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Construction and thermal analysis of a parabolic collector for small scale concentrating thermal system

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<p> Few options are apparent for achieving a benign, sustainable energy future except those relying on the utilization of solar energy in one way or another. Experience with fossil and nuclear sources has revealed an array of unsolved problems of increasing concern as more evidence and understanding emerges. Africa has the world's best solar resources. Several countries have exploited solar energy for water heating, crop drying, medical applications, and telecommunications, among other things. Solar energy can contribute to supply heat energy in households of Sub-Saharan African countries. Having this in mind a small scale dish concentrating solar energy system is being developed at the Eduardo Mondlane University in Mozambique. The system comprises of the collector, the heat storage and the oven. The main structure of the system has been constructed, consisting of the dish reflector, the sun tracker and the piping mechanism. The reflector consists of 6 petals which together resemble nearly a parabolic surface with the following parameters: Diameter…….. Dp = 2400mm Focal length…….. f = 915mm F/D ratio…….. n=0.135 Half opening angle……..66.50o Half complementary angle……..23.49o Angle of incidence……..33.26

The process of gluing trapezoidal mirrors was done on individual petals using the laser beam radiation. Using reflection laws on planar surfaces which states that rays of light parallel to the parabola axis are reflected to a focal point, each trapezoidal mirror tile gluing was preceded by scanning its reflection close to the theoretical focal point. An individual petal was covered by 163 mirror tiles. The reflector surface is comprised by 978 mirror tiles. An infrared camera was used to scan the temperature of the concentrated heat. The maximum temperature reached so far is 350oC. The experimental focal area was found by mapping the reflections of the whole reflective surface. The shape of the receiver/absorber obtained by the scanning process is semi-spherical. The future work is the study of efficiency of the collector as a whole. This will be done by measuring the ambient air temperature, the inlet and outlet temperature of the absorber.

Level (Hons, MSc,
   PhD, other)?

Hons

Consider for a student
   award (Yes / No)?

yes

Would you like to
 submit a short paper
 for the Conference
 Proceedings (Yes / No)?

yes

Primary author: Mr NHABETSE, Tomas (Eduardo Mondlane University, Maputo, Mozambique)

Co-authors: Mr VERIMACH, Amos (Eduardo Mondlane University); Mr TAMELE, Basilio (Eduardo Mondlane University); Prof. CUAMBA, Boaventura (Eduardo Mondlane University); Prof. LOVSETH, Jorgen (The Norwegian University of Science and Technology, Trondheim (Norway))

Presenter: Mr NHABETSE, Tomas (Eduardo Mondlane University, Maputo, Mozambique)

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