Simulation of a collector using waste heat energy in a solar chimney power plant system

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Abstract

Rare techniques have been proposed for twenty four hour operation of a solar chimney power plant (SCPP). In this study, another technique is suggested by utilizing waste heat energy in the form of flue gases flow in conduits within the solar collector. The process of the heat and fluid flow within the collector were simulated using ANSYS software. The predicted performance and enhancement of the collector are presented and discussed. The results show a significant increase in the overall performance of the solar chimney power plant. At 1000 W/m^2 solar radiation, the collector temperature rise is from 19 to 23 K, the updraft velocity is increased from 15.6 m/s to 17.1 m/s, the power output increased from 50.1 kW to 66.1 kW and the efficiency is improved from 0.116% to 0.144%. Although the technique contributes to the performance enhancement of the SCPP, it also contributes to the reduction of global warming by reduction of the exhausted flue gases temperature.
Keywords: air heater, gas turbine, solar chimney power, waste heat energy.

1 Introduction

The solar chimney power plant (SCPP) is truly a renewable technology. The technology works on simple laws of physics. There are three main components namely, collector (also called air heater), turbine and chimney. The collector is the main engine in this system. The air collector traps the heat energy from solar irradiation and as a product due to the absorbed heat and buoyancy effect it increases the kinetic energy of the air enough to drive the turbine. The turbine is placed in the system where it can extract maximum air kinetic energy usually at the base of the chimney. The chimney plays an important role in creating a

WIT Transactions on Ecology and The Environment, Vol 179, © 2013 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/SC130792