

A Study on Renewable Energy for the Mitigation of Climate Change

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ABSTRACT

A solar paraboloidal concentrating collector in a non-planar configuration using reflecting materials of reflectance is 0.7 has been thermally designed and developed and at a 1m focal distance in conjunction with a reverse flat plate absorber with black board paint (both selective and non selective coating) theoretically. To study optical and thermal performance tests like stagnation temperature (T_{ps}), water temperature (T_w), plate temperature (T_p), Thermal efficiency test (η_c), optical efficiency test (η_0), Heat transfer coefficient from surface to water (U), geometrical concentration ratio (C) and overall heat loss coefficient (U_L) has been studied. The concentrator is placed such that all incident parallel rays of light intercepted by the concentrator aperture area reflected to a common focus. In this case the concentrator parabolic in shape. This communication presents the thermal design analysis of a CR- system. The results of some typical numerical calculations are shown graphically and their significance is discussed. There are different kinds of solar concentrating collectors for practical utilization in different cases like solar thermal steam production and distillation, solar candle production, solar gur/ Molases production, solar soap production, solar paddy boiling, solar biscuits production, solar chocolate production, solar salt production, Tobacco curing, solar medical sterilizer etc. Although this work is done for paraboloidal dish type concentrating collector, it will also help to design and fabricate other any type of concentrating collectors for practical utilization under the climatic condition of Bangladesh. Finally, it can be concluded that is feasible and viable to mitigate climate change through Renewable Energy.

Keywords: *Renewable energy, Climate change, Carbon dioxide, mitigation.*

I. INTRODUCTION

Paraboloidal solar concentrator is usually employed to receive the proper concentration of the solar flux on the linear absorbers. The analysis presented in this paper was used to study the performance characteristics of the paraboloidal concentrator in conjunction with a reverse flat plate (a rectangular channel) absorber. It should however be noted that the analysis in general in nature where some assumptions were made to simplify the procedure. In the thermal analysis both the transient and steady state conditions were taken into consideration. This analysis would be applicable to any non-tracking or seasonally tracking concentrator with reverse flat plate absorber exposed to the concentrated flux. The results computed on putting some typical values in the expressions obtained from the analysis are tabulated and presented graphically.

A solar paraboloidal concentrating collector in a non-planar configuration using reflecting materials of reflectance is 0.7 has been thermally designed and developed and at a 1m focal distance in conjunction with a reverse flat plate absorber with black board paint (both selective and non selective coating) theoretically. To study optical and thermal performance tests like stagnation temperature (T_{ps}), water temperature (T_w), plate temperature (T_p), Thermal efficiency test (η_c), optical efficiency test (η_0), Heat transfer coefficient from surface to water (U), geometrical concentration ratio (C) and overall heat loss coefficient (U_L) has been studied. The concentrator is placed such that all incident parallel rays of light intercepted by the concentrator aperture area reflected to a common focus. In this case the concentrator parabolic in shape. This communication presents the thermal design analysis of a CR- system. The results of some typical numerical calculations are shown graphically and their significance is discussed.

I.A Renewable Energy for Bangladesh

From the dawn of civilization energy is one of the most important needs to sustain and develop our daily life. There are different types of energy sources in the universe. They are of mainly natural and some of them are man-made. After all depending on energy regeneration, energy can be categorized into two main different sources which are renewable and nonrenewable sources. Renewable sources of energy are obtained from different natural sources. The sources are mainly sunlight, wind, tides, biomass and geothermal. Statistics has indicated that renewable sources of energy comprise approximate 16% of total global energy that is consumed on daily basis. Nonrenewable sources of energy have continued to produce constant energy throughout the world. This is because of their high availability. Sources of nonrenewable energy can be attributed to natural sources that are not regenerated once the source is depleted. Sources include fossils fuels such as coal and petroleum products e.g. natural gas and diesels. The reservation of this fossil fuel is decreasing very sharply day by day and once it will exhaust. However, this fuel is not environmentally friendly since it emits most significant greenhouse gas CO_2 which causes the global warming due to the rising of temperature in the atmosphere and other detrimental effects results for the threats of our existence. The planet is warming, from North Pole to South Pole, and everywhere in between. Globally, the mercury is already up more than 1 degree Fahrenheit (0.8 degree Celsius), and even more in sensitive Polar Regions. And the effects of rising temperatures aren't waiting for some far-flung future. They're happening right now. Signs are appearing all over, and some of them are surprising. The heat is not only melting glaciers and sea ice; it's also shifting precipitation patterns and setting animals. Energy crisis is one of the most discussed issues in today's world. Most of the countries are trying to withstand this matter by any means but we, the people of Bangladesh, are not much aware of this issue. At present, the generation demand is nearly 10,416 MW (June, 2014) whereas only three-fourth

