Abstract

One of the most widely used solar collectors for process heating and large scale electricity generation is the parabolic trough collector (PTC), in which a tube placed at the focus of the parabola receives concentrated solar radiation. In this work, a novel solar receiver design is proposed that bridges the gap in efficiency between the evacuated and non-evacuated receivers which are presently in use.

In the standard or commercial non-evacuated receivers, the absorbing surface loses the heat to the surrounding ambient and to the heat transfer fluid (useful heat). A novel receiver has been proposed here, in which the absorbing surfaces (metal inserts) are immersed in the heat transfer fluid which is flowing through the inner tube of the receiver. The proposed design reduces the heat loss to the surrounding ambient. Experiments were conducted using water and air as heat transfer fluid (HTF), to compare the performance of the novel receiver with the standard receiver. Single pass experiments using water as HTF did not produce high fluid temperatures. In order to achieve higher fluid temperatures, experiments with recirculation of water were performed. The difference in the thermal performance of the novel receiver and the standard receiver became conspicuous as the losses became predominant. Also, it was observed that the thermal performance of the novel receiver over the standard receiver improved with an increase in the outlet temperature. Experiments using air as heat transfer fluid showed that the novel receiver outperformed the standard receiver in thermal performance. Also, the time response to changes in solar radiation was much lower for novel receiver as compared to standard receiver. Numerical simulations were performed using a one dimensional steady state heat transfer model for both these receivers. These results also indicate that the thermal performance of the novel receiver is superior to the standard receiver. Some interesting observations with regard to the influence of the heat transfer coefficient and incoming solar radiation on energy gain and loss have been noted and will be presented.