Design And Fabrication For Parabolic Solar Water Heater

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Abstract- *The design and development of a parabolic dish solar water heater for domestic hot water application (up to 100oC) is described. The heater is to provide 40 liters of hot water a day for a family of four, assuming that each member of the family requires 10 liters of hot water per day. For effective performance the design requires that the solar water heater track the sun continuously, and an automatic electronic control circuit was designed and developed for this purpose. Experimental test runs carried out showed that the overall performance of the solar water heater was satisfactory. Thermal efficiency of 52% - 56% were obtained, and this range of efficiency is higher than the designed value of 50%. The use of a linear actuator (Super jack) to track the sun eliminates the need for constant monitoring by a human operator and, thus, reduces the cost of labour.*

I. INTRODUCTION

The new type of concentration has been called the ideal concentration by Winston to describe its optical properties. Such a name is somewhat unfortunate in the present context, and we emphasize that this name is not to imply any value judgment whatsoever about the usefulness of this device for solar energy applications. Compared to the flat mirrors, focusing parabolas and lenses that have been used until now, ideal concentrate achieve significantly higher concentration values but require a rather large reflector area; furthermore, their reflection losses are more difficult to assess than those of a simple parabola. We feel that a review is called for at the present time which compares ideal concentrate with conventional ones such as simple parabolas, V-troughs and Fresnel mirrors. This should help provide a rational basis for deciding which concentrator type is best suited for a particular application [1].

For an exhaustive answer to such a question, a detailed systems analysis may be needed, an undertaking which is beyond the scope of the present investigation. To keep this paper reasonably self-contained, we have restricted our attention to the most important general characteristics of solar concentrators: concentration, acceptance angle, sensitivity to mirror and alignment errors, size of reflector area and average number of reflections. In a companion paper we have evaluated the thermal performance to be expected from a solar collector consisting of ideal concentrators. Concentration of solar radiation becomes necessary when high temperatures are desired, or when, as in the case of photovoltaic cells, the cost of the absorber itself is much higher than the cost of mirrors For an exhaustive answer to such a question, a detailed systems analysis may be needed, an undertaking which is beyond the scope of the present investigation. To keep this paper reasonably self-contained, we have restricted our attention to the most important general characteristics of solar concentrate: concentration, acceptance angle, sensitivity to mirror and alignment errors, size of reflector area and average number of reflections. In a companion paper we have evaluated the thermal performance to be expected from a solar collector consisting of ideal concentrate. Concentration of solar radiation becomes necessary when high temperatures are desired, or when, as in the case of photo voltaic cells, the cost of the absorb itself is much higher than the cost of mirrors

II. OBJECTIVE

- To make water heater portable.
- To increase efficiency as compared to flat plate collector.
- To make the product available at lower cost

III. PROBLEM STATEMENT

The dependence of the great majority of humanity on fossil fuels for energy consumption is at a dangerously high level. The governing bodies of the world have begun to come to terms with the fact that fossil fuels will not last forever, much less in a world whose population grows in the fast rate that ours does. The only problem is not that they are running out, but the methods that are used to harvest these fossil fuels are most of the time very harmful to the environment as well it's relatively cheap, and any imperfections can be repaired with filler afterwards, (It is easier to fill than grind off.) The various materials to design components were locally sourced and manufactured by moulding and fabrication as the need demanded.

Once the mould is finished the parabolic plate can be cast from it with other material are- i.e. more concrete, fiberglass, reinforced fibre polymer, clay, paper etc. If you wish to use the dish as a microwave antenna then construction should be made with fiberglass and "bird" wire netting or "aluminum foil" should be incorporated within the layers of fibre-glassing; or perhaps coat the parabolic surface with a heavy copper based paint (many coats) This will provide the necessary reflective surface for the microwave energy. If using fiber glassing, a "chrome" paint, or highly silvered paint could be applied before applying the finish top clear gel coat, this may provide satisfactory mirrored surface. Shinny aluminum foil could also be "laid and rolled" before the top gel coat and might provide a good reflector. Thin polished stainless steel sections cut to fit in together could be laid onto the surface and held into position from the rim and centre, and would provide a good mirrored surface for any use. Silicon sealant applied sparingly might "hold" any stubborn pieces down.

