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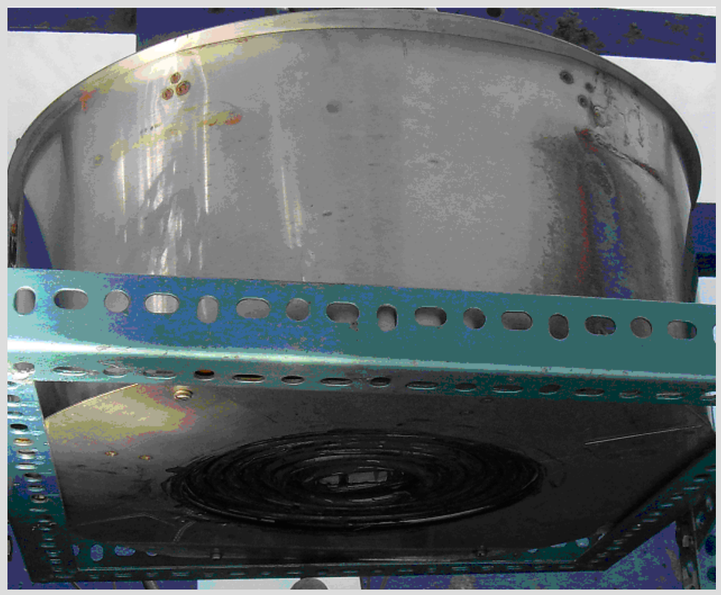
Assessment of the Efficiency of Solar Radiation Concentrating System

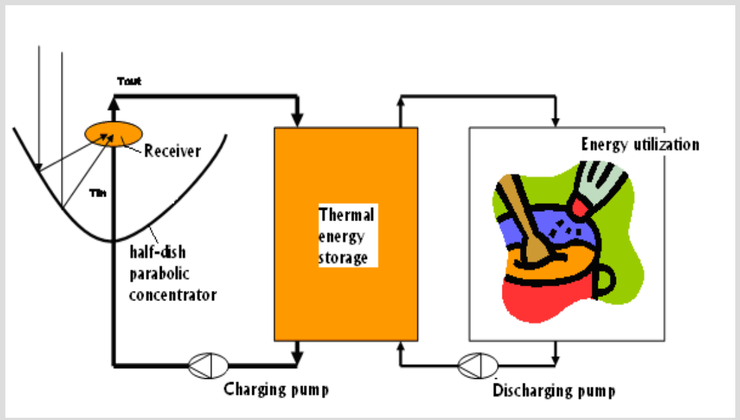
A Solar Radiation Concentrating System (SCRS) for generation of high temperature heat for a solar oven was developed and has been evaluated at the University of KwaZulu-Natal, South Africa. The system concentrates direct solar radiation on a small area receiver which absorbs the radiation and converts it into thermal energy that may be stored and used for several applications where food preparation and water pasteurization is the priority. This system can be very helpful for rural communities situated inside the sunbelt, far away from the conventional electricity grid. In these areas the main energy source is Biomass and this have a number of harmful effects on the people's health and environment. On an ideal SRCS, the amount of concentrated solar energy is proportional to the concentrator dimensions. The receivers are made as small as possible to reduce heat losses. Thus, in this work the concentrator has a paraboloidal shape, since from mathematics a parabola has a point focus.

The big challenge in the construction of the concentrator is to achieve a good parabolic shape due to curvature in different regions of the parabola. For this, it is convenient to construct a dish reflecting surface by using small elementary mirrors (tiles) compared to using a single continuous mirror. Therefore, the concentrator in this research work is composed by trapezoidal tiles of an acrylic mirror material. The concentrator is a half-dish, with 2.4 meters of aperture diameter.

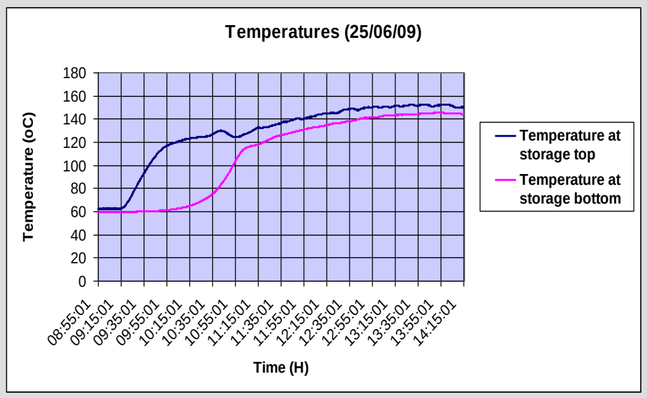


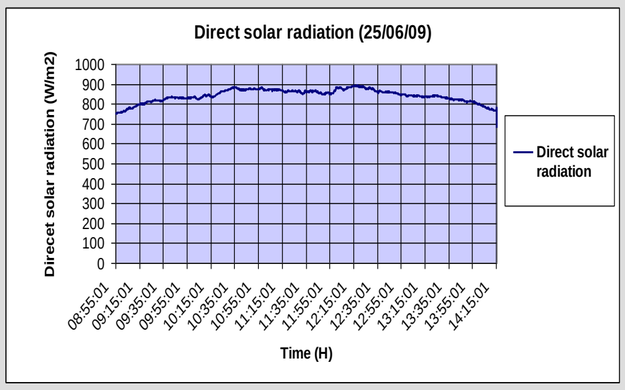
The receiver is a stainless steel coil, spiral shaped, covered by a surrounding box for insulation. Inside pipe a oil (Calflo HTF) is circulated as heat transfer fluid.

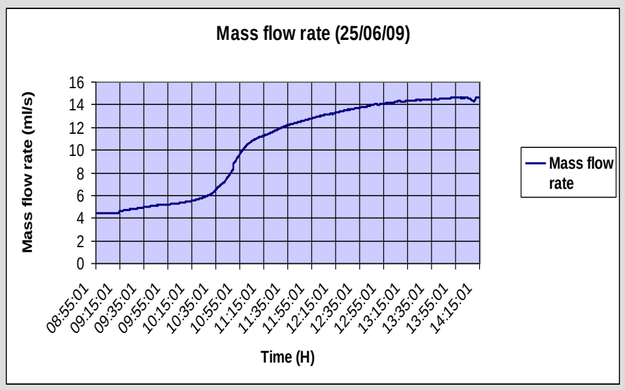
The general idea of the system is to pump the cold heat transfer fluid from a thermal storage to the receiver where it absorbs the heat. The hot fluid from the receiver is pumped to charge a heat storage system, and the cycle continues. In a way to assess the efficiency of the system a useful energy and heat losses of the system has to be measured.



Results and conclusion:







The solar radiation concentrating system is capable of producing enough heat for food preparation and water pasteurization which is the main objective. The efficiency of the system was about 47%, but can be greatly improved by better insulation (storage and transfer pipes were not insulated in this test) and sharper focus (misaligned tiles caused part the incident solar radiation to miss the receiver). The Calflo heat transfer fluid can be used as heat transfer fluid

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