Indian Institute of Science

Design of Photovoltaic Systems

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Let us perform an experiment using peltier element, we will try to consoled it or understanding of both free and force convection first without fan we will see how the relative cooling of the objective to be cooled is and then we will introduce a fan and then see how the cooling effectives improved.

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Let us take heat zinc it is bottom aluminum block it is heat zinc and another smaller aluminum block which I have placed on top here and that is the object to be cooled, we will use the per tier element I hope your recognize this pen tier element I showed this earlier. I will introduced it in between these two blocks and place it in between these two blocks so that the hot surface of the pen tier element will be in contact with the heat zinc surface.

The cold surface of the pen tier element will be in contact with the tip aluminum block which will be cooled. So let us do this.

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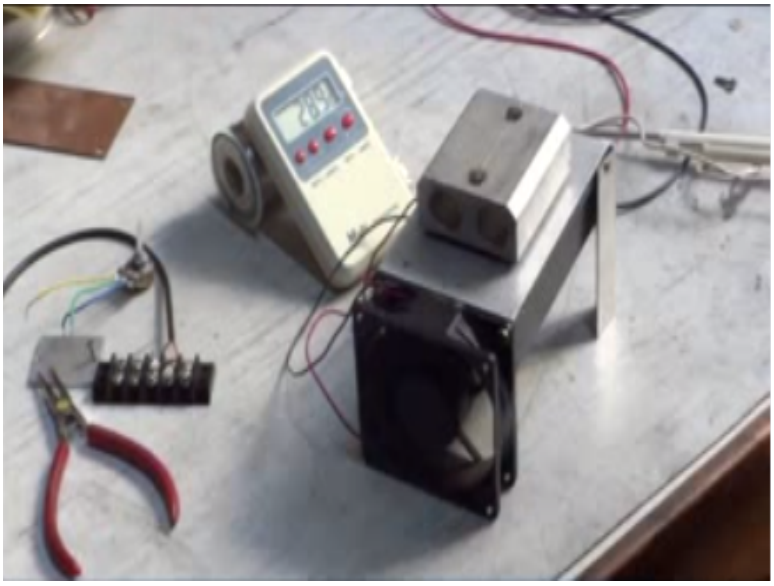

Absorb the heat zinc and the block to be cooled, there are two holes drilled in this aluminum block they are basically to handle test tubes in order to experiments with fluids inside the test tubes. Let me now take the pen tier element and carefully insert it in between the two blocks after inserting the pen tier element between the two blocks carefully tight and the screws on the top and the blocks, so that the peltier element is firmly held in between these two blocks. Next we connect the wires leads of the peltier element to the power supply you connect the black lead to the negative of the power supply and the red of the positive of the power supply is connected to the read lead.

Now switch on the power supply adjust the voltage allow around 1.5 amps of current to flow through the peltier element the voltage is indicating around 7.5 volts and the current is close to 1.5 amps, so now we will take a digital thermometer place it near the peltier system and use the probe to measure the temperatures the cold and the hot junctions. We will now allow the thermometer to stabilize the ambient temperature and then we will leave the system on fort sometime may be around 15, 20 minutes, so that the temperature stabilizes and then we will take the measurement.

The ambient is around 27.4 let us now measure the cold junction temperature not actually the cold junction the temperature of the cold aluminum block you will see that the temperature is lesser than the ambient reducing let us see to what level it reduces it is fairly stabilizing now

probably it will settle down at around 20 to or maybe 22.2, it is fairly stable at 22.2 so we can say that the aluminum block is a term 22.2.

Now let us measure the temperature of the heat zinc to which the hot junction is connected see that the temperature is raising rapidly it is going beyond the ambient temperature of 27.4, so it will probably stabilize at around 38 or so yeah around 38 38.1 the heat zinc is hot you touch it, if you keep the probe aside it will trying to settler to the ambient it will go down to 27.4. so you see that in this experiment we are not used a blower it is just free convection.

The cold junction of the peltier junction is connected to this block and then it is giving a temperature reading of around 22.2 and the heat zinc cause hot at around 38^0 C and we gave an input potential of 7.5 volts across the pen tier terminals passing a current of 1.5 amps. Now let us introduce forced cooling let us fix a fan and then see if there is any improvement have use a small DC fan just to show that force convection even a small amount of air blowing controlled a block can improve the performance a great deal.

By will fit a fan to one of the heat zinc as shown I will connect couple of support pillars to the front so that the heat zinc is level, so now we have the fan of the support pillars connected so now you have two wires coming from the fan and two wires coming from the peltier element. So let me connect the positive of the peltier element to the positive of the fan both the wires red wires I will connect together, then I will connect the crocodile clip connected to the power supply I will connect he black wires of the fan and the peltier element together and then connect the negative of the power supply to that.

So we have the connection establish I will turn it around so that it is a convenient position you of course now see the fan and we now ready to switch on the let us now switch on the power supply the fan will start rotating you see that, now the current is drawn not only by the peltier element it is also drawn by the fan, so there will be slight increase in that current so it is 1.5 amperes is 1.7 amps all else remaining the same, now we will leave the system for some time and take measurements order 15 20 minutes.

Absorb now that the voltage is still remaining at around 7.5 volts the current as more to around 1.7 amps, so 0.2 amps the contribution of the fan. So I am now taking the readings so I am taking the reading of the cold aluminum block with force cooling, so it set 19.6 much lower than the

free convection cooling this reaches around 18.7 ^{0} C probably it will settle at this value or maybe 18.6, so it is now fairly stable the aluminum block is now settle to around 18.6^{0}C.

We can now see the temperature of the heat zinc to which the hot junction is connected the heat zinc temperature is higher definitely, so you will see that the heat zinc temperature raises is beyond ambient now but it will be much lower than what it was with the free convection. So it si settle around 30^{0} 30.8^{0}C around 31 probably. So we can say that it is around 31^{0} C, so you see the difference here 31 to around 18.6 close to around 130 C difference same in the earlier case but now the temperature as gone down. The heat zinc temperature is also gone down and that is the advantage of having force convection.