The first chapter of project report deals with the introduction, which includes the basic idea of our project and objectives. The second chapter consist of literature review by considering all surveys, journal and research papers. The third chapter considers system experimental work including design calculations, drawing basic setup, assembly and details of project layout. The forth chapter is about the conclusions.

Geometry of Parabolic Trough Solar Collector Parabolic

Trough Solar Collector (PTSC) which is also called cylindrical parabolic collector employs linear imaging concentration. These collectors are comprised of a cylindrical concealer of parabolic cross – sectional shape, and a circular cylindrical receiver located along the focal line of the parabola.

Basically it consists of (i) a parabolic reflector of about 1-6 m aperture width, (ii) an absorber tube made of steel or copper with diameter 1-5 cm and coated with selective coating, and (iii) a concentric tubular glass cover surrounding receiver with a gap of about 1- 2 cm. The cylindrical parabolic reflector focuses all the incident sunlight onto a metallic tubular receiver placed along its length in the focal plane. The heat transfer fluid is allowed to flow through the receiver.

Radiation concentration at a parabolic trough

Parabolic troughs have a focal line, which consists of the focal points of the parabolic cross sections. Radiation that enters in a plane parallel to the optical plane is reflected in such a way that it passes through the focal line.

The following four parameters are commonly used to characterize the form and size of a parabolic trough: trough length, focal length, aperture width, i.e. the distance between one rim and the other, and rim angle, i.e. the angle between the optical axis and the line between the focal point and the mirror rim:

The focal length, i.e. the distance between the focal point and the vertex of a parabola, is a parameter that determines the parabola completely

The rim angle, i.e. the angle between the optical axis and the line between the focal point and the mirror rim, has the interesting characteristics that it alone determines the shape of the cross-section of a parabolic trough. That means that the cross-sections of The rim angle, i.e. the angle between the optical axis and the line between the focal point and the mirror rim, has the interesting characteristics that it alone determines the shape of the cross-section of a parabolic trough. That means that the cross-sections of parabolic troughs with the same rim angle are geometrically similar. The cross-sections of one parabolic trough with a given rim angle can be made congruent to the cross-section of another parabolic trough with the same rim angle by a uniform scaling (enlarging or shrinking). If only the shape of a collector cross-section is of interest, but not the absolute size, then it is sufficient to indicate the rim angle. Two of the three parameters rim angle, aperture width and focal length are sufficient to determine the cross-section of a parabolic trough completely, i.e. shape and size. This also means that two of them are sufficient to calculate the third one.

Geometrical parameters of real parabolic troughs

We see that the rim angle should neither be too small nor too large. The rim angle is related to the distance between the different parts of the mirrors and the focal line.

The rim angle is a very important constructive trait of collectors. For instance, it has an effect on the concentration ratioand on the total irradiance per meter absorb er tube [W/m]. Qualitatively, we can understand in the following way that there must be some ideal rim angle range and that it should neither be too small nor too large. If the rim angle is very small, then the mirror is very narrow and it is obvious that a broader outer parts of the mirror is very long and the beam spread is very big, hence reducing the concentration ratio. A mirror with a smaller rim angle and the same aperture width would permit a higher concentration ratio.

Last but not least there is an economical aspect that limits the reasonable rim angle: At high rim angles the outer parts have a low contribution to the energy yield in relation to the mirror area.

IV. DIMENSIONS OF PARABOLIC SOLAR HEATER

- Length of parabolic plate=2.4 m
- Aperture Width=1m
- Diameter of absorber pipe=3.8cm
- Length of absorber pipe=1.3m
- Focal length=0.25m
- Concentration height=0.25m
- Rim angle=90deg

V. CONCLUSION

1. From the experiments it was found that there as an increse of final temperature of water
2. By water it was seen that maximum temperature reached was 45deg cel.
3. In this project it was seen that we develop a forced solar water circulation system which gives higher efficiency than natural circulation.
4. It was seen that time required for maximum temperature is less for parabolic collector than flat collector
5. The need of compact sized solar water heating system is fulfilled by our system
6. Our system costs less than conventional flat plate collector system available in markets.

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