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Design configurations and possibilities of reflector shape for solar compound parabolic collector by ray tracing simulation

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Abstract

The objective of this paper is to study various possible configurations of reflectors of the compound parabolic collector (CPC) and select the suitable design as per the requirement. CPC is composed of two parabolic segments which show a wide range of design possibilities with its basic construction. This construction is based on design parameters like acceptance angle, rim angle, parabolic segments, truncation of parabolas, and location of the focus point and concluded for the suitable end application. A graphical ray tracing (GRT) simulation is used to examine the pattern of solar ray concentration for each design possibility. The various reflector configurations are generated from the design-morphological chart and compared on the basis of region and density of ray's concentration. The research emphasizes a novel approach of constructing a CPC with possible design configurations which can find a great scope for further research. The various configurations would help engineers to select and design a CPC as per the requirement.

Keywords: Compound parabolic collector; CPC types; CPC application; design possibilities; graphical ray tracing; reflector configuration;

1. Introduction

Compound parabolic collector (CPC) is a non-imaging type of solar collector made by combining two parabolas either in a symmetric or asymmetric manner [1-6]. The acceptance angle of the CPC allows this solar collector to use a direct as well as a diffuse component for the energy collection. A basic construction of CPC includes design parameters like aperture width, CPC height, acceptance angle, CPC length, absorber shape, size, and location. These design parameters allow engineers to modify a CPC with respect to end application i.e. thermal and/or electrical. Winston and Hinterberger [7] discovered the concept of CPC which is further modified by A. Rabl [2] and Stine and Geyer [8]. Figure 1 shows the basic

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