of which is considered to be available. Only 62% of the population has access to electricity with a per capita availability of 321 kWh per annum which is significantly lesser in comparison with developing countries. Due to insufficient production of electricity, according to the demand we, the city dwellers, are suffering from load-shading in pick hours even in off-pick hours. The problem of load-shading is getting more serious because of over dependency on fossil fuel. The world reserve of natural gas is limited and it is alarming that natural resources are about to diminish in this century. However, nuclear energy will be alternative source but it has some major drawbacks. Burning fossil fuels causes emission of Green House Gases (GHGs) which in turn cause global warming and pollute environment. We have to take into account that our population grows enormously and the use of energy is still significantly growing. The energy crisis will be a serious problem in future. So, we should think of suitable alternative. To fulfill the omnipresent demand of electricity, green energy would be the most suitable one.

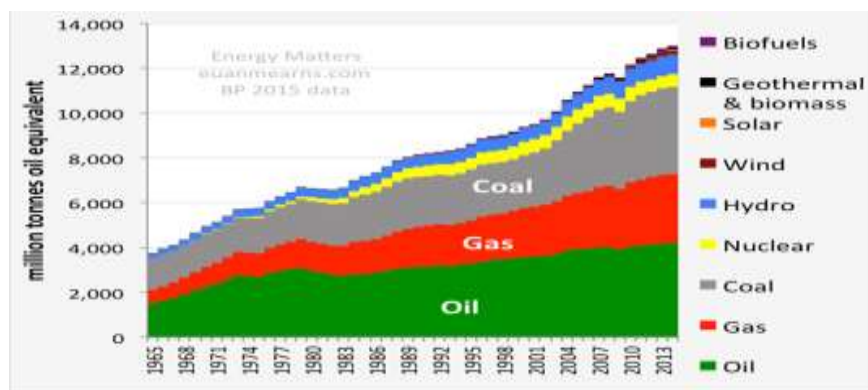


Figure 1: Global Energy Consumption

Because of remaining limitation of non renewable energy, modern people already have recognized importance of renewable energy. That's why modern scientists are attempting hardly for more utilization of renewable energy. Under the circumstance, Bangladeshi energy specialist also starting works how to make proper utilization of renewable energy in Bangladesh. Bangladesh is a small country but it has a large population amount of mineral sources. Already the government of Bangladesh has accepted a noble plan to provide electricity for all by the year 2020. But at present only 32% of total population has got grid connected electricity. In the near future it is not possible to give connection all the remote area and the offshore Islands within the national grid system. It is very expensive to expand the national grid in those isolated areas. Hence therefore we can assure in this situation of Bangladesh, renewable energy could be effective and alternative systems which fulfill the electricity demand in the off-grid areas.

II. OBJECTIVE OF THE STUDY

1. To disseminate the Renewable Energy for the mitigation of Climate Change
2. To Popularize the Renewable Energy for the mitigation of Climate Change

III. METHODOLOGY

There is a lot of concentrating collector which has been developed by the researchers like paraboloidal concentrating collector, compound parabolic collector (CPC), compound parabolic trough, linear Fresnel reflector concentrating collector, linear Fresnel lens type concentrating collector etc. It is called CR (Concentrator-Receiver system) system. The receiver is in reverse mode. The receiver is made by copper materials.

