Hourly yield prediction of a double-slope solar still hybrid with rubber scrapers in low-latitude areas based on the particle swarm optimization technique

ABSTRACT

Several studies have attempted to improve the productivity of solar stills and build expressive models for yield prediction. However, most of these models do not consider the amount of condensed water that falls from the condensing cover towards the solar still basin, especially in the case of small-slope covers. This oversight can significantly affect the accuracy of these models. In this study, we developed a fairly simple method to estimate the amount of distilled water produced every hour from the double-slope solar still hybrid with rubber scrapers (DSSSHS) in low-latitude areas. The proposed model is based on the determination of the best values for the unknown constant (C) and the exponent (n) for the Nusselt number expression used to formulate the equation for the estimation of the hourly yield of a solar still (HYSS). This was achieved by solving an optimization problem using the particle swarm optimization (PSO) algorithm in which the optimal yields were determined by estimating the optimal values of the unknown C and $n$parameters. This technique, which is used for the first time in this study to build a yield prediction model, avoided the conventional trial-and-error approach to calculating unknown coefficients in a proposed model. Furthermore, the use of rubber scrapers to collect the condensed water that accumulates on the inner surfaces of the condensing cover enhanced the accuracy of the measurement of solar still experimental yields, which consequently improved the accuracy of the model. The proposed model was validated against the experimental data collected in this study. The results showed that the built model was able to accurately estimate the HYSS values.

Keyword: Double-slope; Yield; Solar still; Rubber scrapers; Particle swarm optimization