CESARE'17
International Conference Coordinating Engineering for Sustainability and Resilience
Dead Sea, 3-8 May 2017

NUMERICAL INVESTIGATION OF THE ENHANCED PERFORMANCE OF SOLAR PONDS USING NANOPARTICLES

A. Anagnostopoulos[1]

[1]*Department of Chemical and Process Engineering, Faculty of Engineering and Physical Sciences, University of Surrey, GU2 7XH, UK*

e-mail: rg123@hotmail.gr ;

Keywords: Renewable Energy, Energy Storage, Nanoparticles, Solar Pond

ABSTRACT

A series of numerical models was developed in order to predict and investigate the thermal performance of a Salinity Gradient Solar Pond (SGSP). A 1-D simplified model using non-linear first order differential equations was developed in MATLAB and a more elaborated 2D and 3D finite element model was developed in COMSOL Multiphysics, based on a set of Partial Differential Equations, which govern the phenomena of heat transfer and radiation in semi-transparent media.

The developed models were compared in terms of their accordance with published experimental data sets from two different test sites. The 3D model was proven to be the most accurate (7%) with the 1D model being the least (13%). The potential enhancement of the thermal performance of a SGSP by adding nanoparticles in the Lower Convective Zone (LCZ) was investigated numerically. The existence of the nanoparticles was simulated taking into account their thermal and optical properties. The 3D model showed an average temperature increase of 20% in its LCZ, whereas the 2D presented a temperature increase of 19%.The 1D model showed the least improvement (15%). This was attributed to the ability of the 2D and 3D models to account for the optical properties of the suspended nanoparticles.