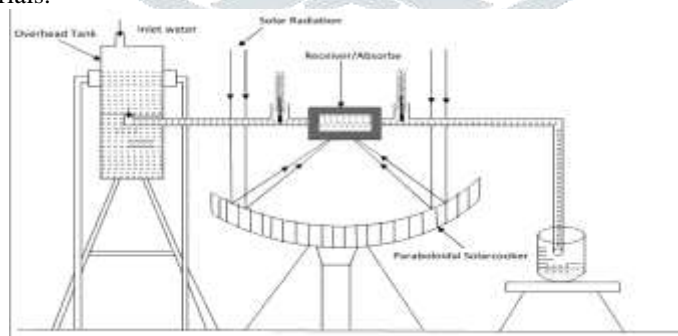


Fig.1: An experimental setup of a solar paraboloidal dish type concentrating collector

Fig.1 shows design of an experimental setup of a solar paraboloidal dish type concentrating collector. It is used here for steam production and distillation.

IV. RESULTS & DISCUSSION

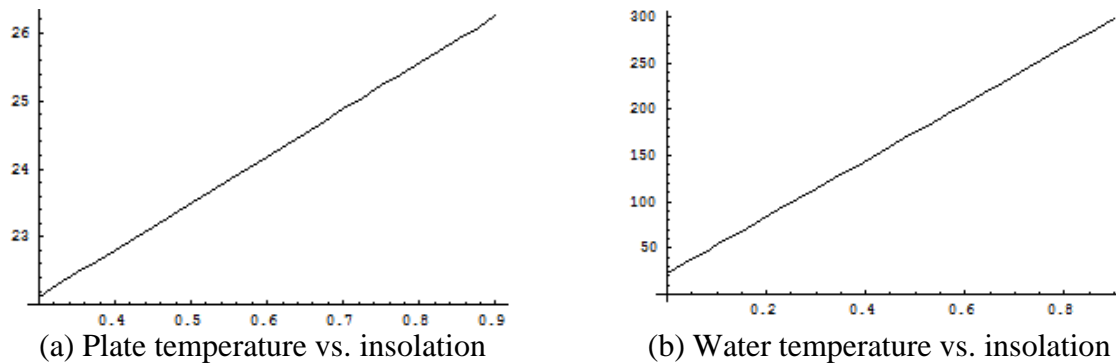


Fig. 2: Variation of (a) plate and (b) water temperature with beam radiation

Fig.2 shows the comparative variation of plate and water temperature with beam radiation. It is seen that at lower insolation level, the plate and water temperature difference is narrower than that at higher insolation. It is also appears that at zero insolation the plate & water will be almost at the same temperature. The reason is obvious from the fact that with the increase of insolation, the plate can absorb energy more quickly than the water can through the plate where as overall heat loss factor (U_L) increases at the elevated temperature. This results in the difference of temperature in the plate & water.

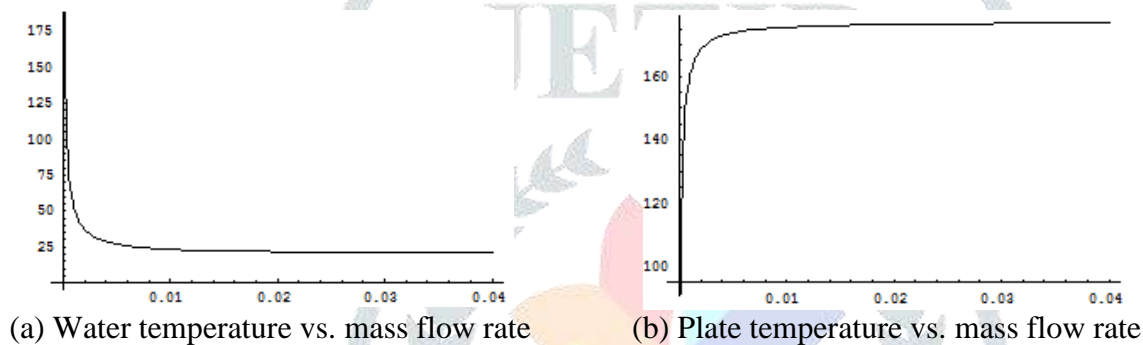


Fig. 3: The variation of (a) plate and (b) water temperature with mass flow rate

The variation of plate and water temperature with mass flow rate of heat transfer fluid is shown in figure 2. It is seen that the temperature decreases is initially at a faster rate and then settles down approaching the ambient temperature. With the increase in mass flow rate the operating temperature decreases. As expected the system efficiency increases with decrease in operating temperature when U_L is less than that are higher operating temperatures.

