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Factorial design of experiment for modeling solar still parameters

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ABSTRACT

The design of experiments method is used to evaluate the performance of the solar still's input factors influencing the responses. Nine factors (solar radiation, basin area, saline water depth, insulation material, insulation thickness, absorptivity, ambient temperature the thickness of glass cover, and wind speed) that have an impact on the performance of the solar still were studied to show their effects on the responses. Three system's responses (distilled water, water temperature and glass cover temperature) were evaluated. An accurate theoretical model of the thermal behavior of the solar still was developed. The highly complex behavior of the solar still was accurately described by the developed mathematical model. A numerical technique (Runge–Kutta method) is used to solve the non-linear system of differential equations. The statistical analysis to show the effect of solar still's factors on solar still performance was evaluated using Minitab software. The statistical results demonstrate that the most important factors that have high effect on the solar still productivity are basin area, saline water depth, and solar radiation respectively. While the insulation thermal conductivity, ambient temperature, and glass thickness have no effect on the performance of still. On the other hand, water depth, solar radiation and wind speed have major impact on the water and glass temperature.

Keywords: Solar still; Design of experiments; Factorial design; Fins; Thickness; Productivity; Water depth; Insulation

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