kg)	0.16823	0.27472	8.41e-002	5.4792e-002		9.9997e-002	
Centroid X	9.5e-002 m						
Centroid Y	1e-003 m	4.5e-003 m	7.5e-003 m	1.05e-002 m	-2.5e-003 m	1.35e-002 m	-5.5e-003 m
Centroid Z	-9.5e-002 m						
Moment of Inertia Ip1 (kg.m^2)	5.0614e-004	8.2702e-004	2.5305e-004	2.969e-004		3.0083e-004	
Moment of Inertia Ip2 (kg.m^2)	1.0122e-003	1.6529e-003	5.0608e-004	5.9358e-004		6.0165e-004	
Moment of Inertia Ip3 (kg.m^2)	5.0614e-004	8.2702e-004	2.5305e-004	2.969e-004		3.0083e-004	
STATISTICS							
Nodes	1728	2391	1728	672		1728	
Elements	225	1114	225	56		225	

TABLE 4.3: INPUT:

SI.NO	DESCRIPTION	VALUE
1.	Temperature on Sheet Metal 1	45℃
2.	Heat Flux	682.048 W/m^2
3.	Temperature on Sheet Metal 2	22℃

1. Temperature of the p and n junction:

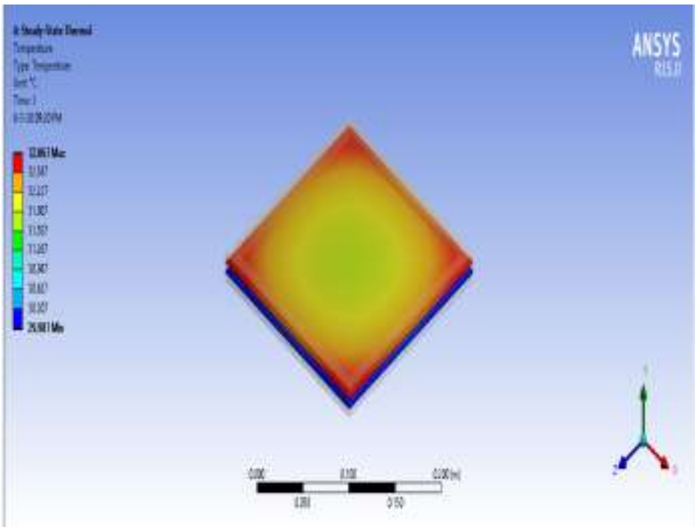


Fig.4 TEMPERATE OF BOTH JUNCTION

Temperature at P junction = 32.867 ℃

Temperature at N junction = 29.987 ℃

2. Total heat flux:

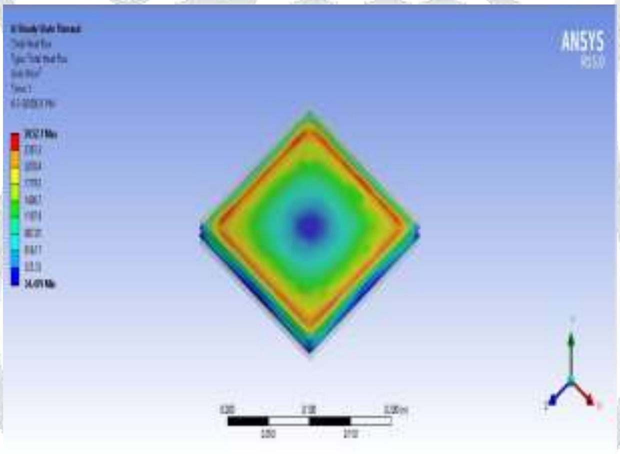


Fig. 5 TOTAL HEAT FLUX

Heat Flux: Maximum = 2652.1 W/m^2

Minimum = 34.479 W/m^2

3. Temperature of total body:

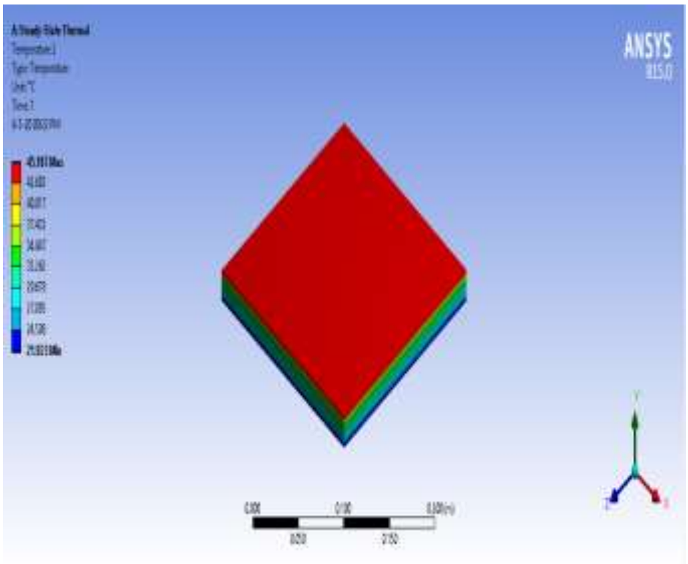


Fig. 6 TEMPERATURE OF TOTAL BODY

Temperature: Maximum = 45.187, Minimum = 21.923 ℃

IV. Conclusion

The “ATMOSPHERIC THERMAL PANEL” is developed for the purpose of producing electrical energy 24*7 with compact size. We have designed and built a long-lifetime panel with a minimal need for maintenance and high energy potential. The Atmospheric thermal panel design, configuration, structural calculation results and experimental setup have been presented. We have provided an unique structural design which increases electrical output and makes the panel to work with high potential. This design also increases the temperature difference between the higher junction and lower junction. Thus the structure with material design of the panel is optimized in order to improve the efficiency of the electrical output.

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