Desalination and Water Treatment
www.deswater.com

doi:10.5004/dwt.2017.0742

73 (2017) 64–72
April

Heat transfer prediction on flat solar collectors for the water purification system integrated to an absorption heat transformer

T. Hernández[a], S.G. Pérez[a], O. Flores[a], J.A. Hernández[b,*], D. Juárez-Romero[b], A. Álvarez[b], A. Huicochea[b], J.V. Galaviz-Rodriguez[c]

[a]*Posgrado en Ingeniería y Ciencias Aplicadas de la Universidad Autónoma del Estado de Morelos, Av. Universidad No. 1001, Col Chamilpa, CP. 62209, Cuernavaca, Morelos, México, Tel. +52 01 777 3297084; emails: teresa.hernandez@alumnos.uaem.mx (T. Hernández), sandro.perez@uaem.mx (S.G. Pérez), oliver.flores@uaem.mx (O. Flores)*
[b]*Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp), Universidad Autónoma del Estado de Morelos (UAEM), Av. Universidad No. 1001, Col Chamilpa, CP. 62209, Cuernavaca, Morelos, México, Tel. +52 01 777 3297084; emails: alfredo@uaem.mx (J.A. Hernández), djuarez@uaem.mx (D. Juárez-Romero), aalvarez@uaem.mx (A. Álvarez), huico_chea@uaem.mx (A. Huicochea)*
[c]*Carretera al Carmen Xalpatlahuaya SN, Carmen Xalpatlahuaya, 90500 Huamantla, Tlax, email: galaviz_4@hotmail.com (J.V. Galaviz-Rodriguez)*

Received 29 June 2016; Accepted 20 September 2016

ABSTRACT

This paper analyzes the prediction of the heat transformer obtained by two flat solar collectors' systems configured in series and parallel, as well as a third system which occurs with the union of the two previous. Solar flat collectors' systems were coupled to water heating energy source directed to integrated absorption heat transformer to a water purification system, maximizing efficiency. A feed-forward ANN (Artificial neural network) with standard BP (back propagation) algorithm was applied to heat transformer prediction. In view of statistical performance criteria i.e., RMSE (root mean square error) and R^2 (correlation coefficient), a supervised ANN with 5-5-1 topology (five inputs, five neurons in the hidden layer and one output layer) and *Levenberg–Marquardt* training algorithm represented the optimal model. This ANN considers useful total irradiation, water temperature in the heating tank, sampling time (second, day and month) as input parameters; and the heat gained by the water in the tank of warming as output parameter. The numerical results for the simulations of the heat output gained, for these 38 tests on each configuration, had an $R^2_{\text{series}} \geq 0.994$, $R^2_{\text{parallel}} \geq 0.998$, $R^2_{\text{coupled}} \geq 0.994$ with regard to experimental results. The proposed ANN models were appropriated to control the system.

Keywords: Artificial neural network; Solar energy; Absorption heat transformer

*Corresponding author.

Presented at the EDS conference on Desalination for the Environment: Clean Water and Energy, Rome, Italy, 22–26 May 2016.