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Shatar, N.M.[a] , Sabri, M.F.M.[a b] , Salleh, M.F.M.[c] , Ani, M.H.[d]

Energy, exergy, economic, environmental analysis for solar still using partially coated condensing cover with thermoelectric cover cooling

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[a] Department of Mechanical Engineering, Faculty of Engineering, Universiti Malaya, W.P. Kuala Lumpur, 50603, Malaysia
[b] Centre for Energy Sciences, Universiti Malaya, W.P. Kuala Lumpur, 50603, Malaysia
[c] Department of Electrical Engineering, Faculty of Engineering, Universiti Malaya, W.P. Kuala Lumpur, 50603, Malaysia
[d] Department of Manufacturing and Materials, Kulliyyah of Engineering, International Islamic University Malaysia, W.P. Kuala Lumpur, 50728, Malaysia

Abstract
The declining freshwater resources can be overcome using thermal desalination methods such as solar still. However, the productivity of a solar still is highly dependent on the environment and design. In this study, an improvement of the passive solar still with a partially coated condensation cover and a thermoelectric cooling system was made. The effect of varying thermoelectric cooling power (12 W and 36 W) was investigated and compared with a reference solar still under the tropical weather conditions of Malaysia. The performance of the solar still was analysed in detail based on freshwater yield, energy, exergy, environmental and economic aspects. The results showed that freshwater production could be increased by up to 126% with a 36 W thermoelectric cooling capacity. The energy efficiency improved by 44%, but the exergy efficiency decreased by 25% compared to the reference solar still. The results of the energy matrices show that the minimum energy payback time and maximum energy production factor for the coated glass solar still are 6.55 years and 0.15, respectively. The amount of carbon dioxide mitigated by the modified solar still was 2.97 tonnes of CO2 in a lifetime. The lowest cost per litre was found to be $0.036 with a thermoelectric cooling power of 36 W. The highest exergo-economic and enviro-economic values analysed for the coated glass solar still with thermoelectric cooling were 4.64 kWh/$ and $83.21, respectively. © 2023 Elsevier Ltd

Author Keywords
4E analysis; Combined wettability; Partially coated condensing cover; Solar still; Thermoelectric cooling

Index Keywords
Carbon dioxide, Cooling, Desalination, Distillation, Energy efficiency, Exergy, Meteorology, Passive solar, Solar heating, Water; 4e analyse, Coated glass, Combined wettability, Condensing covers, Cooling power, Energy, Fresh Water, Partially coated condensing cover, Solar stills, Thermoelectric cooling; Glass

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Correspondence Address
Sabri M.F.M.; Department of Mechanical Engineering, Malaysia; email: faizul@um.edu.my

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