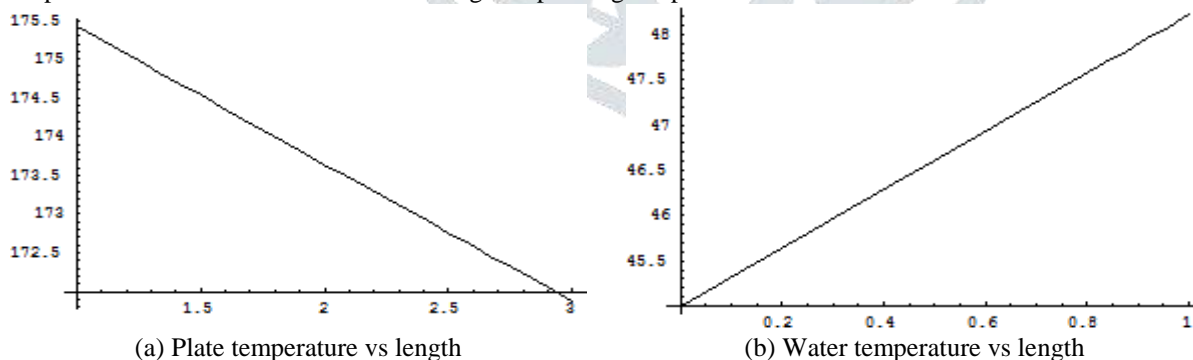


Fig. 4: The variation of (a) plate and (b) water temperature difference with the length

The variation of plate and water temperature difference with the length of the rectangular channel absorber is shown in Fig. 4. It is seen from the figure that with the increasing length the plate & water temperature difference tends to zero meaning there by that at the end of a long absorber channel, the plate and water temperature become the same. As expected the plate & water temperature increases more or less exponentially with the length of the absorber channel.

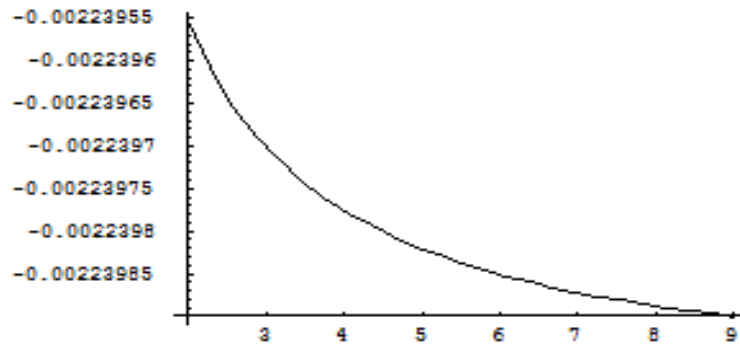
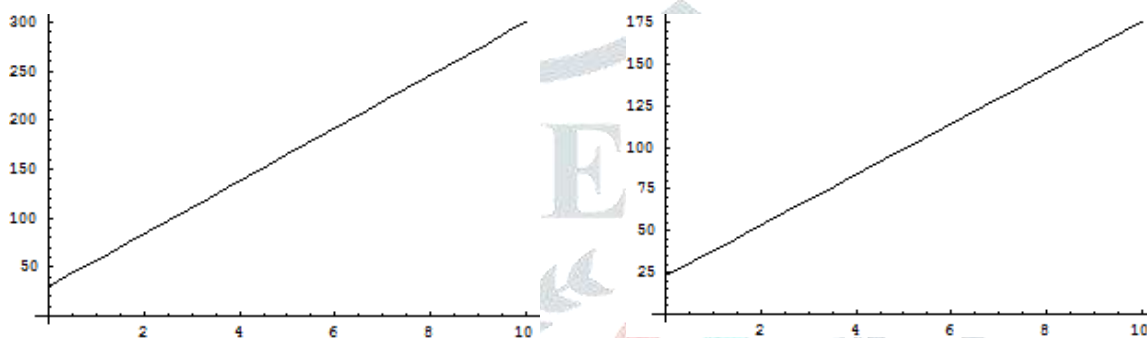


Fig. 5: Variation of mass flow rate of heat transfer fluid on the efficiency of the CR- system

The effect of variation of mass flow rate of heat transfer fluid on the efficiency of the CR- system is shown in Fig. 5. It is observed that the mass flow rate increases the efficiency increases. From the figure it is observed that about 8% increase in efficiency occurs when mass flow rate is varied from .001 kg/sec to 0.007 kg/sec. No appreciable change is observed during the variation between 0.007kg/sec-0.017 kg/sec onward.



