Fabrication and Characterization of a Prototype Parabolic Trough Solar Concentrator for Steam Production

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ABSTRACT

Parabolic trough solar concentrators (PTSC) are gaining acceptance as transducers for renewable energy from the sun. During production of power using PTSC's no green house gases are produced. In this work parabolic trough solar concentrators for steam production made from appropriate materials were designed, fabricated and characterized. Appropriate materials considered in this work are locally available. The appropriate materials that were tested were aluminium sheet, car solar reflector and aluminium foil. Concentrators made from these materials produced efficiencies which compared favorably with the ones made from selective materials and automatically tracked; aluminium sheet 54.65 %, car solar reflector 53.16 % and aluminium foil 49.26 %. These results were lower than for Luz collector 68 %, Euro trough 65.2% and the sky fuel 73%. The highest temperature of heat transfer fluid obtained was 248.3 ^{o}C Therefore these fabricated concentrators can provide green power which would reduce amount of green house gases produced. Current research in the area of parabolic trough solar concentrators is on reducing the cost of concentrator and making it more effective and consequently delivering electrical power at lowest possible cost. Towards this end, parabolic trough solar concentrators were fabricated by use of appropriate materials that are readily available and affordable. The use of common mathematical expressions in the design demystifies the PTSC technology of design by localizing the design activities. In this work, heat losses from the receiver have been reduced by having it in the interior of the concentrator, due to the stagnant air imposed between the receiver and its cover. Modified collector testing loop with reference to ASHRAE-93-77 was applied in collector testing. Among other procedures used were calorimetric determination of intercept factor, overall heat loss coefficient and temperature control e.t.c.

Use of automatic more precise tracking system, evacuated receiver tube and use of selective coatings made the efficiencies of documented PTSC higher than for the ones that were locally fabricated.