ABSTRACT

The design, construction and investigation of two compound parabolic concentrators (CPCs) with tubular absorber (evacuated tube absorber) is presented. The two CPCs are East-West aligned. The first CPC is with optimum acceptance half angle (26^o), and the second CPC with acceptance half angle (15^o) truncated to (20^o) for economic reasons. Then, to (26^o) to compare its performance with the first CPC. Finally, to (59^o) and compared. Water is used as working fluid. The experimental tests have carried out in Kirkuk (280 km north of Baghdad) (35.47^o N, 44.39^o E) during selected days of the months of June and December/2014 and January/2015. The performance of CPCs have evaluated by using outdoor experimental measurements. A significant difference is seen between the instantaneous thermal efficiency of 3.84× CPC (θ_c=20^o) and 2.32× CPC (θ_c=26^o), and between those for 3.61× CPC (θ_c=26^o) and 2.32× CPC (θ_c=26^o). The difference between the instantaneous thermal efficiency of 2.32× CPC (θ_c=59^o) and 2.32× CPC (θ_c=26^o) is small compared with the difference of the first and the second CPCs. The instantaneous thermal efficiency of 2.32× CPC (26^o) is higher than those for other three CPCs. The experimental results have shown that the maximum thermal efficiency of the full 2.32× CPC (26^o) is 0.708, and those of the 3.93×CPC (15^o), when it is truncated to 3.84× CPC (20^o), 3.61× CPC (26^o) and 2.32× CPC (59^o) are 0.51, 0.52 and 0.66, respectively. The effect of CPC truncation on the geometry, optical properties and performance of the 3.84× CPC show that as the truncation level increases the concentration ratio decreases due to increase the acceptance angle, and aperture area decreases due to decrease the aperture width. While the average number of reflections are decreases and this leads to increasing in the optical efficiency. As the concentration ratio decreases from (3.93× to 1×), the thermal efficiency, thermal losses and optical efficiency increase from (0.47 to 0.63), (1.58 to 7.2 W/m^2.K) and (0.494 to 0.797), respectively.