(a) Plate temperature vs. concentration ratio (b) Water temperature vs. concentration ratio

Fig. 6: Variation of the (a) plate and (b) water temperature with concentration ratio

The variation of the plate and water temperature with concentration ratio is shown in Fig. 6. It is shown that the plate & water temperature difference increases with the increase in concentration ratio, the plate can absorb energy quicker that the heat transfer fluid can do through the absorber plate after incurring different sorts of heat losses. This leads to the widening of plate & water temperature difference with the increase in the concentration ratio.

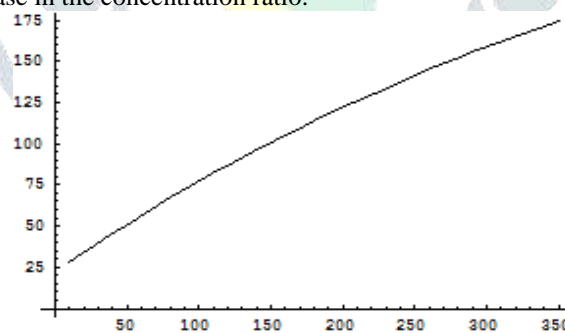


Fig. 7: Variation of stagnation temperature with the hour of the day

The variation of stagnation temperature with the hour of the day is shown in Fig. 7. It is seen that as time goes on the stagnation temperature starts increasing almost linearly and then after sufficient time span around solar noon, it tends to saturate at certain temperature when insolation level attains the peak value. The variation of temperature may attribute to the fact that the insolation varies with the time of the day.

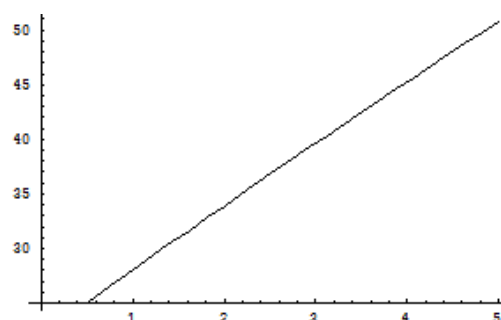


Fig. 8: Variation of stagnation temperature with the length of the absorber

The variation of stagnation temperature with the length of the absorber is shown in Fig. 8. It is observed that with the increase of the observer channel, the stagnation temperature rises sharply and almost linearly at the beginning and then settles down exponentially at its saturation level. The computed values of the performance characteristics for a particular mass flow rate, insolation and ambient temperature are shown in appendix for comparison with measured values for both selective & non-selective coatings.

V. CONCLUSIONS

With rapid industrialization, the earth's environment is being gradually polluted due to uncontrolled emissions. A topic of great concern is the increase of CO₂ concentrations in the atmosphere causing significant greenhouse effects. In our present research, the principal goal would not only be a remediation of this environmental problem but also would produce value-added products along with electricity. Some researchers has been reported their findings using highly expensive electrodes. As a matter of fact, direct electrochemical conversion of CO₂ to useful products has been under investigation for a few decades. Metal-based catalysts, such as copper, platinum iron, tin, silver and gold along with carbons have been the primary focus for CO₂ reduction, with some very high Faradaic efficiency for methane conversion. Copper is arguably the best known metal catalyst for electrochemical CO₂ reduction capable of electrochemically converting CO₂ into more than 30 different products including carbon monoxide (CO), formic acid (HCOOH), methane (CH₄) and ethylene (C₂H₄) or ethane (C₂H₆), but efficiency and selectivity for any product heavier than methane are far too low for practical use beside the cost. However, to the best of my knowledge, paper based carbon electrode has not been used until now for the conversion of CO₂ into useful products, accept nanomaterial's based paper electrode has been used for the development of paper biosensors and ion selective electrodes following potentiometric method. But by far this material have not been used yet in an electrochemical cell for the conversion and storage of energy. Since the paper is a very light substrate compared to others metallic electrodes, it might be an excellent carbon based flexible, low weight, high capacity cathodic material for low weight battery that might be economically viable as well.

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