ABSTRACT

Xu, Jiayan. M.S., Purdue University, August 2012. Optical Analysis of External Compound Parabolic Solar Collectors . Major Professor: Ming Qu. Professor.

Due to the growth of population and industrialization of the world, the demand of energy is keeping increasing. Concentrating solar thermal collectors can efficiently capture the solar energy and heat working fluid to a high temperature that is ideal for the use of power generation, water heating, or HVAC.

This thesis is a study of geometric design of external compound parabolic solar collector (XCPC). XCPC is a relatively new type of solar thermal collector which is designed using noniamging optics theory. In this work, a optical model is developed using MATLAB to perform ray-tracing analysis for various geometric design of XCPC. The study includ,es the impact of different geometric design to optical efficiency. Then, the simulation results is combined with weather condition of various locations using TMY3 weather data.

The results indicate that the design of XCPC is very efficient and can concentrate above 90% of income radiation to the absorber when the incident angle is within the acceptance angle. Also, for location dominated by beam radiation, a smaller acceptance angle and higher concentrating ratio is preferred. For location dominated by diffuse radiation, a wider acceptance angle is preferred so mare diffuse radiation can be utilized.