Computational Investigation of Cascaded Solar Thermal Cavity Receiver

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Abstract- The performance of solar parabolic dish cavity receiver system is affected by thermal and optical losses through it. There are two losses in cavity receiver. One is convective and radiative and other is conduction heat loss from tube to insulation. But the major constituent of losses through cavity receiver is convective and radiative heat loss. In the proposed research work the design of central cavity receiver is analyzed and a new design of cascaded solar thermal cavity receiver is proposed to heat loss using computer software. A heat transfer and flow simulation is proposed for solar thermal cavity receiver at various inclination and different temperatures. The numerical study combine laminar natural convection, surface heat conduction and surface radiation heat transfer in modified Cavity receiver of solar parabolic dish collector is also proposed in research work. An experimental setup is proposed to investigate the performance of the cascaded solar thermal cavity receiver.

Keywords-- Solar Collector, CFD receiver analysis, Double tubing.

I. INTRODUCTION

The energy problem is very serious in India. More than one thousands crores are spending by country every year for importing the oil from other country. In spite of discoveries of oil and gas off the west coast, the import of crude oil continues to increase and the price paid for it now dominates all other expenditure. This oil and gases are conventional sources of energy which is finish in coming few year. Therefore it is essential to find or developing the alternative energy sources.

One of the best option is to make more use of solar energy. Solar energy can be used directly or indirectly such as heating of water or air, drying, cooking and distillation etc. By using the solar radiations fluid is heated and used for other applications like refrigeration or power generation etc.

In solar thermal cavity receiver with singal tubing having the more convective heat loss. Our intention is that to reduces the these convective heat losses by providing double tubing in cavity receiver. The computational investigation of cascaded solar thermal cavity receiver is carried out by using the CFD software on computer.

The heated fluids can in turn be used for applications like power generation or refrigeration. A second way in which solar energy can be used directly is through the photovoltaic effect in which it is converted to electrical energy. Indirectly, the sun causes winds to blow, plants to grow, rain to fall, and the temperature differences to occur from the surface to the bottom of the oceans.

Fig. 1 parabolic dish collector

Useful energy can be obtained for commercial and noncommercial purposes through all these renewable sources.

II. CONVECTION & STAGNATION ZONE

Stagnation zone:

The total heat content by zone which is above the horizontal line and this zone is increases with increases angle

Convection zone:

The zone below the horizontal line and which actually comes in contact with surrounding air. This zone is increases with decrease in angle.
III. OVERVIEW

Until the CFD Analysis is carried out only on the single tubing cavity receiver by many researchers. From this analysis they analyse the temperature distribution in different shape cavity receiver at different angle with respective horizontal and are as follows.

Fig. (a) shows the cavity receiver inclined at 90° with respect to horizontal axis. At this angle there is total stagnation zone and minimum convective heat losses.

Fig. (b), (c), (d) shows the cavity receiver inclined at 60°, 45°, 30° respectively. In this stagnation zone decreases with decrease in angle and increase in convective zone.

Fig. (e) shows the receiver in horizontal direction that is at 0°. In this convective zone is more than stagnation zone.
IV. PROJECT WORK

We have to do the computational fluid dynamic (CED) analysis of double tubing cavity receiver. The purpose of double tubing is to reduce convective heat losses and study the temperature distribution profile.

In this we are trying to recover 2% to 3% convective heat losses and increases the efficiency of the plant.

V. CONCLUSION

From CFD Analysis of double tubing cavity receiver we conclude that:
1. Convective heat losses are get minimize.
2. Determine the stagnation and convective zone in the receiver.
3. Determine the spacing between two tubes in such a way that outer tube absorbs more heat from inner tube.
4. Finally increases the efficiency of the system.

REFERENCES